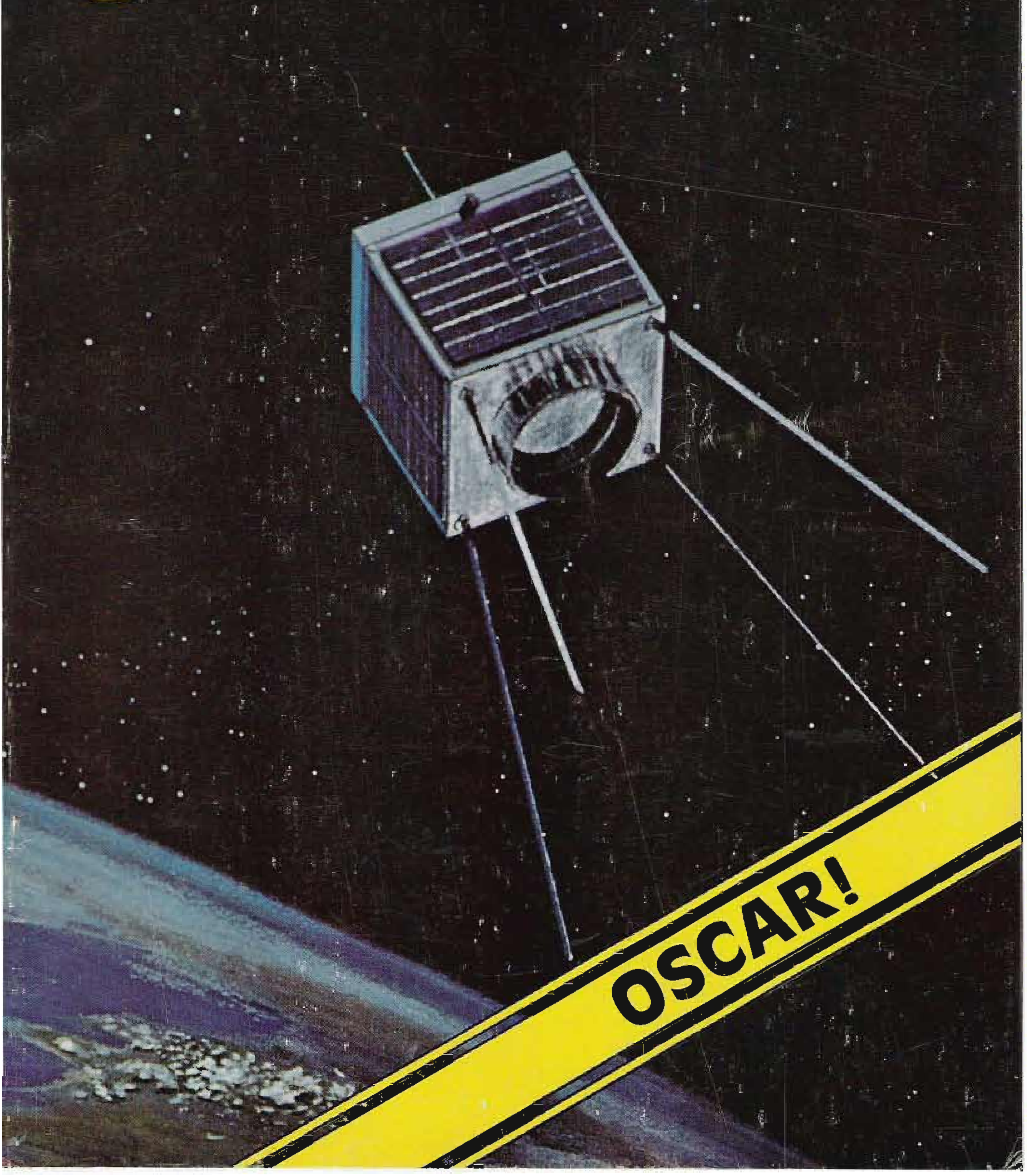
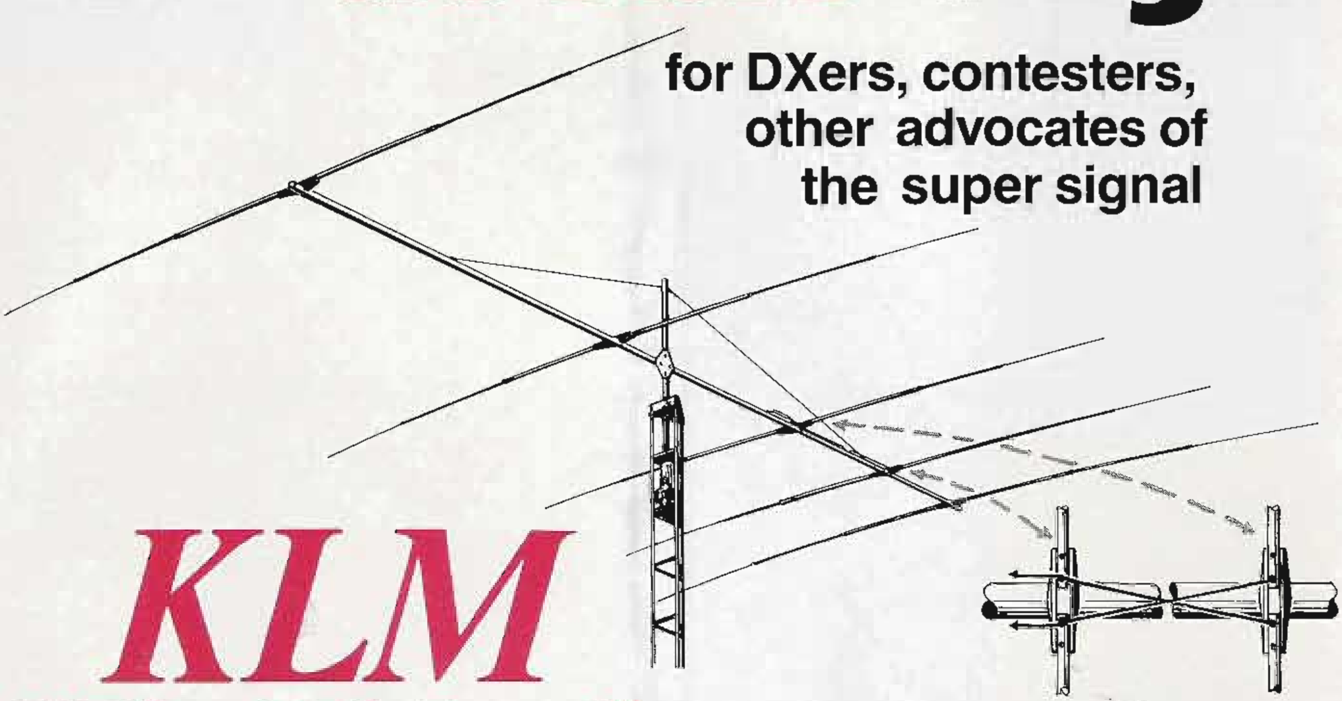
NOVEMBER 1977
$2.00

73 AMATEUR RADIO



the double edge

for DXers, contesters, other advocates of the super signal



KLM "Big Sticker" monobanders

with double driven elements

full gain, low VSWR, CW/phone operation without retuning.

KLM beams with **double** driven elements continue to be the choice of amateurs throughout the world. They are performance proved . . . clearly superior . . . and there are good reasons for this superiority.

Unlike most other multi-element yagis, KLM's "Big Sticker" series of monobanders operate at high efficiency over the entire CW and phone portions of any given amateur band **without retuning.** Forward gain is high, the pattern is clear, VSWR is low across the band limits specified.

Among other advanced design considerations, KLM uses log-periodic techniques with **double** driven elements to assure **full excitation** and low VSWR on beams covering the full 40, 20, 15 and 10 meter amateur bands. In addition, the frequency response of KLM "Big Stickers" rolls off very rapidly beyond band extremes thereby minimizing harmonics and adjacent channel interference.

These are husky, well constructed beams that use strong, lightweight elements and booms of 6063-T832 weather-resistant aluminum. Hardware is top quality stainless steel. The insulated mounting brackets (pictured below), an exclusive KLM design, are molded of GE polycarbonate "Lexan," a material that has excellent insulating qualities and very high mechanical strength.

KLM insulating support bracket

Available monobanders: 4 element, 40 meters. 5 and 6 element, 20 meters. 6 element, 15 meters. 5 and 6 element, 10 meters.

At your dealer. Full specifications on request.

and, for a heavy-duty rotator that will point them . . . and keep them pointed . . . under tough weather conditions, use the KLM-1500 HD-

KLM 1500-HD Rotator

KLM electronics, inc.

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ME-3 microminiature tone encoder

Compatible with all sub-audible tone systems such as: Private Line, Channel Guard, Quiet Channel, etc.

- Powered by 6-16vdc, unregulated
- Microminiature in size to fit inside all mobile units and most portable units
- Field replaceable, plug-in, frequency determining elements
- Excellent frequency accuracy and temperature stability
- Output level adjustment potentiometer
- Low distortion sinewave output
- Available in all EIA tone frequencies, 67.0 Hz-203.5 Hz
- Complete immunity to RF
- Reverse polarity protection built-in

$29.95 each

Wired and tested, complete with K-1 element

master charge
THE INTERBANK CARD

communications specialists

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BREA, CALIFORNIA 92621
(714) 998-3021

K-1 FIELD REPLACEABLE, PLUG-IN, FREQUENCY DETERMINING ELEMENTS

$3.00 each

73

#206 NOV 1977

COVER: AO-8. Rendering by R. Michael Smithwick WA6TUF; photo courtesy of AMSAT.

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NEVER SAY DIE

... de W2NSD/1

EDITORIAL BY WAYNE GREEN

MICROCOMPUTING: HOW'S IT DOING?

In addition to the uses of microcomputers in amateur radio, I looked upon this new field as an opportunity for radio amateurs to get into a new business which had the prospects of growing in an extraordinary way over the next few years. It seemed to me that amateurs were ideally suited to take advantage of this opportunity.

As a result of the large number of articles in *73* during 1975 and 1976, an estimated 25,000 amateurs have gotten interested in microcomputers and become involved with them. Quite a few of them have gone on to try for the golden ring through manufacturing or distributing microcomputers and peripherals.

Has the field grown as I predicted? For once my optimism was about equal to history instead of ahead of it and, yes, it has grown. By way of example, the first computer store opened in August, 1975. Not only is it still going, but by August, 1976, there were 50 computer stores around the country. By August, 1977, there were about 500 computer stores and no sign of any letup in growth. Have you heard of Nashua, New Hampshire? Well, there are two stores in that city, with a third getting ready to open!

What does it take to get into this business? If you go about it right . . . and I wrote a book on this subject a few years ago . . . you can start out with very little and build it quickly. You can also start out with a lot (as an investment) and let a managing firm hire the experienced people for you . . . and there already is such a firm in the business. Figure on about $250,000 if you go the straight investment route.

Perhaps typical of the underfinanced system of starting a store is the experience of a chap who wrote me recently. He opened his computer store in a major city with less than $1000 in the bank. His sales the opening month were $51. The second month he sold $5,500 worth of equipment and books. The third month it was $14,000 in sales. $27,000 the fourth month, and $31,500 the fifth month. Sales were slowed down a bit due to slow deliveries from many manufacturers, plus a growing need for cash for expansion. By the sixth month, he was ready to open a second store in the area.

Growth is a little slower out in the boondocks, but it is still healthy and very forgiving. More and more stories are coming in from readers of *Kilobaud* who have walked into one computer store after another with a big roll of money in their pocket with the intent of buying a computer system . . . only to be turned away by the utter neglect of the "salespeople." The fact is that few stores are run by people experienced in marketing and sales . . . as yet.

How has it been for people entering the manufacturing part of the business? Probably not untypical is the firm run by two young chaps I know. They got interested in microcomputers a couple years ago, but didn't have the money to shell out for an Altair system . . . so they built and programmed their own. I visited them in early August, 1976, and they had a working system which they had put together in a workshop in one corner of the garage. It looked good to me and I suggested that they show it at the next computerfest.

Dealers liked it at the show and placed orders . . . and they are going strong today. Not bad for a couple of 20-year-olds. Their system really had the crowds gathered around at Computermania . . . and every one of the television news teams made sure to include it on their coverage of the show.

Another youngster is 16-year-old Jeff of Jefftronics. He sells parts and small circuits. You'll see him at just about every computerfest in the country with his booth.

THE MARKET IS CHANGING

Microcomputing is a lot more complicated a hobby than amateur radio, so it is limited in its appeal. An awful lot of people won't spend the time and effort necessary to tackle this hobby. The result of this has been the inevitable dropping off of beginners in computing. There are a lot of new hobbyists, but not the flood that came into the hobby last year . . . a good part of which were radio amateurs responding to the articles in *73*.

This drop in hobbyists has, as I predicted, been taken up by the increasing interest of businessmen in microcomputers as ways to save money for their firms. Few computer stores now report less than 50% of their business going this route and many are experiencing up to 90% business sales. The hangup on earlier sales to business was the lack of suitable programs and dependable equipment. Now that these obstacles are being overcome, the increase in sales to this market should overshadow the hobby market completely.

There is still a big need for more equipment and more programs. My prediction is that we will see programs being sold in large numbers . . . perhaps about the way phonograph records and books are sold today. After all, once you have a computer, you can use it for business, for games, to write music, to generate creative art, to study any subject ever known to man, etc. There are hundreds of thousands of programs needed. I think we will see sales volumes on the order of $75 million per day just in programs within the next ten years . . . and I may be very low with that figure.

THE PIRATES ARE COMING! THE PIRATES ARE COMING!

While I've had a few beefs about CBers — in particular the HFer branch of the CBers — getting adventurous and coming into the ham bands, these have all been verbal reports — no one has written as yet about it. I'll take the problem a little more seriously when I have a few written reports on the situation in my hand.

But let's say that it is bound to happen, so what can we do about it? What have you done or would you do if you came up against a bootlegger on the air? It isn't that tough on two meters, where repeater groups have organized their act fairly well and are generally able to talk the bootlegger into getting together for coffee, only to have him met by The Fuzz. This has helped many a ham get back his stolen two meter rig.

On ten meters, you can easily tell if the chap is coming in via ground wave or skip. If he's local, it is time to hook up a loop and start hunting, helped by some other local hams. A personal visit by as many of your club members as you can round up — maybe 50? — will create an impression that should get through to all but the most hardened cases. A mass of people can be intimidating, even without any direct threats of violence.

What about reporting the miscreant to the FCC? Sure, complete with tape recordings, but don't expect much . . . if anything. The fact is that most of the responsibility for preserving our bands is in our hands. If we act to keep bootleggers out, we may succeed. We've seen how powerless the FCC is to keep some 100,000 or so HFers out of a band, even though they have a list of most of the people involved.

If you or your club has had any success with discouraging bootleggers,

Continued on page 183

KENWOOD

. . . pacesetter in amateur radio

TS-520S

AND DG-5 DIGITAL FREQUENCY DISPLAY

The TS-520S combines all of the fine, field-proven characteristics of the original TS-520 together with many of the ideas and suggestions for improvement from amateurs worldwide.

FULL COVERAGE TRANSCEIVER

The TS-520S provides full coverage on all amateur bands from 1.8 to 29.7 MHz. Kenwood gives you 160 meter capability, WWV on 15.000 MHz., and an auxiliary band position for maximum flexibility. And with the addition of the TV-506 transverter, your TS-520S can cover 160 meters to 6 meters on SSB and CW.

DIGITAL DISPLAY DG-5 (option)

The Kenwood DG-5 provides easy, accurate readout of your operating frequency while transmitting *and* receiving.

OUTSTANDING RECEIVER SENSITIVITY AND MINIMUM CROSS MODULATION

The TS-520S incorporates a 3SK35 dual gate MOSFET for outstanding cross modulation and spurious response characteristics. The 3SK35 has a low noise figure (3.5 dB typ.) and high gain (18 dB typ.) for excellent sensitivity.

NEW IMPROVED SPEECH PROCESSOR

An audio compression amplifier gives you extra punch in the pile ups and when the going gets rough.

VERNIER TUNING FOR FINAL PLATE CONTROL

A vernier tuning mechanism allows easy and accurate adjustment of the plate control during tune-up.

FINAL AMPLIFIER

The TS-520S is completely solid state except for the driver (12BY7A) and the final tubes. Rather than subsitute TV sweep tubes as final amplifier tubes in a state of the art amateur transceiver, Kenwood has employed two husky S-2001A (equivalent to 6146B) tubes. These rugged time-proven tubes are known for their long life and superb linearity.

HIGHLY EFFECTIVE NOISE BLANKER

An effective noise blanking circuit developed by Kenwood that virtually eliminates ignition noise is built into the TS-520S.

RF ATTENUATOR

The TS-520S has a built-in 20 dB attentuator that can be activated by a push button swich conveniently located on the front panel.

PROVISION FOR EXTERNAL RECEIVER

A special jack on the rear panel of the TS-520S provides receiver signals to an external receiver for increased station versitility. A switch on the rear panel determines the signal path . . . the receiver in the TS-820 or any external receiver.

VFO-520 — NEW REMOTE VFO

The VFO-520 remote VFO matches the styling of the TS-520S and provides maximum operating flexibility on the band selected on your TS-520S.

AC POWER SUPPLY

The TS-520S is completely self-contained with a rugged AC power supply built-in. The addition of the DS-1A DC-DC converter (optional) allows for mobile operation of the TS-520S.

EASY PHONE PATCH CONNECTION

The TS-520S has 2 convenient RCA phono jacks on the rear panel for PHONE PATCH IN and PHONE PATCH OUT.

CW-520 — CW FILTER (OPTION)

The CW-520-500 Hz filter can be easilly installed and will provide improved operation on CW.

AMPLIFIED TYPE AGC CIRCUIT

The AGC circuit has 3 positions (OFF, FAST, SLOW) to enable the TS-520S to be operated in the optimum condition at all times whether operating CW or SSB.

The TS-520S retains all of the features of the original TS-520 that made it tops in its class: RIT control • 8-pole crystal filter • Built-in 25 KHz calibrator • Front panel carrier level control • Semi-break-in CW with sidetone • VOX/PTT/MOX • TUNE position for low power tune up • Built-in speaker • Built-in Cooling Fan • Provisions for 4 fixed frequency channels • Heater switch.

TS-520 Specifications

Amateur Bands: 160-10 meters plus WWV (receive only)

Modes: USB, LSB, CW

Antenna Impedance: 50-75 Ohms

Frequency Stability: Within ±1 kHz during one hour after one minute of warm-up, and within 100 Hz during any 30 minute period thereafter

Tubes & Semiconductors:

Tubes (S2001A x 2, 12BY7A)	3
Transistors	52
FETs	19
Diodes	101

Power Requirements: 120/220 V AC, 50/60 Hz, 13.8 V DC (with optional DS-1A)

Power Consumption: Transmit: 280 Watts Receive: 26 Watts (with heater off)

Dimension: 333(13⅛) W x 153 (6.0) H x 335(13- (13-3/16) D mm(inch)

Weight: 16.0 kg(35.2 lbs)

TRANSMITTER

RF Input Power: SSB: 200 Watts PEP CW: 160 Watts DC

Carrier Suppression: Better than -40 dB

Sideband Suppression: Better than -50 dB

Spurious Radiation: Better than -40 dB

Microphone Impedance: 50k Ohms

AF Response: 400 to 2,600 Hz

RECEIVER

Sensitivity: 0.25 uV for 10 dB (S+N)/N

Selectivity: SSB:2.4 kHz/-6 dB, 4.4 kHz/-60 dB

Selectivity: CW: 0.5 kHz/-6 dB, 1.5 kHz/-60 dB (with optional CW-520 filter)

Image Ratio: Better than 50 dB

IF Rejection: Better than 50 dB

AF Output Power: 1.0 Watt (8 Ohm load, with less than 10% distortion)

AF Output Impedance: 4 to 16 Ohms

DG-5

SPECIFICATIONS

Measuring Range: 100 Hz to 40 MHz

Input Impedance: 5 k Ohms

Gate Time: 0.1 Sec.

Input Sensitivity: 100 Hz to 40 MHz: 200 mV rms or over, 10 kHz to 10 MHz: 50 mV or over

Measuring Accuracy: Internal time base accuracy ±0.1 count

Time Base: 10 MHz

Operating Temperature: -10° to 50° C/14° 122° F

Power Requirement: Supplied from TS-520S or 12 to 16 VDC (nominal 13.8 VDC)

Dimensions: 167(6-9/16) W x 43(1-11/16) H x 268(10 9/16) D mm(inch)

Weight: 1.3 kg(2.9 lbs)

DG-5

The luxury of digital readout is available on the TS-520S by connecting the DG-5 readout (option). More than just the average readout circuit, this counter mixes the carrier, VFO, and heterodyne frequencies to give you your exact frequency. This handsomely-styled accessory can be set almost anyplace in your shack for easy to read operation . . . or set it on the dash-board during mobile operation for safety and convenience. Six bold digits display your operating frequency while you transmit and receive. Complete with DH (display hold) switch for frequency memory and 2 position intensity selector. The DG-5 can also be used as a normal frequency counter up to 40 MHz at the touch of a switch. (Input cable provided.)

NOTE: TS-520 owners can use the DG-5 with a DK-520 adapter kit.

KENWOOD

...pacesetter in amateur radio

TS-820S

WITH DIGITAL FREQUENCY DISPLAY

We told you that the TS-820 would be best. In little more than a year our promise has become a fact. Now, in response to hundreds of requests from amateurs, Kenwood offers the TS-820S*... the same superb transceiver, but with the digital readout factory installed. As an owner of this beautiful rig, you will have at your fingertips the combination of controls and features that even under the toughest operating conditions make the *TS-820S the Pacesetter that it is.*

Following are a few of the TS-820S' many exciting features.

PLL • The TS-820S employs the latest phase lock loop circuitry. The single conversion receiver section performance offers superb protection against unwanted cross-modulation. And now PLL allows the frequency to remain the same when switching sidebands (USB, LSB, CW) and eliminates having to recalibrate each time.

DIGITAL READOUT • The digital counter display is employed as an integral part of the VFO readout system. Counter mixes the carrier VFO, and first heterodyne frequencies to give *exact* frequency. Figures the frequency down to 10 Hz and digital display reads out to 100 Hz. Both receive and transmit frequencies are displayed in easy to read, Kenwood Blue digits.

SPEECH PROCESSOR • An RF circuit provides quick time constant compression using a true RF compressor as opposed to an AF clipper. Amount of compression is adjustable to the desired level by a convenient front panel control.

IF SHIFT • The IF SHIFT control varies the IF passband without changing the receive frequency. Enables the operator to eliminate unwanted signals by moving them out of the passband of the receiver. This feature alone makes the TS-820S a pacesetter.

*The TS-820 and DG-1 are still available separately.

TS-600

TV-506

An easy way to get on the 6 meter band with your TS-520/520S, TS-820/820S and most other transceivers. Simply plug it in and you're on . . . full band coverage with 10 watts output on SSB and CW.

Experience the excitement of 6 meters. The TS-600 all mode transceiver lets you experience the fun of 6 meter band openings.

This 10 watt, solid state rig covers 50.0-54.0 MHz. The VFO tunes the band in 1 MHz segments. It also has provisions for fixed frequency operation on NETS or to listen for beacons. State of the art features such as an effective noise blanker and the RIT (Receiver Incremental Tuning) circuit make the TS-600 another Kenwood "Pacesetter".

TR-8300

Experience the luxury of 450 MHz at an economical price.

The TR-8300 offers high quality and superb performance as a result of many years of improving VHF/UHF design techniques. The transceiver is capable of F_3 emission on 23 crystal-controlled channels (3 supplied). The transmitter output is 10 watts.

The TR-8300 incorporates a 5 section helical resonator and a two-pole crystal filter in the IF section of the receiver for improved intermodulation characteristics. Receiver sensitivity, spurious response, and temperature characteristics are excellent.

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TS-700S

WITH DIGITAL FREQUENCY DISPLAY

Check out the new "built-ins": digital readout, receiver pre-amp, VOX, semi-break in, and CW sidetone! Of course, it's still all mode, 144-148 MHz and VFO controlled.

Features: Digital readout with "Kenwood Blue" digits • High gain receiver pre-amp • 1 watt lower power switch • Built in VOX • Semi-break in on CW • CW sidetone • Operates all modes: SSB (upper & lower), FM, AM and CW • Completely solid state circuitry provides stable, long lasting, trouble-free operation • AC and DC capability (operate from your car, boat, or as a base station through its built-in power supply) • 4 MHz band coverage (144 to 148 MHz) • Automatically switches transmit frequency 600 KHz for repeater operation. Simply dial in your receive frequency and the radio does the rest . . . simplex, repeater, reverse • Or accomplish the same by plugging a single crystal into one of the 11 crystal positions for your favorite channel • Transmit/Receive capability on 44 channels with 11 crystals.

VFO-700S

Handsomely styled and a perfect companion to the TS-700S. This unit provides you with the extra versatility and the luxury of having a second VFO in your shack. Great for split frequency operation and for tuning off frequency to check the band. The function switch on the VFO-700S selects the VFO in use and the appropriate frequency is displayed on the digital readout in the TS-700S. In addition a momentary contact "frequency check" switch allows you to spot check the frequency of the VFO not in use.

TR-7400A

Features Kenwood's unique Continuous Tone Coded Squelch system, 4 MHz band coverage, 25 watt output and fully synthesized 800 channel operation. This compact package gives you the kind of performance specifications you've always wanted in a 2-meter amateur rig.

Outstanding sensitivity, large-sized helical resonators with High Q to minimize undesirable out-of-band interferance, and give a 2-pole 10.7 MHz monolithic crystal filter combine to give your TR-7400A outstanding receiver performance. Intermodulation characteristics (Better than 66dB), spurious (Better than −60dB), image rejection (Better than −70dB), and a versatile squelch system make the TR-7400A tops in its class.

Shown with the PS-8 power supply

(Active filters and Tone Burst Modules optional)

TR-7500

This 100 channel PLL synthesized 146-148 MHz transceiver comes with 88 pre-programmed channels for use on all standard repeater frequencies (as per ARRL Band Plan) and most simplex channels. For added flexibility, there are 6 diode-programmable switch positions. The 15 KHz shift function makes these 6 positions into 12 channels. 10 watt output, ±600 KHz offset and LED digital frequency display are just a few of the many fine features of the TR-7500. The PS-6 is the handsomely styled, matching power supply for the TR-7500. Its 3.5 amp current capacity and built-in speaker make it the perfect companion for home use of the TR-7500.

TR-2200A

The high performance portable 2-meter FM transceiver. 146-148 MHz, 12 channels (6 supplied), 2 watts or 400 mW RF output. Everything you need is included: Ni-Cad battery pack, charger, carrying case and microphone.

KENWOOD

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Kenwood developed the T-599D transmitter and R-599D receiver for the most discriminating amateur.

The R-599D is the most complete receiver ever offered. It is entirely solid-state, superbly reliable and compact. It covers the full amateur band, 10 through 160 meters, CW, LSB, USB, AM and FM.

The T-599D is solid-state with the exception of only three tubes, has built-in power supply and full metering. It operates CW, LSB, USB and AM and, of course, is a perfect match to the R-599D receiver.

If you have never considered the advantages of operating a receiver/transmitter combination . . . maybe you should. Because of the larger number of controls and dual VFOs the combination offers flexibility impossible to duplicate with a transceiver.

Compare the specs of the R-599D and the T-599D with any other brand. Remember, the R-599D is all solid state (and includes four filters). Your choice will obviously be the Kenwood.

R-599D T-599D

R-300

Dependable operation, superior specifications and excellent features make the R-300 an unexcelled value for the shortwave listener. It offers full band coverage with a frequency range of 170 KHz to 30.0 MHz • Receives AM, SSB and CW • Features large, easy to read drum dials with fast smooth dial action • Band spread is calibrated for the 10 foreign broadcast bands, easily tuned with the use of a built-in 500 KHz calibrator • Automatic noise limiter • 3-way power supply system (AC/Batteries/External DC) . . . take it anyplace • Automatically switches to battery power in the event of AC power failure.

Fine equipment that belongs in every well equipped station

HF LINES

820 Series

TS-820S . . . TS-820 with Digital Installed
TS-820 . . . . 10-160 M Deluxe Transceiver
DG-1 . . . . . . Digital Frequency Display for TS-820
VFO-820 . . Deluxe Remote VFO for for TS-820/820S
CW-820 . . . 500 Hz CW Filter for TS-820/820S
DS-1A . . . . . DC-DC Converter for 520/820 Series

520 Series

TS-520S . . . 160-10 M Transceiver
DG-5 . . . . . . Digital Frequency Display for TS-520 Series
VFO-520 . . Remote VFO for TS-520 and TS-520S
SP-520 . . . . External Speaker for 520/820 Series
CW-520 . . . 500 Hz CW Filter for TS-520/520S
DK-520 . . . . Digital Adaptor Kit for TS-520

599D Series

R-599D . . . . 160-10 M Solid State Receiver
T-599D . . . . 80-10 M Matching Transmitter
S-599 . . . . . External Speaker for 599D Series

CC-29A . . . . 2 Meter Converter for R-599D
CC-69 . . . . . 6 Meter Converter for R-599D
FM-599A . . FM Filter for R-599D

SHORT WAVE LISTENING

R-300 General Coverage SWL Receiver

VHF LINES

TS-600 . . . . 6 M All Mode Transceiver
TS-700S . . . 2 M All Mode Digital Transceiver
VFO-700S . . Remote VFO for TS-700S
SP-70 . . . . . Matching Speaker for TS-600/700 Series
TR-2200A . . 2 M Portable FM Transceiver
TR-7400A . . 2 M Synthesized Deluxe FM Transceiver
TR-7500 . . . 100 Channel Synthesized 2 M FM Transceiver
TR-8300 . . . 70 CM FM Transceiver (450 MHz)
TV-506 . . . . 6 M Transverter for 520/820/599 Series

POPULAR STATION ACCESSORIES

HS-4 . . . . . . Headphone Set
MB-1A . . . . Mounting Bracket for TR-2200A
MC-50 . . . . Desk Microphone
PS-5 . . . . . . Power Supply for TR-8300
PS-6 . . . . . . Power Supply for TR-7500
PS-8 . . . . . . Power Supply for TR-7400A
VOX-3 . . . . VOX for TS-600/700A

Trio-Kenwood stocks a complete line of replacement parts, accessories, and manuals for all Kenwood models.

MORE ACCESSORIES:

Description	Model #	For use with
Rubber Helical Antenna	RA-1	TR-2200A
Telescoping Whip Antenna	T90-0082-05	TR-2200A
Ni-Cad Battery Pack (set)	PB-15	TR-2200A
4 Pin Mic. Connector	E07-0403-05	All Models
Active Filter Elements	See Service Manual	TR-7400A
Tone Burst Modules	See Service Manual	TS-700A; TR-7400A
AC Cables	Specify Model	All Models
DC Cables	Specify Model	All Models

The Kenwood HS-4 headphone set adds versatility to any Kenwood station. For extended periods of wear, the HS-4 is comfortably padded and is completely adjustable. The frequency response of the HS-4 is tailored specifically for amateur communication use (300 to 3000 Hz, 8 ohms).

The MC-50 dynamic microphone has been designed expressly for amateur radio operation as a splendid addition to any Kenwood shack. Complete with PTT and LOCK switches, and a microphone plug for instant hook-up to any Kenwood rig. Easily converted to high or low impedance. (600 or 50k ohm)

TRIO-KENWOOD COMMUNICATIONS INC.
1111 WEST WALNUT/COMPTON, CA 90220

KENWOOD
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LETTERS

NEVER SATISFIED

Two FCC policies, both in contradiction to FCC rules, have led to a gross inequity in the reassignment of two-letter W and K callsigns. Rule section 97.53 (j) states that, "Callsigns which have been unassigned for more than one year are normally available for reassignment."

An existing Commission policy does not conform to the spirit or to the letter of that rule. The contradictory policy came to light when an amateur requesting a specific two-letter callsign previously held by a silent key received a "no action" response from the Commission. The following is an excerpt from a letter written by Charles A. Higginbotham, Chief, Safety and Special Radio Services Bureau, to the amateur's congressman. The specific callsign involved has been deleted as the action is currently being reviewed by the FCC. In that letter, Mr. Higginbotham stated, "Although the amateur station license with callsign K--- did expire on December 15, 1975, Commission procedure is such that callsign K--- will not be purged from Commission records, and thus be available for reassignment, until some time in the future. We purge our records at irregular intervals. For this reason, we are unable to predict when callsign K--- will become available." That letter was written in July, 1977, a full eighteen months after the callsign holder's license expired.

That policy, in and of itself, would not be so bad except for another Commission policy. That policy, as set forth in Mr. Higginbotham's letter, is that "... we do not 'hold' applications in anticipation of the availability of callsigns."

That second policy results in the following scenario: An eligible amateur desires a specific two-letter callsign; he researches the status of the callsign and finds that the prior holder is deceased or has let his license expire and a period of twelve months has elapsed; the amateur immediately makes application for the specific two-letter callsign; the Commission, upon receiving the application, returns it with a "no action" letter because the callsign has not yet been "purged" for reassignment. We all know how long it takes from the time an application is sent off until the time a response is received. In the interim, a less diligent amateur puts in a request for the same callsign. By chance, the callsign is "purged" the day before the second amateur's application is reached. An inequity has resulted.

The result of such Commission policies is that amateurs requesting specific two-letter callsigns enter into a game of Russian roulette with the Commission. The object of the game is to guess the date the Commission records will be "purged" and to time one's application for a specific callsign so that it will be received immediately after the purge.

One of these two arbitrary Commission policies must be changed in order to result in the equitable assignment of specific two-letter callsigns. If the Commission's policy with respect to the purging of its records is changed, applicants will know precisely when specific callsigns will become available for assignment. On the other hand, if applications are held until specific callsigns become available, applicants will know that if their application for a specific callsign is received prior to another application, they will be assigned such specific callsign when it becomes available.

Concerned amateurs are urged to write the FCC and demand that these policies be changed so that fairness exists with respect to the assignment of specific two-letter callsigns.

Kenneth S. Widelitz WA6PPZ
President
Personal Communications Foundation
Los Angeles CA

TOUGH ONE

Many thanks for printing my letter asking for someone to monitor the Novice exam. I was able to contact a helpful ham and I was successful on my first attempt.

I might add that the exam was one of the hardest I have taken dealing with communications. Many of the questions do not appear in any of the guides I bought.

F. Cuillo WA2RQA
Wassaic NY

UNCHARACTERISTIC

I was moved very near to anger and rage (very uncharacteristic) by the letter of one M. P. Lewton appearing in the August issue, favoring the loss of part of the 220-225 MHz amateur band to the citizen's service. After several days, I have calmed sufficiently to write this letter briefly stating my objections to Mr. Lewton and his three points, as follows:

1. His statement that "we amateurs ... could operate on the lost frequencies with our CB license" falsely assumes that I either have such a license now, or would ever stoop so low.

2. To say that giving up any amateur frequency would be compensated for by the availability of cheap radios seems to imply that amateurs cannot now use those frequencies, but will wait for the cast-off and surplus of a citizen's band instead of building or buying equipment intended for amateur service. That would be a sad commentary on the technical and financial state of radio amateurs if it were true. Nobody's making any more frequency spectrum, and to trade this precious resource for a few cheap CB sets that could be converted would be a bad deal for amateurs.

3. My answer to "CB really needs more room ..." is to look at what they are doing with the frequencies they now have. I am deeply embarrassed to think that people all over the world with shortwave receivers can tune across 11 meters during an opening and form their opinion of American mentality and demeanor from what they must hear from CB operators. If I had the power, I would move all CB operation to a single channel at 10 kilohertz, where they could share the frequency on a non-exclusive basis with Project Sanguine!

Jerold R. Johnson WA5RON
Austin TX

WATCH YOUR STEP

The 5th Signal Command in Worms, Germany, reports that the German federal postal and telecommunications department is to begin a "crackdown" on illegal CB operation by Americans in West Germany.

Some of the requirements for CB (low power radiotelephone) operation are: 2 Watts input, 500 milliwatts output to the antenna, omnidirectional antenna only; operation on channels 4 to 15 only; no connections to the public telephone system; and you cannot use a mobile as a base. Fees are DM 5 ($2.25) a month for mobiles, and DM 15 ($7.75) for a base. These must be paid on each unit. Absolutely forbidden are: beam antennas, linear amplifiers, and operation outside the federal republic of Germany. Also, you can't use your ears on the transport routes to and from West Berlin.

Travis Wade, vice-president of the Frankfurt area CB club, reports that most Americans in that area are so afraid of getting a "midnight knock" at the door by a German postal official that many of these people have gone QRT until they think that they can operate their illegal rigs again. It should be noted here that the German Polizei and the American MPs do not hesitate to call up the American CBers when there is an emergency or a lost child, etc.

American hams here in Germany would be well advised to carry a copy of their license in their car at all times, and to remove their equipment when their dependents are using their vehicles.

One good thing about operating in Germany is that you have a great deal of security about having mobile 2 meter gear. The penalties for auto break-in are severe and swift. So is the fine for illegal CB operation, sometimes as high as DM 3,000 ($1,300) plus imprisonment.

Sgt. Charles E. Martin
WA4YRA/DA1NR
APO NY

ACTION

I finally am getting off my rear to write. I have been faithfully reading *73* since I gave up my membership (and sub) to another organization. I think you are publishing the best ham radio magazine on the market.

Now, a proposal, strictly food for thought. How about a new, completely independent amateur radio league (call it what you like) — an organization that would represent its membership and not just use their money, an organization that thinks more of its duties to its members for WARC rather than a new building, an organization that listens to its members and answers their letters. I could go on and on, but I think you have the idea. Can you imagine a headquarters in New Hampshire? Unheard of! How about some response from *73* readers on this?

Keep up the objectivity of your magazine. A little controversy is great and helps keep the air cleared. Keep up the good work and best of luck.

Chuck Coffee WA6FLV
Rota, Spain

ANTI-RY

I just received my September issue of *73* and am sorry to say I don't like it at all; it is all one-sided for RTTY. I have nothing against RTTY, but a whole issue of it is too much.

I have noticed in the past few months that you are specializing on one field in each issue. I hope that this is not going to be your practice. I think the magazine will be a total loss or a bore to other readers who are not interested in that field.

One more thing I would like to see in your magazine is an article on amplifiers, especially on 15 and 10 meters. They are bad enough on 20m; let's hope they keep it there. I want everybody to enjoy ham radio, not just the ones with high power.

Donald Laroche WA2FXQ
Syracuse NY

HOT STUFF

I just wanted to send off my kudos to Mark Clark WB4CSK for his letter (Sept. 1977). I used to be a CBer, but I learned and studied and worked at the darn thing until I finally started getting regular correspondence from Uncle Charlie (in the form of upgraded licenses!) almost regularly.

I'm 14 years old (I got my Novice and Tech while I was 13) and first got my Novice and Tech back in the fall

Continued on page 48

De WA3ETD

John Molnar WA3ETD
Executive Editor

SPECIAL ISSUES

This issue of *73* is dedicated to OSCAR users, present and future. As you probably know, the newest amateur satellite launching is planned for the first of the year — details are in this issue. This bird will feature a UHF downlink for the first time, in the international amateur satellite band, no less! Many existing Mode B stations will be able to use their equipment with no problems. Hopefully, the new AMSAT entry will promote interest in UHF receiver design and techniques!

Even if you are not interested in satellites, the antenna and equipment referenced in the OSCAR articles can be used for standard VHF/UHF communications — who knows, the antenna you've been looking for might be described in an OSCAR article.

I have had several complaints about the special interest *73* issues this summer. Okay, I agree, not everyone is interested in RTTY and OSCAR. However, the content of the articles is applicable to all aspects of amateur communication. Please don't close your mind to new technology — satellites are becoming more and more commonplace in the amateur community; future AMSAT shots are going to provide hemisphere repeater operations — think about it!

At any rate, there are no more special issues in the mill right now. All suggestions for the same are appreciated!

THE COVER

The cover shot on this issue of *73* is an artist's rendition of the new bird — it really has not been launched yet! Credit to R. Michael Smithwick WA6TUF for the cover.

TAKE COVER

An article slipped into the RTTY issue last month that needed an editor's comment. The article, "RTTY Local Loop," is not really perfect for beginners. An isolation transformer is definitely required to isolate the loop from the power line! Otherwise, a shock could result from contact with the loop jacks if the plug is incorrectly polarized. In order to be safe, the isolation transformer should be inserted between the bridge and the power line. Be careful!

AN APOLOGY

Due to the extra demands placed on the *73* staff by Wayne's Computermania show, I have fallen behind in processing new manuscripts. I am currently about two weeks behind — take heart, your manuscript is not lost. As this is our deadline week, I will make a super effort to read all manuscripts by next week. Expect to have heard from me by the time you read this.

NEW TRENDS

Let me know what you think about the Gunnplexers and microwave information. If the general readership is not especially interested in new things, I will cease — however, until then, prepare yourselves! The experiments with the Gunnplexers are continuing; hopefully, in a month I will be able to write about the Doppler radar system I'm developing. This system is based on a counter with a modified timebase that will allow direct readout of range, speed, or whatever. Again, Computermania cut deeply into my free time!

I obtained a Hughes neon-helium laser tube the other day, and am attempting to integrate it into some kind of experimental communications system. So far, a power supply using an automotive ignition coil is under construction. By the way, ignition coils are a good source (cheap) for high voltage at low current. A 24-volt transformer and variac can be used to drive the coil, which is nothing more than an autotransformer. It was very easy to obtain the 1200 volts required to fire my laser using such a scheme.

My wife is beginning to wonder what's up at our home — between the microwaves and now the laser, she's thinking about building a copper screen around the living area. Be careful when playing with these devices!

DEIMOS

So, you think SSTV is only good for transferring QSL cards and pix of the shack? This picture is courtesy of *73* associate editor Dave Ingram K4TWJ. Dave obtained the picture from the "N6V" gang at the Jet Propulsion Laboratory. This picture is computer processed, and formerly unreleased. Dave has been doing considerable work in slow and fast scan television with JPL — so without additional comment, I'll let the Viking News Center (Pasadena CA) tell the story:

"This is a computer-generated color picture of Deimos, smaller of the two satellites of Mars. A pair of images of Deimos from Viking Orbiter 1 — one taken through the camera's violet filter, the other through the orange filter — were combined in this single image to search for color differences on the surface of Deimos. Resolution in this picture shows objects as small as 200 meters. Deimos is a uniform gray color; slight tints of orange on the rims of some craters are artifacts of the image process. A small blur beside the large crater at the right is where scientists removed a reseau mark from the original image. The reseau marks etched on the imaging system are used to make precise measurements of the objects in the photos."

Editor:
Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

CONTESTS

Information on all 1978 contests should be forwarded as soon as possible *directly to me* for publication. Help avoid multiple contests on the same weekend with conflicting schedules by having your dates published as early as possible. Also, don't forget to send abbreviated results and any award information.

For a slight twist this year, take a listen during the OK DX contest. Last year there was good activity from Europe even though it was on the same weekend as Sweepstakes.

Anyone interested in a fine newsletter for contesters should check the *National Contest Journal*, published bi-monthly by the Southern California Contest Club, edited by Pete Grillo N6CJ. Subscription rates are $4/year in USA, $5/year elsewhere. For more information write: NCJ, PO Box 3762, Glendale CA 91201.

ARRL SWEEPSTAKES

CW
Starts: 2100 GMT Saturday, November 5
Ends: 0300 GMT Sunday, November 6
Phone
Starts: 2100 GMT Saturday, November 19
Ends: 0300 GMT Sunday, November 20

Sweepstakes is sponsored by the ARRL and is open to all amateurs in the US, US possessions, and Canada. No more than 24 hours of operation are permitted during the 30-hour contest period. Time spent listening counts as operating time and off periods may not be less than 15 minutes. Times on and off as well as QSO times must be entered in the log. Each station may be worked only once, regardless of band.

CLASSES:

All entries will be classified as either single or multiple operator stations. Single operator stations will be further classified by input power: Class A = 200 Watts dc or less, Class B = above 200 Watts. All ARRL affiliated clubs may also participate in the club competition.

EXCHANGE:

Number, precedence, your call, CK, and ARRL section. Send A for precedence if power is 200 Watts dc or less, otherwise send B. For CK, send the last 2 digits of the year you were first licensed.

SCORING:

Score 2 points for each completed QSO. Final score is sum of QSO points multiplied by the total number of ARRL sections plus VE8 (max. 75).

AWARDS:

Certificates will be awarded to the highest scoring Class A entry and the highest scoring Class B entry in each section, provided there are at least 3 single operator entries or the score is 10,000 points or more. Certificates will also be awarded for high scoring Novices and Technicians. Multi-operator entries are not eligible for certificate awards and will be listed separately in the results.

FORMS:

It is suggested that contest forms be obtained from ARRL, 225 Main St., Newington CT 06111. All entries with 200 or more QSOs must have a cross-check sheet to check for duplicate QSOs. Each log must show date, QSO time, times on/off, exchanges sent and received, band and mode.

Note: These rules were taken from last year's contest.

RSGB 7 MHz DX CONTEST

Phone
Starts: 1800 GMT Saturday, November 5
Ends: 1800 GMT Sunday, November 6

EXCHANGE:

Report and serial number, starting with 001.

SCORING:

Non-British Isles stations score 5 points for each contact with the British Isles; those outside Europe score 50 points. All may claim a bonus of 20 points for each British Isles numerical prefix worked (G, GC, GD, GI, GM, GW – 2, 3, 4, 5, 6). Contacts with stations using GB prefixes will not count for bonus points.

AWARDS:

Non-European stations must make at least 10 QSOs to qualify for an award.

LOGS:

Logs and entries must be addressed to the HF Contests Committee, c/o J. Bazley G3HCT, Brooklands, Ullenhall, Solihull, West Midlands, England, to arrive no later than December 29.

MISSOURI QSO PARTY

Starts: 1800 GMT Saturday, November 12
Ends: 2300 GMT Sunday, November 13

The 13th annual QSO party is sponsored by the St. Louis Amateur Radio Club in an effort to activate some of the hard-to-get Missouri counties. The same station may be worked once per band and mode. Missouri mobiles will count separately from each different county.

EXCHANGE:

QSO Number, RS(T), and QTH; county for MO stations; state, province, or country for others. MO mobiles start with #1 from each county activated.

FREQUENCIES:

3540, 3910, 7040, 7240, 14040, 14270, 21110, 21360, 28110, 28600, 50-50.5.

SCORING:

Score 1 point per QSO; MO stations multiply contact points times number of states, provinces, and countries; others multiply by number of MO counties (115 max). MO mobiles total separate score from each county activated.

AWARDS:

Certificates to top scores in each state, province, country, top 10 MO entries, and top 3 MO mobiles.

ENTRIES:

Mailing deadline for logs is December 15. Address all entries to: St. Louis ARC – KØLIR, 842 Tuxedo Blvd., Webster Groves MO 63119. Include an SASE for results.

DELAWARE QSO PARTY

Saturday, November 12
0001 to 0600 and 1600 to 2200 GMT
Sunday, November 13
0001 to 0600 and 1600 to 2200 GMT

Sponsored by the Delaware ARC, contest is open to all amateurs. Stations may be worked once per band/mode for QSO points.

EXCHANGE:

QSO number, RS(T), and QTH – county for DEL, ARRL section or country for others.

SCORING:

DEL stations score one point per QSO and multiply total by number of ARRL sections and countries worked. Others score 5 points per DEL QSO and multiply by 1 if one DEL county is worked, 3 if two counties worked, and 5 if all three counties worked (counties = Kent, New Castle, and Sussex).

FREQUENCIES:

CW – 3560, 7060, 14060, 21060, 28160.

Phone – 3975, 7275, 14325, 21425, 28650.

Novice – 3710, 7120, 21120, 28160.

ENTRIES AND AWARDS:

Appropriate awards given top scorers and a special certificate to all stations working all three Delaware counties. Mailing deadline is Dec. 31 to John R. Low K3YHR, 11 Scottfield Drive, Newark DE 19713. Include an SASE for results or W-DEL certificate.

EUROPEAN DX CONTEST

RTTY
Starts: 0000 GMT Saturday, November 12
Ends: 2400 GMT Sunday, November 13

Rules for the contest are the same as for the Phone section, with one exception: In the RTTY section, contacts with one's own continent are permitted and count 1 point per QSO. Multipliers will be counted as before.

Complete rules appeared in the August issue on page 22. Briefly, the basic rules are as follows:

Use all bands 3.5 through 28 MHz, with only 36 hours of operation out of the 48-hour contest period for single operator stations. The 12-hour rest period may be taken in up to 3 periods. Classes include single operator (all band), and multi-operator with single transmitter.

EXCHANGE:

RST and progressive QSO number starting with 001.

SCORING:

Each QSO will count 1 point. A station may be worked once per band. Each QTC (given or received) counts 1 point – see August issue. The multiplier for non-European stations is the number of European countries worked on each band. Europeans will use the ARRL countries list. In addition, each call area in the following countries will be considered a multiplier: JA, PY, VE, VO, VK, W/K, ZL, ZS, UA9/UAØ. The multiplier on 3.5 MHz may be multiplied by 4; the multiplier on 7 MHz may be multiplied by 3; the multiplier on

CALENDAR

Nov 3-4	YLRL Anniversary Phone Party
Nov 5-6	ARRL Sweepstakes – CW
Nov 5-6	RSGB 7 MHz CW Contest
Nov 12-13	IPA Contest
Nov 12-13	European DX Contest – RTTY
Nov 12-13	Missouri QSO Party
Nov 12-13	Delaware QSO Party
Nov 13	OK DX Contest
Nov 19-20	ARRL Sweepstakes – Phone
Nov 19-20	WWDXA International CW Contest
Nov 19-20	All Austrian Contest
Nov 26	Ten Meter Ground Wave Contest
Nov 26-27*	CQ WW DX CW Contest
Dec 3-4	ARRL 160 Meter Contest
Dec 10-11	ARRL 10 Meter Contest
Dec 17-18	CW Christmas Party

*Described in last issue.

14/21/28 MHz may be multiplied by 2. The final score is the total QSO points plus QTC points, multiplied by the sum total multipliers from all bands.

AWARDS:

Certificates to highest scorer in each country, reasonable score provided. Continental leaders will be honored. Certificates will also be given to stations with at least half the score of the continental leader.

LOGS:

Use a separate log sheet for each band. Logs for the RTTY section should be mailed no later than December 1. North American stations may send their contest logs to: H. E. Weiss WA3KWD, 762 Church St., Millersburg PA 17061, USA. All others should send their logs to: WAEDC – Committee, D-895 Kaufbeuren, Postbox 262, Germany.

IPA CONTEST

Saturday, November 12
0800 to 1000 and
1400 to 1700 GMT
Sunday, November 13
0800 to 1000 and
1400 to 1700 GMT

Sponsored by the International Police Association Radio Club – German Section (IPARC), the contest is designed to enable participators to work the Sherlock Holmes Award (SHA). The contest is open to all radio amateurs and SWLs. Members may work anyone, non-members may only work members. General call is "CQ IPA." Cross-band and cross-mode contacts are not allowed. All contacts must be on CW or SSB.

EXCHANGE:

Non-members send RS(T) and serial number. Members send IPA, RS(T), and serial number.

SCORING:

Every completed QSO counts 2 points on 80/40 meters, 4 points on 20/15/10 meters. Stations may be worked once per band. Multiplier is number of DXCC countries; every band counts separately. Final score is QSO points times multiplier.

FREQUENCIES (as allowed):

SSB – 3650, 7075, 14295, 21295, 28650.

CW – 3575, 7025, 14075, 21075, 28075.

AWARDS AND ENTRIES:

Certificates to winners and three highest scores. Any amateur fulfilling the conditions of the SHA50, SHA100, or SHA200 during the contest may apply with application sheet. Approval of 2 licensed hams is not necessary for contest application. SHA rules, IPARC membership list, SHA application sheet, contest log sheet, and contest score or certificates are available from Vince Gambina WB4QJO, 7606 Kingsbury Road, Alexandria VA 22310 – include an SASE, please! Contest entries must be postmarked no later than December 31 and sent to Adolf Vogel DL3SZ, Ritter-von-Eyb-Strasse 2, D-8800 Ansbach, Germany.

INTERNATIONAL OK DX CONTEST

Contest Period:
0000 to 2400 GMT
Sunday, November 13

The participating stations work stations of other countries according to the official DXCC Countries List. Contacts between stations of the same country count only as a multiplier, but 0 points. All bands from 160 to 10 meters, CW and phone may be used. (OK stations are only licensed to operate CW on 160 meters.) Crossband as well as cross-mode contacts are not valid.

EXCHANGE:

Exchanges consist of a 4 or 5 digit number indicating the RS(T) and ITU zone.

SCORING:

A station may be worked once only on each band. A complete exchange of codes counts one point, but three points for a complete contact with a Czechoslovak station (except as noted above for stations in the same country). The multiplier is the sum of the ITU zones from all bands. Final score is then the sum total of contact points times the multiplier.

CATEGORIES:

A – single operator, all bands; B – single operator, one band; C – multi-operator, all bands. Any station operated by a single person obtaining assistance, such as in keeping the log, monitoring other bands, tuning the transmitter, etc., is considered as a multi-operator station. Club stations may work in category C only.

AWARDS:

A performance list of participants will be worked out by the contest committee for each country. A certificate will be awarded to the top scoring operators in each country and each category. The "100 OK" award may be issued to stations for contacts with 100 Czechoslovak stations, and the "S6S" award (and/or endorsements for individual bands) may be issued to a station for the contacts with all continents. Both awards will be issued upon a written application in the log. No QSL cards are required for either award.

LOGS:

A separate log must be kept for each band, and must contain date and time in GMT, station worked, exchange sent and received, points (0, 1 or 3), and ITU zone (with the first QSO for that zone only). The log must contain in its heading the category of the station (A, B, or C), name and callsign, address, and band or bands. Also, indicate the sum of contacts, QSO points, multipliers, and the total score of the participating station. Each log must be accompanied by the following declaration:

I hereby state that my station was operated in accordance with the rules of the contest as well as all regulations established for amateur radio in my country, and that my report is correct and true to the best of my belief.

Logs must be sent to The Central Radio Club, Post Box 69, Prague 1, Czechoslovakia – postmarked no later than December 31, 1977. A list and map of ITU zones is available for 2 IRCs from the same address.

WWDXA INTERNATIONAL CW CONTEST

Starts: 0000 GMT Saturday,
November 19
Ends: 2400 GMT Sunday,
November 20

Sponsored by the Worldwide DX Association and *DXers Magazine*, the objective is to contact as many amateurs in as many ITU zones and countries as possible using all available frequencies. All assigned amateur radio frequencies from 0.1 MHz to 25 GHz including transponders and repeaters of amateur satellites may be used. There are no contest limits; you may use complete automation devices, including tape recorders, auto keyers, readout devices, or other automatic CW devices. You must, however, follow the rules and regulations governing amateur radio in your country. Multi-operator, multi-transmitter entrants are encouraged. Single operator, single transmitter, single band entrants must state single category for special recognition. All entrants are assumed to be multi/multi/multi unless otherwise stated. The purpose is to encourage group contesting to enhance teamwork and interaction. Shortwave listener entries are a separate category.

EXCHANGE:

All stations must exchange reports and ITU zone numbers. Mobiles changing zones during the contest period will make changes in report sent to show the new zone. Shortwave listener logs must reflect zone numbers.

SCORING:

3 points for contact on different continent, 1 point for contact of different country but same continent, 10 points for contact by satellite transponders or repeaters, 0 points for your country contact, but multipliers count. Multipliers are each ITU zone contacted per band and each country contacted per band. Final score is total QSO points times total multiplier. SWLs score same but on heard basis. Land and sea mobiles count as different continent (3 points).

ENTRIES AND AWARDS:

Submit your contest summary sheet to the contest committee. *Do not submit your logs* – only the summary sheet. Include name and callsigns of all operators and listeners. Contest committee reserves the right to request your log to verify your entry in the event of close or tie scores. Summary sheet must be postmarked before January 1; contest synopsis will be mailed to each entrant before February 15. Trophies, prizes, or negotiables are solicited for award within country of origin. Results of the contest committee are final. Mail entries to: Frank Jerome W5AT, 908 Holoway, Midwest City OK 73110.

ALL AUSTRIAN CONTEST

Starts: 1900 GMT
November 19
Ends: 0600 GMT
November 20

The contest is open to all amateurs; power input must be in accordance with licensing regulations. All contacts must be on 160 meters, on CW only. Foreign stations use the call "CQ OE," Austrian stations will use the call "CQ TEST." The authorized sub-allocations for Austria are: 1.823-1.838, 1.854-1.873, 1.873-1.900 MHz.

EXCHANGE:

RST and QSO number starting with 001. Each exchange must be confirmed by repeating the exchange code.

SCORING:

Every completely logged QSO (date, time in GMT, frequency in MHz, call of station, exchanges given and received) counts one point. Multipliers are 2 points for every Austrian "Bundesland" (OE 1-9), and one point for every prefix. Multiply QSO points times multipliers for final score. Every station can be contacted only once. If a station is contacted twice, the second QSO must be clearly marked as a duplicate and does not count.

ENTRIES:

Logs must be postmarked no later than December 15 and sent to: Landesverband Salzburg des OVSV, "AOEC 1977," c/o Ing. Wolfgang Latzenhofer OE2LOL, Pfeifferhofstrabe 7, A-5020 Salzburg, Austria.

TEN METER GROUND WAVE CONTEST

November 26
9 pm to 1 am Local time

Sponsored by the Breeze Shooters of Pennsylvania, send an SASE to Richard Evanuik WA3LUM, 311 Evergreen Ave., Pittsburgh PA 15209, for logs and new rules. There will be separate categories for Novice/Technician classes.

AMSAT

AMSAT-OSCAR 7 ORBITAL DATA CALENDAR

In cooperation with AMSAT, Skip Reymann W6PAJ has published an improved AMSAT-OSCAR orbital data calendar containing all orbits for 1978 for AMSAT-OSCAR 7. Designed so that it may be hung on the wall, the calendar includes information on the operating schedules and frequencies for the spacecraft, and also the telemetry decoding equations. Also included is step-by-step information on how to determine times of passage of the satellite.

The orbital calendar is available postpaid for $5.00 U.S. funds or 30 IRCs ($3.00 to AMSAT members, and free to AMSAT Life Members). Overseas orders will be airmailed. Orders and payments should be made in U.S. currency to: Skip Reymann W6PAJ, P.O. Box 374, San Dimas CA 91773.

Important – To speed up handling of your order, please include a gummed, self-addressed label.

Proceeds from the Orbital Calendar benefit AMSAT.

Looking West

Bill Pasternak WA6ITF
24854-C Newhall Ave.
Newhall CA 91321

Coordinators, coordination councils, and concerned spectrum users should take note of the following date: September 23, 1978. If plans jell as it now appears they will, on that date the Southern California Repeater Association, the San Diego Repeater Association, and the 220 Club of San Diego will cosponsor this nation's first *VHF/UHF National Voluntary Coordination and Band Planning Meeting* in the city of San Diego, California.

It has been obvious for a long time that coordinators and coordination councils all over the nation face similar problems and that some format has to be found to get all of these people under one roof for a day or so to give them a chance to talk over their ideas with one another. No individual or group had made any move toward setting up such a get-together. The initiating step took place at the August 20, 1977, SCRA General Membership Meeting held in La Jolla. In his remarks welcoming the SCRA to the La Jolla-San Diego area, Sam Deer suggested that the SCRA schedule its fall, 1978, meeting so that it could be held at the 1978 ARRL National Convention that he and his staff are putting together at this time. "Why not make it a national coordinators meeting instead?" suggested Bob Thornberg WB6JPI, and at that moment was born the idea of SCRA hosting the first meeting of this kind.

However, an event of this scope would necessitate support from as many amateurs as possible, and since this will be a seminar held in San Diego, it was felt that the amateur community of that city must be directly involved. Therefore, after some quick discussions and a few letters, it was decided that rather than have it be an SCRA-sponsored gathering, it would be cosponsored by the three organizations mentioned above.

Since plans are still in the formative stages, it's hard at this moment to describe any program for the meeting itself. One suggested plan is to hold two separate sessions, with technical issues discussed in the morning and matters of a political nature taken up after a good lunch. However, since it has been but two weeks since the idea itself was conceived, exact plans have yet to be formulated. In either case, it is hoped that this meeting will be attended by delegates from all voluntary coordination councils (and/or coordinators) here in the United States and worldwide, as well as individual amateurs who are truly concerned with overall VHF/UHF voluntary spectrum management.

Further information on this meeting will soon appear both here and in most other amateur publications. In the interim, if you think you might want to attend or wish to make reservations for a seat (the meeting is *free*, but the sponsors would like to know how many people to expect), drop a note to the attention of Mr. Paul McClure, Secretary, Southern California Repeater Association, PO Box 2606, Culver City CA 90230. Mark your envelope "Coordination Meeting Info Request," and please include an SASE. This meeting may mark a historic moment in amateur radio's future, so plan to attend.

CALL FOR PAPERS

SCRA Chairman Jim Hendershot has informed me that I have been "volunteered" by the SCRA to handle their involvement in the meeting. One idea that I have is to invite you who plan on attending to submit formal "papers" for consideration and/or presentation at the seminar next September. In this way, many divergent opinions and ideas could be expressed in a short time on such topics as "The Future of Voluntary Spectrum Management by Amateurs," "Coordination Methods for Relay Communication," "The Anatomy of a Voluntary Coordination Council," "User Involvement in Repeater Coordination," "Advanced Coordination Techniques Using Microprocessors," "Possible Voluntary Coordination of Non-Relay Spectrum Operations," etc. You need not limit yourself to the aforementioned list – use your imagination. Even if you oppose the concept of voluntary spectrum management and feel you have a good argument to prove your point, go ahead and submit a presentation. Since this seems to have been placed in my lap anyhow, it is my intention to get a "judging committee" put together that will be made up of the best technical minds I can muster. Those authors whose papers are selected will be invited to present them at the meeting.

I guess that at this point some "ground rules" might be in order. First, use whatever written format you like. It's content, not writing form, that's important. Second, it should be long enough to present your views in an easy-to-understand manner, yet not so overly long as to put everyone to sleep. One way to be sure is to read it into a tape recorder after you have finished it. If it runs no longer than, say, 15 minutes and holds your interest, then you have a potential winner. If, after listening for 45 minutes, you find yourself falling asleep, then I suspect that some text editing is in order.

Let's set a submission cutoff date of June 15, 1978. This will give the committee a chance to read and judge all submissions and notify those authors selected. However, once you find out that you are one of the chosen presenters, it's up to you to get to the meeting on your own. Neither the SCRA, SANDRA, or the 220 Club of San Diego will be responsible for providing transportation to the meeting, lodging, or any other expenses. Costs of such would be prohibitive. However, if you are one of the "dedicated" ones, you have already planned to attend both the ARRL National and this meeting, so dust off the typewriter and get going. Send all submissions to my attention, in care of the SCRA PO box in Culver City. Also, if you want your presentation returned should it not be chosen, please enclose an SASE.

PETE HOOVER ON USER INVOLVEMENT IN REPEATER COUNCILS

Herbert "Pete" Hoover III W6ZH is probably one of the most respected members of this nation's amateur community. On August 20, 1977, Pete addressed the membership of the SCRA on the topic of "User Involvement in Repeater Councils." Here is a partial text of Pete's talk:

"I've been involved in repeaters at one time or another, of one kind or another, since I got back from Europe in 1964. I had control station for one of them for a while, first AM and now FM. I'm not a stranger to the mode of communication; however, I am not as far aside as Stan Brokl is, who wrote the comment in here *(referring to an article that appeared in various local radio club newsletters)* saying that the two meter repeaters are very close to CB activity. I wish they were in some respects.

"A week ago, I was in Dallas talking to the REACT International Convention. They have a repeater on 460. I think they have a bunch of them. They do a good job with them. They're commercial users.

"I would much rather be stuck on the road and have to ask REACT for help than I would be stuck on the road and have to ask the average repeater user for help. You might as well just forget it. Why? Because repeater operators are primarily interested in themselves. They are interested in commercial communications suppliers like themselves *(referring to repeater owner operators)*. They are not user-oriented. Okay, fine, ATV is the same sort of thing, perhaps. But there is a problem in the southern California region – at least four people have mentioned it in different terms today: There are no more frequencies *(referring to available southern California two meter and 220 MHz channel pairs)* under the present situation.

"And not only that, the communications service suppliers, the people who provide communications services – which are you people primarily – repeater operators *(owners)* are becoming increasingly remote for the reason that you exist: your users. The comment was made here earlier today – Is it possible to include a user viewpoint in this kind of organization? I'm telling you, you'd better!

"You are, for all intents and purposes, a communications utility. Remember the words – they're going to be used more and more. Think back on the utilities that you normally think about when you hear the words. Power company, gas company, railroads, airlines, truckers. They abused the users of their services to the point where the federal government stepped in. And, ladies and gentlemen, if the repeater community does not get its act together, you are going to hear that as a suggestion

Continued on page 23

Pete Hoover W6ZH addresses the SCRA at La Jolla.

FCC Math

John F. Leahy WB6CKN
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This is the first in a series for hams and would-be hams who have trouble with math. What we'll do over the months is take the equations and other math stuff you run into in FCC exams and handle them in a relaxed yet thorough fashion, so that when you go to face the friendly executioners down at the FCC office, you'll be well prepared to breeze through any math curves thrown at you.

So, if you are a person who can handle simple adding, subtracting, multiplying, and dividing okay, but tend to shrivel up into a quivering blob when faced with math that is more demanding, this series is for you!

First, let me assure you that if you fit into this category, you have plenty of company. Recent studies have shown that better than half the adults in the country can't add. Of course, people in electronics tend to be somewhat more capable along math lines than most, but if you're not a scientist, engineer, math buff, or something, chances are there are areas of math where you do not quite feel at home, to put it mildly.

Since the series will start with simple stuff and progress through all the math you could possibly need to pass any FCC exam (and just about anything you might run into in popular books and magazines, for that matter), you should be able to eliminate areas of difficulty with very little trouble, providing, of course, that you do what's necessary to let the series go to work on you. A good quiet nook (not the ham shack, unless you're good at resisting temptation), far removed from shrieking kids and a hysterical XYL, plentifully supplied with paper and writing materials, is usually helpful.

No doubt some of the math of this series will be second nature to you. There's no reason why you shouldn't skip such. A quick glance through each bite-sized part as it comes along should tell you if this is an area where you need some review or not. Since each part is pretty much self-contained, skipping certain sections or jumping back and forth should introduce few problems.

One urgent recommendation: If you are one of the vast multitude for whom math has been, is now, and, you fear, ever will be a major catastrophe, RELAX! I really mean relax. *The biggest single obstacle to mastery of anything is being uptight about it. If you can learn to relax away the fears, anxieties, and inner turmoil that have built up over the years, you will find that there is no area of math you cannot completely master, given the right approach and sufficient time.*

A good way to relax with math is to consider it a game. If you like checkers or chess or bridge, you can like math. It's just a matter of developing the right outlook. If you enjoy doodling or have ever spent time on picture or crossword puzzles, then you are indubitably a person who can enjoy, yes, take real pleasure in, math. And there is this consideration: Whereas in bridge or checkers or chess, someone has to lose the game if someone else wins, in math no one need lose. You might be delayed for a while, reviewing something you've forgotten, or distracted (that lithesome bikinied lass next door), but there's no losing unless you choose to lose. And you will find that solving a math problem in electronics is just as satisfying as winning a game of chess, if you let it be. In fact, as you progress along finding yourself more and more successful, you may very well become almost as hooked on math (yea, verily) as you are on amateur radio. But enough of this — let's quit talking and start building.

As I said earlier, we'll work primarily with the equations you might well find in an FCC exam. One of the first, which appears in various forms, is f = 300,000,000/wavelength. We'll dally a bit on this formula so as to develop some of the approaches we'll use throughout the series.

Another way you might see it written is $f = c/\lambda$, where c is the symbol ordinarily used for 300,000,000 meters per second, the velocity of light, and λ, the Greek letter lambda, is the symbol used by physicists, engineers, etc., for wavelength.

Before we go any further, let's see what different forms this formula can be wiggled into. To find out what kind of wiggling is legit in electronics math, we'll play around with some numbers. Take the equation 5 = 10/2, which might be translated: 5 equals 10 divided by 2. [Any fraction can be considered a division. Divide the bottom (denominator) into the top (numerator)]. You'll notice that 5 x 2 = 10 and that 10/5 = 2. Well, if math is universally valid (let's not get into philosophical questions here), then using our formula, $f = c/\lambda$, it must be true $f \times \lambda = c$ and that $c/f = \lambda$. (Remember that for purposes of math manipulation, letters can be handled just as though they were numbers.) So there are three basic configurations of the formula. Which of the three should be used in a particular case depends upon whether you are trying to find the frequency or the wavelength (presumably you'll never be solving for the velocity of light).

You may have heard, somewhere, that light (and other electromagnetic waves, including radio) travels 186,000 miles per second. Of course, scientists, in an effort towards uniformity and logic, use meters per second rather than miles per second. A meter, as you may know, is a lot shorter than a mile, in fact a *thousand* of them is still less than a mile. To be more or less precise, a meter is 39.37 inches, a little over a yard in length (a yard, you will recall, is 3 feet or 36 inches long). Now let's take that 186,000 miles and see if it comes out to the 300,000,000 meters of our formula. There are 5,280 feet in one mile, so there must be 5,280 x 186,000 = 982,080,000 feet in 186,000 miles. Anywhere along the line you're not quite sure of the reasoning, it might be a good idea to stop and play around with the ideas involved so as to get a clearer picture of why we do what we do. For example, why did I multiply 5,280 x 186,000 instead of, say, dividing? If you're not sure, then you want to picture the relative sizes of miles, yards, feet, inches, meters, etc., trying mentally to fit the smaller into the larger, asking yourself how many of the smaller fit inside one of the larger, drawing pictures representing their lengths (trying to draw to scale, if possible) and in general playing with drawings and mental pictures until it's crystal clear how we go about converting one unit of measurement into another. Now take that 982,080,000 feet, multiply by 12 (because there are 12" in one foot), and we have 11,784,960,000, the number of inches in 186,000 miles. Now all we have to do is divide that number, 11,784,960,000 inches, by 39.37, the number of inches in one meter, and we have 299,338,582. So 186,000 miles works out to 299,338,582 meters, quite close to the 300,000,000 of our formula. In fact, both 186,000 miles per second and 300,000,000 meters per second are approximations of the value for the speed of light. Approximations are all we need and, indeed, the best science can do.

A few comments are now in order. Notice the large numbers we were into above. Even with a calculator that can handle such numbers, errors are easily made. Electronics is full of computations with numbers larger than those we just experienced. Hence shorthand methods for handling such numbers had to be developed, and you will need to learn them if you have not already done so. We will cover such shorthands in future lessons.

That 300,000,000, then, is the fantastic distance in meters a radio wave travels in one second. What, you might ask, has that to do with frequency and wavelengths? (Our formula, remember, says that frequency equals 300,000,000 divided by wavelength.) As a matter of fact, everything follows logically from the meaning of the two words, frequency and wavelength. Frequency is the number of complete cycles of a particular signal that occur in one second. Wavelength is the distance a wave front travels, zipping along at the speed of light, during the time it takes the generator of that signal to produce one complete cycle.

If we take an example, we should be able to nail this all down. Supposing your CW transmitter's putting out a signal at 3.625 MHz. That's 3,625,000 cycles per second. M in MHz stands for mega, you may recall, and mega means million. With our decimal system the way it is, the 3 in that 3.625 is the millions and the 625 is therefore thousands.

Now we ask ourselves how long it would take for one cycle of that frequency to be produced. Obviously it would be a mighty short bit of time. Well, if there are 3,625,000 cycles in one second, then one cycle takes 1/3,625,000 of a second (just like if you travel at 60 miles per hour, one mile takes 1/60 of an hour, which just happens to be one minute). Again, play around with these ideas, taking different examples, etc., if everything is not crystal clear to you. Notice that number, 1/3,625,000. It is one over or divided by the frequency. So the time it takes for one cycle is simply *1 divided by the frequency* seconds (providing, of course, that you're dealing with a frequency expressed in cycles per second). This particular configuration, 1 divided by the frequency, is called the *period* of the signal. And physicists use the symbol ν, the Greek letter nu, in formulas, etc., when performing calculations that require the use of a signal's period.

Next we ask how far the wave front of our signal would travel in that short period, 1/3,625,000 sec., because whatever that distance is, it is the *wavelength* of our signal. You may recall distance equals speed times time. If I'm going 60 miles per hour, and do so for 3 hours, then I've traveled 3 x 60 or 180 miles all told. For our radio signal, we multiply speed (300,000,000 meters per second) times time or *period* (1/3,625,000 sec.) thusly: 300,000,000/1 x 1/3,625,000 = 300,000,000/3,625,000 which equals 300,000/3,625. If you're not quite sure how we got rid of those last 3 zeros at the *end* of each number, and you'll find that you get the same answer as you would if you simply dropped those last zeros, providing you drop the *same number* of zeros from top (dividend, numerator) and bottom (divisor, denominator). The principle is simple. You're just dividing some power of ten (we'll go into powers later on) by itself, and, as you probably realize, whenever you divide something by itself, the result (quotient) is 1, and 1 times anything is that same anything. So just by crossing out the same number of end zeros on top and bottom, you've carried out a division and gotten rid of a hidden 1!

Before we find what 300,000/3,625 equals, you might notice that 3625 is our original frequency, but as it would look expressed in kilohertz (kHz). In other words, 3.625 MHz equals 3625 kHz (equals 3,625,000 Hz or cycles per second). We'll get back to this in a later lesson, and show how to use our formula, f = 300,000,000/wavelength, with megahertz, kilohertz, or Hertz (as we are in this lesson) without converting the megahertz or kilohertz into Hertz.

Continued on page 23

New Products

OPTOELECTRONICS FC-50 FREQUENCY COUNTER IMPRESSIONS

Considering myself a confirmed UHF/VHF enthusiast, I was pleased to review a new frequency counter useful in the UHF spectrum. My present counter is a home brew 50 MHz job constructed on perfboard, with a prescaler that starts to gasp at 450 MHz. Thus, the new Optoelectronics FC-50 counter with 600 WT prescaler could not have come along at a better time!

Optoelectronics is best known for their clock kits and electronic components. I was surprised to discover that they also offer a quality counter, available in kit and pre-built form. The basic counter is the model FC-50, which will respond in the range of 10 Hz to about 65 MHz. I evaluated a factory-built model, although instructions for the kit builder were provided. The user instructions provided with the kit assume some knowledge of components and mounting techniques; even so, they are easy to follow, and are complemented with several pictorial diagrams.

The FC-50 requires five volts for operation; thus, it can be used in the field with battery power and a 309 regulator. The eight digit LED display features leading zero suppression, which means that only the significant digits of the frequency being monitored will be displayed. The suppressed display is controlled by a front panel toggle switch. The LED display features .4" digits for easy reading. In addition to the leading digit suppress switch, front panel controls consist of a power switch, gate time control, and a prescale switch to enable the optional 650 MHz prescaler. The gate time control is a two-position switch which allows either a one second or 1/10 second sample time. In effect, this allows the display to be updated on either of the time intervals. A BNC connector is provided for rf injection.

The FC-50 counter has a claimed accuracy of 1 ppm (±.0001%). Stability after 25 minutes is also 1 ppm. Input sensitivity to 50 MHz is 10 mV rms, and impedance is 1 megohm with a load of 20 pF. If the 600 WT prescaler is used, the input requirements increase to about 150 mV rms.

Using the counter is a snap! I plugged my unit in and allowed a warm-up period of 10 minutes. My rf probe consisted of a three-inch clip lead twisted into a turn coil. This coil was attached to a short piece of coax which terminated in a BNC connector. I had a 2m Wilson HT nearby, which provided an easy test. Presto . . . the HT provided an accurate count at distances up to five feet from the counter! It was an easy job to calibrate my HT . . . sure enough, several channels were off frequency. No wonder I couldn't hit one of the "local" machines!

The real test came with the 450 MHz HT. This rig provides only 500 mW of output, and was originally calibrated by the old "tweak until you access the machine" method. Amazing — the counter immediately indicated the frequency, and, as it turned out, I was close. Without wasting any time, I checked my entire UHF setup, using the simple coil pickup in all cases.

In my opinion, the Optoelectronics FC-50 counter and 650 MHz prescaler are hard to beat for the price. The eight digit display makes accurate UHF counting possible, and the accuracy is definitely OK for amateur use. Housed in a 6" x 6" x 3" plastic box, the counter is attractive and portable. The most amazing thing about the FC-50, however, is the price. The basic 65 MHz unit in kit form is available for $119.95, complete! Factory wired, the unit costs $165.95. The prescaler kit is available for $29.95, and mounts inside the FC-50 case. This option is controlled by the front panel prescale switch. Sockets are provided for all IC packages, and quality components are in evidence throughout the counter. *Optoelectronics, Inc., Box 219, Hollywood FL 33022.*

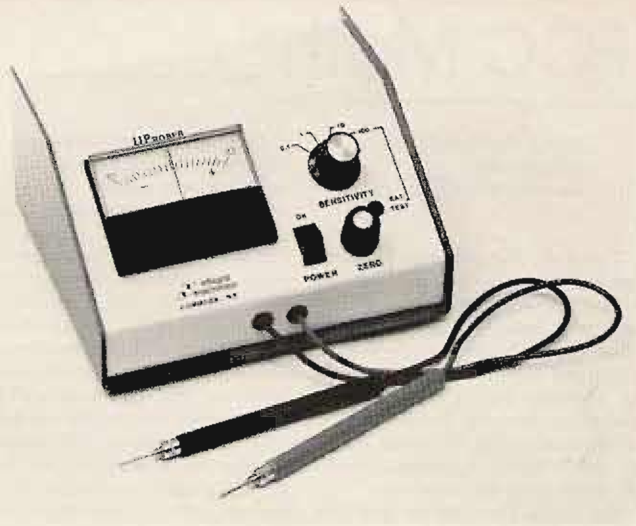
John Molnar WA3ETD
Executive Editor

YAESU INTRODUCES THE MEMORIZER

A solid state, fully synthesized 800 channel 144-148 MHz two meter FM transceiver, Model FT-227R, featuring a photo optic sensor, has been announced by Yaesu Electronics Corporation of Paramount, California. This new Yaesu product has a memory circuit to put you on any preset channel with a flip of the memory switch, and has been designated the Yaesu "Memorizer."

Frequency readout is by means of four large LEDs. Optical sensing eliminates switch problems in frequency selection. PLL techniques are used for fully synthesized frequency control in 5 kHz steps, and a special memory circuit allows instant return to any preselected frequency within the two meter band. Plus or minus 600 kHz offsets, plus any odd split within the two meter band, can be achieved using the memory circuit.

The new FT-227R has automatic final protection, PLL unlock protection, and a busy channel indicator. It provides built-in tone burst, plus optional tone squelch-decoder, and selectable ten Watt or one Watt output. It exceeds the latest FCC requirements with spuries well below the minus 60 dB down requirement with superior cross modulation, overload, and image rejection. Compact (180 mm x 60 mm x 220 mm), lightweight (2.7 kg.), the FT-227R requires 800 mA on receive and 2.5 Amps on transmit at 13.8 V dc plus or minus ten percent. And, best of all, it is priced at under $300! The Yaesu FT-227R is scheduled for late September delivery to all authorized Yaesu dealers. *Yaesu Electronics Corporation, 15954 Downey Ave., P.O. Box 498, Paramount CA 90723, (213) 633-4007.*



Integral's Model 42 current tracing meter.

WIRE-WRAPPING WIRE

The finest industrial quality AWG 30 (0,25 mm) wire-wrapping wire is now available on compact, convenient 50' (15m) rolls. Perfect for small production applications, prototype jobs, or amateur electronics projects, the wire is silver-plated OFHC copper with Kynar insulation. This premium insulation combines excellent electrical and mechanical characteristics with easy stripability and is available in 4 colors (red, white, blue, and yellow), packaged on 1-5/8" (40 mm) diameter spools for easy handling and storage. Available for immediate delivery. *O.K. Machine and Tool Corporation, 3455 Conner Street, Bronx NY 10475.*

CURRENT TRACING METER INTRODUCED BY INTEGRAL ELECTRONICS CORPORATION

A current tracing meter, MICROPROBER Model 42, recently introduced by Integral Electronics Corporation, is specifically intended for isolating defective ICs on assembled printed circuit boards. The new instrument is especially useful in the troubleshooting of bus-oriented circuitry, such as encountered in microprocessor assemblies. Detection of random solder shorts on printed circuit boards and location of extraneous wires in back planes and wire-wrap assemblies are greatly simplified with the aid of this device. The sensitivity of the current tracer, spanning a 10,000:1 range, permits equally effective fault isolation of TTL, DTL, CMOS, and ECL circuits. The instrument is portable and powered by a single 9-volt battery, providing up to 300 hours of continuous operation.

Available from stock to 45 days at $94.50 each. For further information, contact Marcy Talbot, Sales Manager, *Integral Electronics Corporation, P.O. Box 286, Commack NY 11725, telephone (516) 269-9207.*

NEW TWO-WAY TEST SET INCLUDES COMPLIMENTARY CARRYING CASE

A Thruline® directional RF wattmeter and a Bird 100 W dry load constitute the core of the new model 4300-064 test set. Selected especially for convenience in servicing mobile communications equipment, accessories include an rf sampler with variable level control for signal frequency, spectrum and envelope analysis, two UHF connectors, two N connectors (on the Model 43 watt-

Continued on page 168

The "Memorizer" from Yaesu Electronics Corporation.

Looking West

from page 20

more and more often. And who from? Your users. And how many users are there versus how many suppliers? Repeater operators *(owners)*: You don't stand a chance.

"Okay, what's the answer? You can't do it by legislation. It has to be done in a voluntary manner. No two ways about it. You have to have an end objective, and your end objective must be to make better use of the one resource you have, the spectrum. You have to relate what you are doing to the users of your service. You have to ally yourselves as repeater operators *(owners)* with the organizations that your users belong to – Red Cross, Salvation Army, ARES, RACES. Sure, RACES is part of the repeater operators group. I can think of two RACES repeaters that in times of disasters turn themselves off!

"Suggestion (it's been made before, but please give it some serious thought): You've got some very competent people here. Consider, over a period of two years, phasing in something like the following, which is modeled primarily after the commercial FM broadcast practice. You have class A, B, and C stations, from very low power local machines (and this is akin to JR's comment about it being installed in someone's sub-basement, running a half a Watt to a wet noodle) to the 'clear channel stations' *(wide coverage)*, maybe like a .34/.94 on Mt. Wilson. Who knows? Chances are excellent that if you approach it from the same allocations viewpoint that the FCC has in the past used for allocation of FM frequencies (commercial ones for broadcast), you can increase the number of repeaters on the air by three- or fourfold without increasing your spectrum. But you are going to have to instill in your members a discipline that currently does not exist. It will have to be done by cooperation. This is probably going to require an alliance with users, and I am delighted to see someone from northern California here *(referring to NARC Chairman Dave Metts)*, 'cause that's where it begins.

"As a start, the only repeater that I am presently a user of is the ANY repeater in Pasadena. Talking to the people on that repeater, I understand that there is a potential conflict with AQD here in the Claremont area of San Diego. We are willing in Pasadena to reduce our ERP to 1 Watt. That will give us the possibility of covering the San Gabriel Valley and a portion of Los Angeles. We challenge AQD to do the same thing. This kind of thing, I think, will lead to a lot fewer headaches for your technical committees, and probably will give you a better system all around. That and aligning yourself with the Red Cross or any other communications user. Remember, you are only in business because your users let you stay in business. The moment they tire of you, there goes your toy. No longer can you put these things *(repeaters)* on the air for your own personal amusement – which is what most repeaters are on the air for, I'm sorry *(to say)*.

"That's the end of my general comments; I was delighted to see SCRA members at the L.A. Council of Radio Clubs meeting. To my knowledge, that's the first they had ever attended a meeting. I hope it occurs more often. Okay, enough of the lecture; any questions?"

This was transcribed directly from tape recordings made at the time and, with the exception of the deletion of his opening remarks pertaining to WARC '79, is presented totally unedited. Comments on the foregoing can be made either directly to Mr. Hoover or to him through this column.

THE BIG FIRE

By now, most of you are aware of the fact that this summer California suffered some of the worst wide-area fires in the state's history. They seemed to spring forth without warning to consume hundreds of thousands of acres of valuable land. In the case of the big Santa Barbara fire, hundreds were left homeless in the fire's wake.

I have received many reports of how amateur radio – both HF and VHF – has been working at the front lines to provide the necessary communication when called upon to do so. As I write this, the giant Marble Cone fire has just been "contained," and the weary firefighters are into their final "control" phase of the fight. It still will be many days before it's out.

Two people who have supplied information for us are Bob Couger W6KPS, who lives up near the Santa Maria area, and Bob Jensen W6VGQ, who was up in the fire area with a film crew. Their information, along with input derived from a report given to the SCRA by Southwestern Division Director John Griggs W6KW, make up the background for what you are about to read.

The most important aspect of amateur radio's involvement in the firefighting efforts was that amateurs arrived "ready to set up communications" – but were not pushy about it. They simply let those in charge of the overall effort know of their availability, and then waited to be asked to participate. They did not have to wait very long for the call. The fire being in the type of terrain it was, very little land-based communication already existed – and what there was in the

Continued on page 27

FCC Math

from page 21

Now back to that 300,000/3,625. Dividing out, we get 82.8, the length of one wavelength of our 3.625 MHz signal *in meters*. I leave to the reader the exercise of converting 82.8 meters to feet. Just remember there are 39.37 inches in a meter. The answer is below.* You may have noticed that I did not carry the division above out beyond one decimal point. The reason is simple. There's no reason to be more accurate than that here. You get a feel for proper degree of accuracy as you increasingly bump into reality.

Finally, let's tie everything together so we can see what we've done and where we've been. We started, you recall, with the formula f = 300,000,000/wavelength, which, with further symbolism, is $f = c/\lambda$. This can be tortured into the two variant forms: $f \times \lambda = c$ (or simply $f\lambda = c$; multiplication sign need not be written between two letters, and two letters next to each other are understood to be a multiplication) and $c/f = \lambda$. Then we took our elementary-school formula, distance = speed times time, and applied it to our case, getting wavelength = 300,000,000 times *period*. And since period is *1 over frequency*, we derived, really, the formula, wavelength = 300,000,000/f or $\lambda = c/f$, which, as you can see, is the second variant above, only written with the symbols interchanged from one side of the equal sign to the other (after all, it doesn't make much difference whether you say $2 + 2 = 4$ or $4 = 2 + 2$, does it?). So really, you don't need to remember the formula: frequency = 300,000,000/wavelength. All you need is distance equals speed times time, remembering that in our case distance is wavelength, speed is 300,000,000 meters per second, and time is *1 over frequency*. And if you can't remember what variants the formula can take, go back to a simple problem, e.g., $2 \times 3 = 6$, so $6/2 = 3$ and $6/3 = 2$, but notice that 6×3 does not equal 2, nor 6×2, 3, nor does $3 \div$ (divided by) $2 = 6$, etc. Only variations that work with numbers will work with letters. So, $fc \neq \lambda$ ($\neq$ means "does not equal"), $f/c \neq \lambda$, etc.

Now, with all this logic and all these tricks under your belt (if you'll pardon the mixed metaphor), here are a couple for you to work out. Check yourself against the answers (and work) below.

1. What is the free space wavelength of a 146.94 MHz signal (meters and feet)?

2. What is the frequency of a signal whose free space wavelength is 5 inches?

*271.7 feet. We multiply 82.8 by 39.37 to get 3259.8, the number of inches in 82.8 meters. Then divide by 12, getting our answer.

Answers

1. We use the formula $\lambda = c/f$. The 146.94 MHz is 146,940,000 cycles per second. So we have: 300,000,000/146,940,000 = 30,000/14,694 = 2.04 meters. Multiply 2.04 x 39.37 and we have 80.31 inches. Divide by 12 and we have 6.69 feet.

2. Here we are looking for frequency, so we use the formula $f = c/\lambda$. Our formula requires meters, remember, rather than inches. So we must first convert 5 inches into meters. Since there are 39.37 inches in one meter, we are here dealing with a lot less than one meter. In fact we are dealing with 5/39.37 of a meter. Divide that out and we have 0.127 meters. Slipping that into the formula, we have f = 300,000,000/0.127 = 2,362,204,000. Again, we need not carry the division all the way out. Just put in the correct number of zeros after working it out a reasonable amount, so as to get us into the right magnitude. 2,362,204,000 cycles per second is 2362.204 MHz, which is our answer. This matter of how far to work a problem out is not terribly important for our purposes, since FCC exams are multiple choice and once you have the first couple of digits and know the *size* of the answer (whether hundreds, millions, or whatever), you can easily select the correct answer.

Tracking the Hamburglar

STOLEN: Collins KWM 2, s/n 11023, Johnson Viking 250 Watt matchbox, swr bridge, Eico tube checker, electro voice dynamic mobile mike, volt ohmmeter, and all my old *73* magazines starting from the first issue through about 1969. Contact Richard M. Olson, 5123 Mezzanine Way, Long Beach CA 90808.

PURLOINED: Heath HW202 with GE mic and BNC ant. conn. on back. WB8TDW, Ohio lic. No. NA228853, and SS No. 232-72-8842 marked in metal of case. Rig was removed from car in Las Vegas, Nevada. Contact Chuck Young WB8TDW/7, 2165 E. Rochelle #79, Las Vegas NV 89109, (702) 733-8248.

SHANGHAIED: Heath Model 2021 handie-talkie with Model 201 touchtone pad built-in. Channel switch wired wrong in that channels 3, 4, and 5 go to crystal sockets 3, 2, and 1. Crystalled for 146.52 (ch. 3), 146.655 (ch. 4), and 146.94 (ch. 5). Stolen July 23, 1977 in Westport CT. S. W. Daskam K1POK, 38 Settlers Trail, Stamford CT 06903, (203) 329-0187.

Build the Omni-OSCAR!

-- practical omnidirectional antenna

Jay Buscemi K2OVS
8 Wexford Ct.
St. James NY 11780

Due to the extremely good sensitivity of the receiver on Mode B, OSCAR 7, extensive antenna arrays with high gain for the 432 MHz uplink are hardly required. In fact, excessive erp due to the use of high gain arrays by ground stations has been a problem for some time. High uplink erp causes the agc on board OSCAR 7 to desensitize the receiver, thus preventing weaker stations from accessing the satellite. Also, the batteries may be excessively drained by the high current demand, shortening their life.

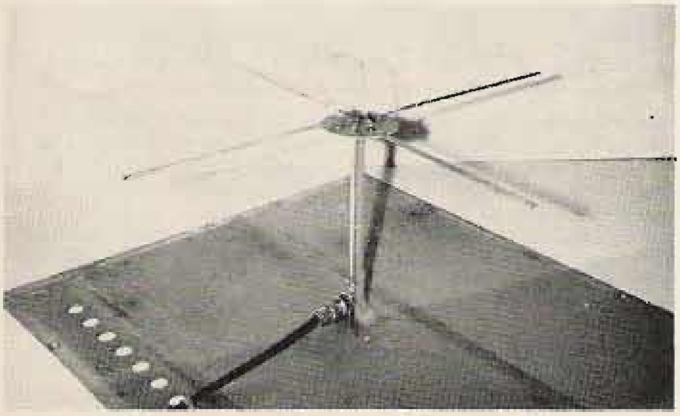
Therefore, simple low gain antennas with omnidirectional characteristics are appropriate for use on this mode. 50-70 Watts of rf into a unity gain antenna will fully access OSCAR 7 for all but the most marginal conditions. The use of an omnidirectional uplink antenna is a tremendous advantage during a satellite pass, as it eliminates the need to track the satellite in azimuth with a directional array. In addition, certain of the antenna designs described here also provide good overhead coverage. Gain arrays perform poorly at high elevation angles unless an elevation rotator is also provided for the antenna.

All the antenna types described here may be constructed for either two meters or 432 MHz. Dimensions for both bands are given in Table 1 and refer to the dimensions designated by A, B, C, etc. in the figures.

Quarter Wave Monopole

The simplest omnidirectional antenna is called the quarter wave monopole (also called the vertical ground plane), which consists of a single vertical element, one-quarter of a wavelength long, mounted over a ground plane of at least one-half wavelength on a side (Fig. 1). This antenna produces a doughnut shaped pattern with a null directly overhead and the pattern falling to zero at the horizon. Obviously, the omnidirectional term as applied to this antenna is only meaningful in the azimuth plane. Its elevation plane pattern is symmetrical but certainly not omnidirectional. This antenna becomes quite ineffective at elevation angles greater than 40 degrees from the horizon, making it almost useless on satellite orbits which pass close (up to 300 miles) to the ground station. Still, its simplicity makes it useful for some applications.

Construction of the monopole is nearly trivial — mount



Turnstile over ground plane (432 MHz).

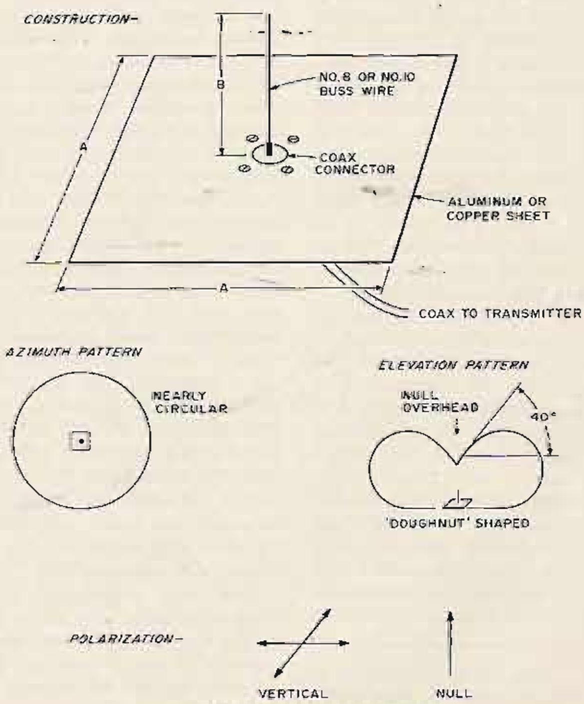
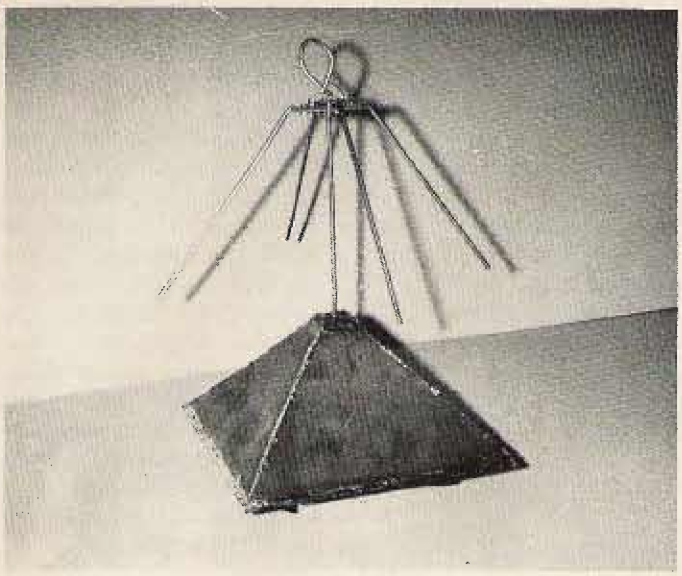
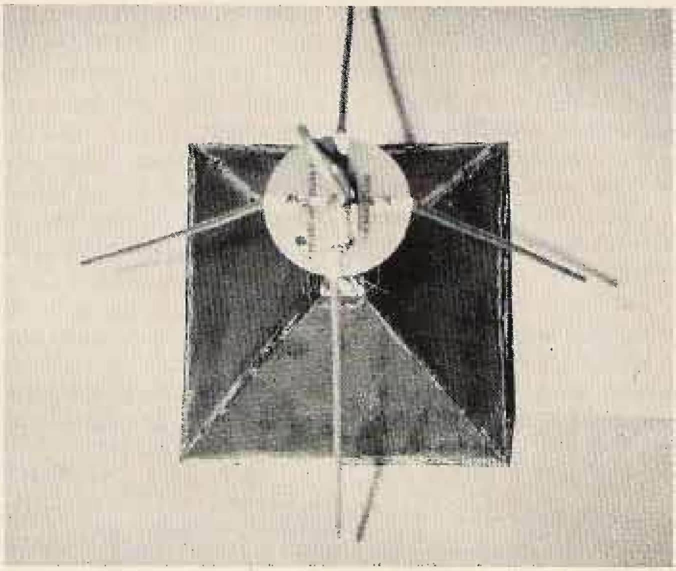


Fig. 1. Quarter wave monopole.



Sloped turnstile over ground plane (432 MHz).



Top view. Sloped turnstile over ground plane.

a panel-mount BNC or N connector in the center of an aluminum or copper sheet and solder a quarter wave long piece of #8 or #10 bus wire to the center pin. The vswr should not exceed 1:5 to 1 without further matching. Trimming the length of the wire will permit a closer match, if desired.

Dipole Over a Ground Plane (Fig. 2)

Another simple antenna which works well on overhead passes of the satellites is the half wave dipole over a ground plane. This antenna provides some gain (1.5-2 dB) overhead, but has nulls off its ends and near the horizon. Like the simple quarter wave monopole, it is linearly polarized (horizontal), so fading due to rotation of the satellite with respect to a ground station is still present. Manual switching between a vertical and horizontal antenna can be done during satellite passes to pick the best polarization at any given time.

In order to minimize the effect of the nulls off the ends of the dipole, this antenna should be oriented so it favors NNW-SSE (in the continental US), as most ascending node passes go out to the NNW during the evening, local time.

No balun is required. The antenna pattern may be slightly skewed, but no real advantage is gained by feeding the antenna in a balanced mode. Purists can add a quarter wave decoupling sleeve over the upright feedline.

As with the quarter wave vertical, the vswr as constructed will generally not exceed 1.5 to 1, and the dipole element lengths may be trimmed to achieve a perfect match. The spacing of the dipole off the ground plane has been chosen for best omnidirectional coverage in the elevation plane. Some gain can be achieved by varying this spacing at the expense of pattern symmetry.

The dipole elements are constructed from 1/8" diameter copper or aluminum tubing, flattened at the end and fastened to a plastic or printed circuit board disc with #4 screws. The feedline (and vertical support) is made from a length of semirigid coaxial cable (RG-405 or equivalent) which is soldered to a coaxial connector mounted on the ground plane. Do not ground the coax connector to the ground plane — it should be mounted on insulated spacers. Cut a clearance hole in the ground plane to provide connector access from the bottom.

Turnstile Over Ground Plane

A worthwhile improvement over the simple dipole may be had by adding an additional dipole fed 90 degrees out of phase to the simple dipole described above. This provides two

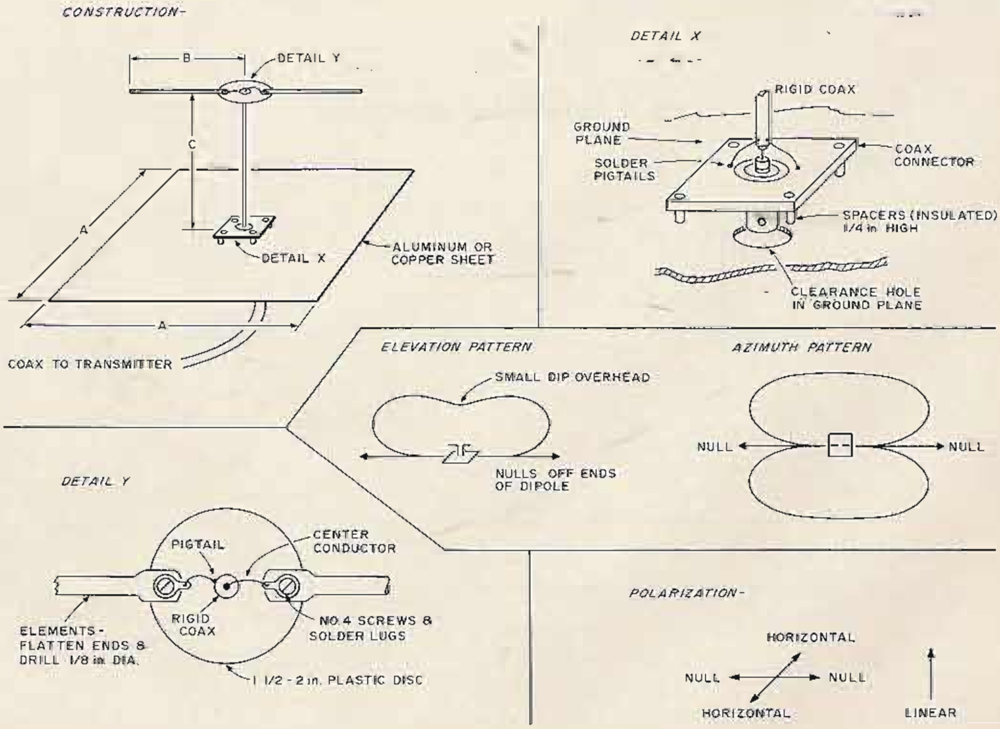


Fig. 2. Dipole over ground plane.

advantages: the antenna will be circularly polarized overhead, and the nulls off the ends of the simple dipole are eliminated, providing a more uniform azimuth pattern.

This antenna, commonly called a turnstile, has been extensively used for HF and VHF ground communications, but its major advantage is in satellite communications — circular polarization overhead is not a factor in ground communications use. Circular polarization minimizes polarization fading overhead when the satellite tumbles or rotates. Near the horizons, this advantage is lost and the antenna exhibits essentially horizontal polarization unless it is aimed at the satellite with an elevator rotator. Obviously, an azimuth rotation is of no advantage, as its azimuth pattern is essentially omnidirectional.

Construction of the turnstile is merely an extension of the technique used for the single dipole over a ground plane (Fig. 2). Two additional dipole elements are installed on the plastic disc at right angles to the original dipole (see Fig. 3). To obtain circular polarization, a one-quarter wavelength phasing line fabricated from RG-405 rigid coaxial cable is connected between the dipole elements. This phasing line is bent into a loop and supported by its solder joints.

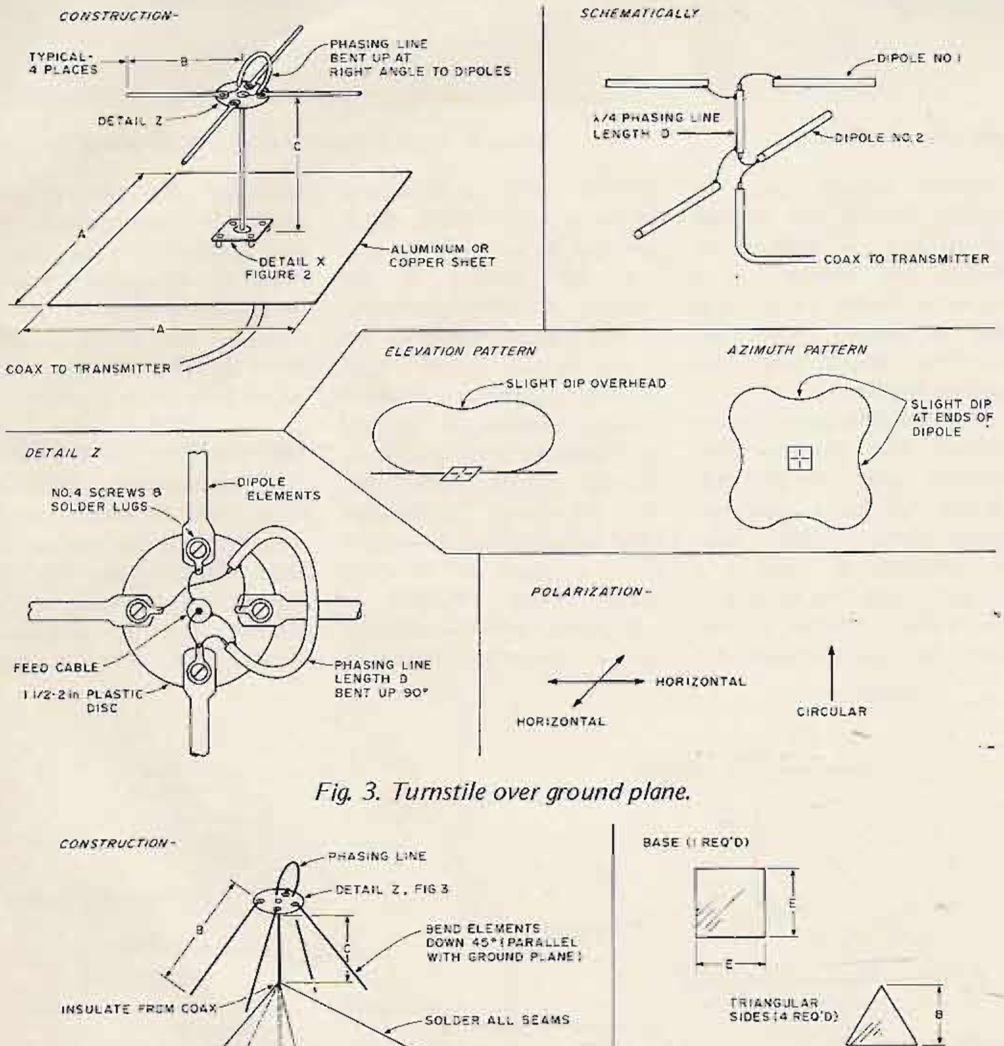


Fig. 3. Turnstile over ground plane.

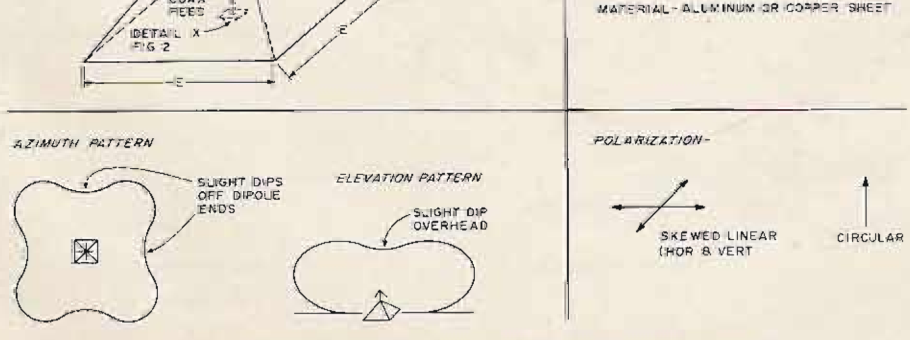


Fig. 4. Sloped turnstile over conformal ground plane.

Detail X of Fig. 2 is also applicable for mounting and feeding this antenna configuration.

If the element lengths, line lengths, and spacings listed in Table 1 are used, vswr should not exceed 2 to 1 over the satellite bandwidth. A near perfect match may be achieved by trimming the element lengths and their spacing off the ground plane. Adjusting the phasing line length for perfect circularity overhead is possible but not critical in this application, as some ellipticity overhead will be of little consequence.

Sloped Turnstile Over Conformal Ground Plane

A developmental antenna presently in use at K2OVS was designed and constructed to overcome one of the major drawbacks of the antenna previously described. All the monopole and dipole configurations exhibit either *all* vertical (monopole) or *all* horizontal polarization on the horizons, thus creating polarization fading when the satellites tumble and rotate. A combination of vertical *and* horizontal polarization (*slant*) at the horizons would be an advantage in obtaining the more uniform performance for all orbiting satellite orientations.

Thus the elements of the basic turnstile were reconfigured at a 45 degree angle and the ground plane beneath them, was shaped to be parallel with each element. Overhead, the antenna is still essentially circularly polarized with slightly less (1 dB or so) gain than the simple turnstile, but the overall gain in uniform performance is worthwhile. In actual tests at this station, no measurable difference in overhead performance was observed between this antenna and the turnstile.

Basic feed and phasing line construction is identical to the turnstile (Fig. 3), and the feedpoint connector is mounted on the base ground plane similar to Detail X in Fig. 2. The elements (Fig. 4) are bent down at a 45 degree angle to the horizontal and a conformal ground plane is fabricated from either aluminum sheet or thin copper or copperclad printed circuit board material. The use of thin copper sheet allows the ground plane assembly to be soldered together with a 250-300 Watt soldering iron or torch.

Again, dimension adjustments may be required if close matching is desired. Furthermore, slight adjustments (±10 degrees) in the element droop angle will also affect the vswr (*and* the pattern). This angle adjustment should be used only as a final tune-up step. Element lengths have the largest effect on vswr.

Results from this antenna were surprising. The 432 MHz prototype was completed five minutes before a Mode B pass favoring US east coast-Europe contacts. A six-foot piece of RG-58 was temporarily connected to the antenna and the KLM Echo 70 (10 Watts output). Three western European stations were worked on that pass with no difficulty. No inference is intended that this design is the ultimate omnidirectional antenna. Rather, it is presented as an example of an unorthodox design which can serve as a starting point for further development and experimentation.

			Dimensions					
			146 MHz		432 MHz		435 MHz	
Reference	Figures	Use	IN	CM	IN	CM	IN	CM
A *	1, 2, 3	Ground plane edge size	40.5	102.8	13.7	34.7	13.6	34.5
B	1, 2, 3, 4	Radiator length	20.2	51.4	6.9	17.4	6.8	17.2
C	2, 3, 4	Ground plane spacing	17.8	45.2	6.1	15.3	6.0	15.2
D **	3, 4	Phasing line length	12.1	30.8	4.1	10.4	4.0	10.3
E	4	Triangle height	28.5	72.4	9.6	24.5	9.5	24.3

*Table 1. Physical dimensions. *Minimum sizes. **Note: Assumes velocity factor = 0.6. For different coax, use ¼ wavelength electrical length.*

Summary

As with all antennas, good horizon coverage is a function of the height of the antenna. These antennas perform well overhead and at higher elevation angles almost independently of their physical height above ground, but performance out at 2,000 miles (satellite near the horizon) could be severely compromised by terrain blockage. Good low angle (DX) coverage is best accomplished with a unidirectional array, such as a yagi or collinear, mounted high and in the clear. An existing VHF array with azimuth control in conjunction with an omni type antenna for higher radiation angles is an ideal combination for all-around satellite work.

As stated before, the antennas described here are hardly the ultimate in omnidirectional types. Further development and experimentation is most rewarding with antenna design. For example, the sloping turnstile might be further improved by extending or reshaping the ground plane, adding an additional set of dipole elements at a 45 degree angle *above* the horizontal, adjusting the droop angle, etc. Accurate comparisons of several antenna designs can be made quite easily using the satellites themselves as an antenna range signal source. A typical pass of 20-25 minutes permits switching between the antennas under test and evaluation of the results. Modification may be accomplished in time for the next pass. The actual pattern of an antenna may be estimated by physically holding the antenna (particularly 432 MHz versions) and rotating it while pointed at the satellite (to estimate circularity), changing its elevation orientation, etc. Fading effects from the satellites themselves tend to be of relatively slow duration (3-4 minutes), so measurements or comparisons made within 2-3 minutes effectively eliminates errors caused by the satellites or atmospheric conditions.

Gain estimates for higher gain VHF arrays may also be made using the satellite by switching back and forth between a reference antenna (e.g., dipole) and the antenna under test while observing the received signal level on the station receiver. A calibrated attenuator will permit more accurate measurements. Set a level with the reference antenna, switch to the gain array, and insert attenuation in the antenna line until the received level is the same as it was with the reference antenna. The gain of the array may then be read off the attenuator dial. Obviously, different line losses must be accounted for and the polarization of both antennas should be the same.

The present OSCAR satellites are providing the amateur fraternity with a unique opportunity for VHF-UHF antenna experimentation. Future "stationary" (geosynchronous) satellites may serve as permanent antenna ranges in the sky, permitting extended development, adjustment, and measurement times for antenna work.

It is hoped that the ideas presented here will encourage further experimentation and development in VHF-UHF antennas and fill a need for the present OSCAR satellites. ■

Looking *West*

from page 23

way of phone service was being overloaded with traffic. Much of the communications handled by amateurs was what might best be termed of the "health and welfare" variety, permitting firefighters to get word to their relatives as to where they were, locating people for other people, etc. It should be noted that firefighters came from all over the USA, and for many there was but one way to get a message to the "folks back home": via amateur radio. Amateur communications was not limited to this small aspect, however — not by a long shot.

Both VHF repeaters and HF point-to-point were used to relay information to and from areas where the fire was being fought, relay firefighting orders, and handle just about every conceivable form of traffic that you might imagine. In all, over three hundred amateurs (under the direction of Ed Gribi, emergency coordinator for the area) from all over the state (and even from out-of-state) volunteered their services at one time or another. I am told that no offer of help was turned down.

Repeater systems served well and continue to do so. At least two machines were brought into the area by concerned amateurs who realized the communications need. One came from a group at Vandenberg AFB, and was installed at the Hunter-Liggett Military Reservation near Paso Robles, to give coverage from the Questa Grade to Salinas. Its channel pair is .28/.88, and it's under the trusteeship of W6LIO. I've also been told that the .84/.24 group out of the Bay area literally "smoke tested" their new Motorola repeater (destined for service atop Mt. Diablo) by installing it in a portable configuration at a point near the northern tier of the fire area. It performed flawlessly. Again, it's hard to know exactly what's transpiring since I am forced to report from secondhand information rather than from an eyewitness viewpoint. Suffice it to say that amateur radio and its people have done and are doing their share and more to aid in the formidable effort to stop the raging infernos. They are giving their time, talent, and equipment because there is a need and a job to be done. I am proud of each and every one of them. They know and they care. They're getting the job done.

Get Set For OSCAR 8

-- details on the new bird!

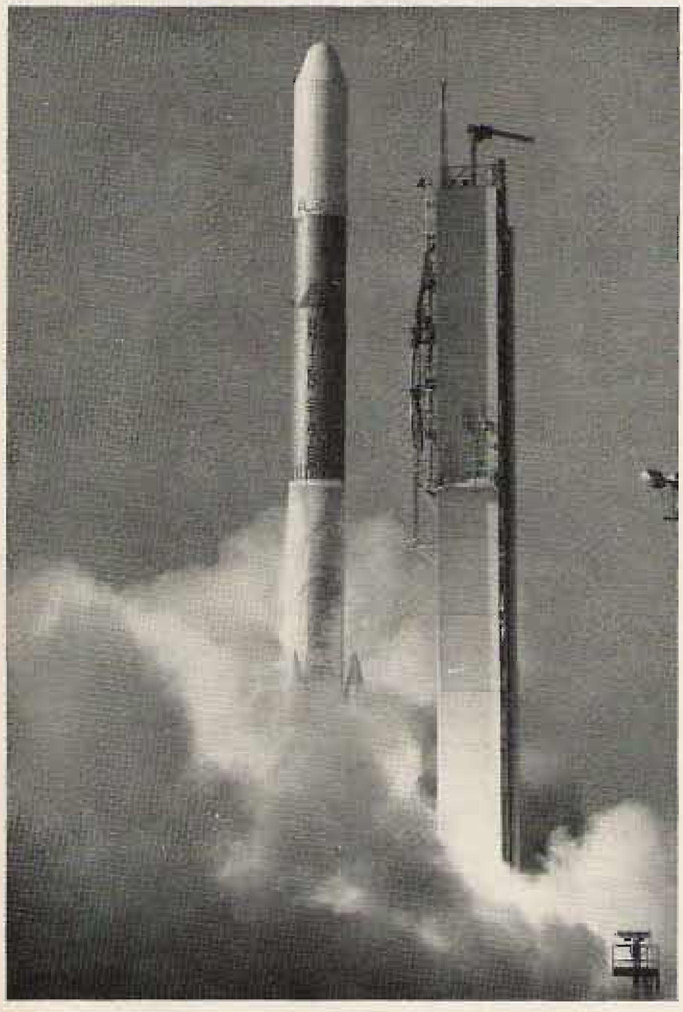


Fig. 1. Up, up, and away! This photo of the OSCAR 7 launch shows what's in store for AMSAT-OSCAR D.

Gary L. Tater W3HUC
7925 Nottingham Way
Ellicott City MD 21043

Five, four, three, two, one, blast-off! Soon a new amateur satellite will be carried into Earth orbit. Are you ready to start making contacts via this new satellite? If not, read on, and you'll discover what you need to use AMSAT-OSCAR D (to be called AMSAT-OSCAR 8 after a successful launch).

Why AMSAT-OSCAR 8?

Because AMSAT's Phase III spacecraft will not be operational until early 1980 and OSCAR 6 cannot be counted on until then, AMSAT felt that AMSAT-OSCAR 8 would provide a continuation of the existing amateur satellite program and insure that amateurs would have a reliable satellite for communications over the next few years.

One major objective of the AMSAT-OSCAR 8 (AO-8) mission is to provide a satellite for use as an educational tool in schools. Other objectives include the continuation of demonstrations by stations in the amateur satellite service, experimenting with the feasibility of using satellites with small amateur terminals for bush communication, emergency communication, communication between medical centers and isolated areas, aeronautical, maritime, and land mobile communications, direct satellite to home voice broadcasting to simple amateur receivers, and other similar applications. Further objectives are to demonstrate special operating techniques that enhance the usefulness of low orbits for these satellite applications and to test a new communications transponder frequency combination for improved operation for moderate power amateur stations.

Building the Satellite

For longer than a year now, AMSAT members from many countries have been planning, designing, and building a satellite called AMSAT-OSCAR D. Because a project like this is extremely complex, it takes many amateurs, pooling all their knowledge and abilities, to turn the stringent design and reliability requirements into a ready-to-launch satellite.

Some of the complex issues that had to be settled and turned into hardware were the receivers and transmitters for the transponders, the antennas and antenna deployment system for the large antennas, the satellite stabilization system, the power system, and hardware both in the satellite and on the ground for commanding the satellite. As a user, you're primarily concerned with the transponders that make satellite communications so much fun, but there are really eleven major subsystems in AO-D:

1. 2m to 70 cm transponder;
2. Two to ten meter transponder;
3. Morse code telem-

1. **Japan AMSAT Association 2m to 70 cm Transponder — Mode J**
   - Input frequency passband between 145.90 and 146.00 MHz.
   - Output frequency passband between 435.10 and 435.20 MHz.
   - Power output is 4 Watts PEP.
   - Downlink passband is inverted from uplink passband.
   - Linear operation — SSB and CW are preferred modes.
   - Morse code telemetry beacon at 435.095 MHz.
2. **AMSAT Two to Ten Meter Transponder — Mode A**
   - Input frequency passband between 145.85 and 145.95 MHz.
   - Output frequency passband between 29.40 and 29.50 MHz.
   - Downlink passband is not inverted from uplink passband.
   - Linear operation — SSB and CW are preferred modes.
   - Morse code telemetry beacon at 29.40 MHz.

Table 1. Summary of AMSAT-OSCAR D transponders.

Ch. 1	Total solar array current
Ch. 2	Battery charge-discharge current
Ch. 3	Battery voltage
Ch. 4	Baseplate temperature
Ch. 5	Battery temperature
Ch. 6	Rf power out. — Mode J

Table 2. Morse telemetry channels.

etry system;
4. Satellite command system;
5. 10m antenna deployment system;
6. Battery charge regulator;
7. Solar cells;
8. Instrumentation switching regulator;
9. Magnetic attitude stabilization system;
10. Satellite structure, wiring, and rf cabling;
11. 14-28 volt power switching regulator.

Building a satellite like AO-D proceeds pretty much along the same lines as most electronic projects do. First, each electronic system is tested as a breadboard and then laid out for a printed circuit board. To insure that the satellite functions reliably for years, each integrated circuit, transistor, and diode is screened by burning the part in by applying power to the part for several hundred hours. Then the component is mounted onto a printed wiring board. After each system is mounted in the satellite structure, the satellite is tested under the vacuum conditions and temperatures it will see in space. Because amateur satellites are launched on a space available basis, they are mounted on the launch vehicle neatly tucked under the primary satellite as you can see from the accompanying pictures. In Fig. 3 you can see Dave W6OAL inspecting the electrical connections for the pyrotechnical shears which, when fired, cut the Marmon clamps that released OSCAR 7 from the Delta launch vehicle. A heavy duty spring then ejects the satellite into its orbit path. A few seconds later, the ten meter antenna is deployed by a pyrotechnical shear mechanism aboard the spacecraft.

Getting Ready

There will be two communication transponders on AO-8 for which you will need equipment. Only one transponder will be operated at a time because of spacecraft battery constraints.

The Mode A transponder is a two to ten meter unit similar to the one on AMSAT-OSCAR 7 and has the same frequency plan (input frequency passband between 145.85 and 145.95 MHz, output frequency passband between 29.4 and 29.5 MHz). You should plan to use about 80 Watts erp made up of output power from your transmitter, coax cable losses, and antenna gain. A ten meter preamp should stand you well for copying the Mode A downlink.

The second transponder, constructed by members of the Japan AMSAT Association in Tokyo, uses a two meter input, 435 MHz output frequency combination which has not yet been flown in the AMSAT Phase II series. This transponder, designated Mode J, operates with an input frequency passband of 145.90-146.00 MHz, and an output frequency passband of 435.10-435.20 MHz. The power output is 4 Watts PEP, so a small 435 MHz antenna should produce a strong signal to your receiver. As noted in Table 1, the output passband is inverted, i.e., upper sideband uplink signals become lower sideband downlink signals. The same transmitter you use for Mode A can be used on Mode J.

Antennas

In general, simple antennas such as ten meter dipoles and four element 2m and 70 cm beams will provide excellent results. The AO-8 Mode J 435 MHz downlink antenna is a simple monopole and will provide a linearly polarized signal. Likewise, the spacecraft's Mode A ten meter downlink antenna is a linearly polarized dipole, oriented perpendicular to the stabilization magnet in the spacecraft as in AMSAT-OSCAR 6.

Although you can transmit on two meters to the satellite using a linearly polarized antenna and get good results, if you are a perfectionist, you might like to try circular polarization.

Both the Mode A and Mode J transponders on AO-8 use the same receiving antenna, a canted turnstile comprised of four 18-inch lengths of ½-inch carpenter's rule fed by a hybrid and matching network so as to develop circular polarization. One port of the hybrid feeds the Mode A receiver such that

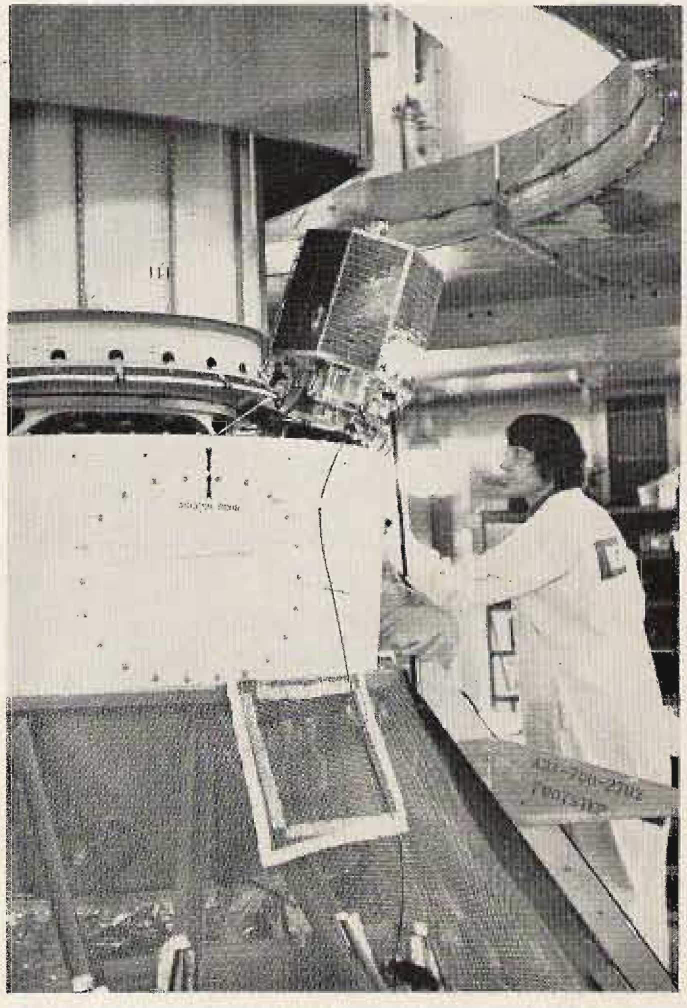


Fig. 2. Jan W3GEY inspecting OSCAR 7 on the Delta launch vehicle.

left-hand circular polarization is required by users in the Northern Hemisphere and right-hand circular polarization in the Southern Hemisphere. A second port of the hybrid is connected to the Mode J receiver such that right-hand circular polarization is required in the Northern Hemisphere, and left-hand circular polarization in the Southern Hemisphere.

Telemetry System

So that everyone can watch the status and health of the spacecraft, AMSAT-OSCAR 8 will contain a six channel Morse code telemetry system. The Morse telemetry on 29.40 or 435.095 MHz will be set at 20 words per minute, but you can slow it down by recording it and playing it back at a slower rate. You will hear the telemetry as three digit numbers with the first digit being the channel number and the next two digits being the telemetry value. A sample telemetry frame would look like this: 120 255 380 451 551 660 HI 120 255.

Although the equations to convert the telemetry values to engineering units have not been finalized as of this writing, the channel selections have been made and they are listed in Table 2.

Using AMSAT-OSCAR 8

Once AO-8 becomes operational and you've assembled your station, you can begin to make contacts picking up new states and countries each time you get on the satellite. If you need help, contact AMSAT at Box 27, Washington DC 20044 for the name of the nearest AMSAT Area Coordinator who, as an experienced satellite user, can give you a hand.

In addition to making contacts and working new states through the satellite, AMSAT hopes that you will consider using AMSAT-OSCAR 8 to perform experiments and educational demonstrations. These efforts gain amateur radio much needed beneficial publicity and provide AMSAT with documented facts to support requests for future launches.

Your experiments might begin with such simple experiments as using a power meter to plot the minimum power needed to hear your return signal in the downlink from your earliest acquisition of signal to loss of signal. Possibly you could measure the frequency change in the beacon due to the Doppler effect of the satellite's velocity.

As a guide to what you can do with AO-8, other experiments are listed in Table 3. Perhaps you can add some interesting experiments to this list. When you complete an experiment, be sure to write to AMSAT with your results, you will be contributing to the future of amateur radio.

Conclusion

If you are already a user of OSCAR 6 and OSCAR 7, then you're set to operate through OSCAR 8, and you know how exciting satellite communications are. If you are not ready for OSCAR 8, then now is the time to get your station ready to join the fun. See you on AMSAT-OSCAR 8! ■

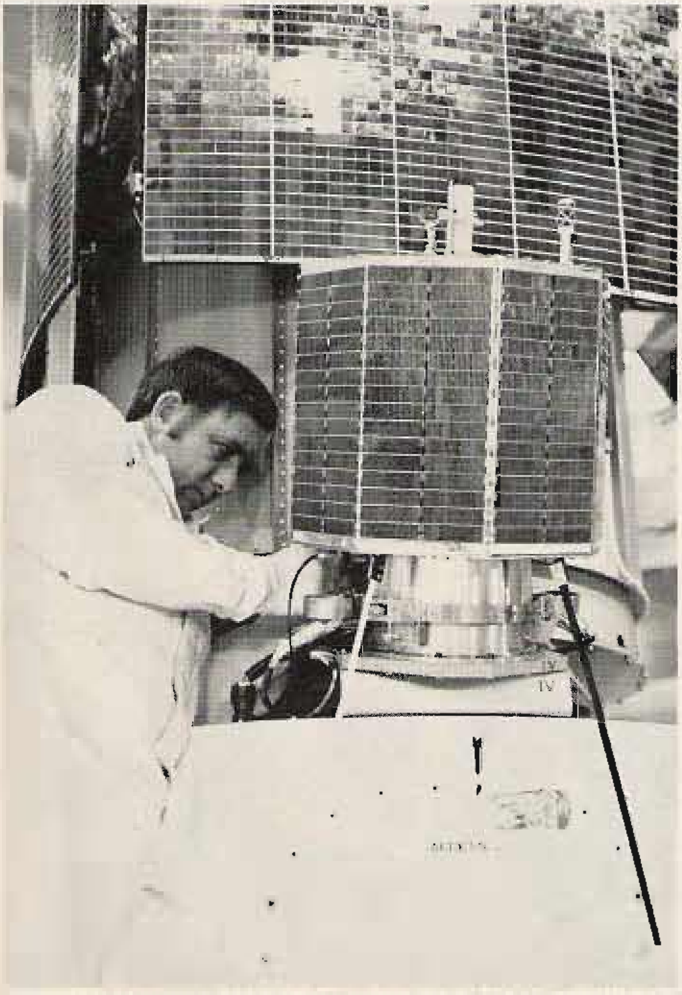


Fig. 3. W6OAL puts the finishing touches on AMSAT-OSCAR 7.

A) Educational demonstrations in schools and for youth groups.
B) Ranging (distance measurement) experiments to determine satellite or user position.
C) Doppler (range rate) measurements to determine satellite or user position.
D) Emergency Locator Transmitter (ELT) experiments to locate downed aircraft or ships in distress.
E) Small terminal user experiments using hand-held equipment, or mobile terminals operated from an automobile, airplane, boat, motorcycle or bicycle.
F) Emergency communications demonstrations with portable equipment.
G) Medical data transmission experiments, including the transmission of analog or digital physiological data (e.g., ECGs and EEGs).
H) Data collection from remote, unattended ground terminals (rain gauges, wind gauges, etc.).
I) ASCII data transmission experiments, including remote accessing of digital computers.
J) Slow scan and medium scan television experiments.
K) Remote control experiments (such as radio control aircraft, garage door opener, remotely controlled kitchen ovens, etc.)
L) Transponder interlinking experiments between AO-7 Mode B and AO-8 Modes A and J.
M) Multiple access experiments (such as quantitative experiments to evaluate the effects of power sharing with different modulation techniques).
N) Ground station automation (closed loop monitoring of downlink signals and automatic adjustment of uplink power and frequency).
O) Broadcast demonstrations using the transponder in a single access mode, evaluating performance for different modulation modes.
P) Extended range communications experiments to attempt transmission or reception beyond the normal maximum satellite range.
R) Low power (QRP) user experiments to determine the minimum power needed to sustain communications.
S) Traffic nets scheduled on the satellite.
T) Automatic tracking of ground station antennas in azimuth and elevation (either on an open loop or closed loop basis).
U) Unattended, automatic telemetry data collection (e.g., using tape recorders for later analysis).
V) Unattended online or offline computer processing of received Morse code telemetry data, with printout of parameter values and units. Automatic decoding of Morse code characters in the presence of noise.
W) Experiments involving physical parameters, e.g., determination of spacecraft spin characteristics and orientation from telemetry data.
X) Traffic handling with RTTY using autostart techniques.

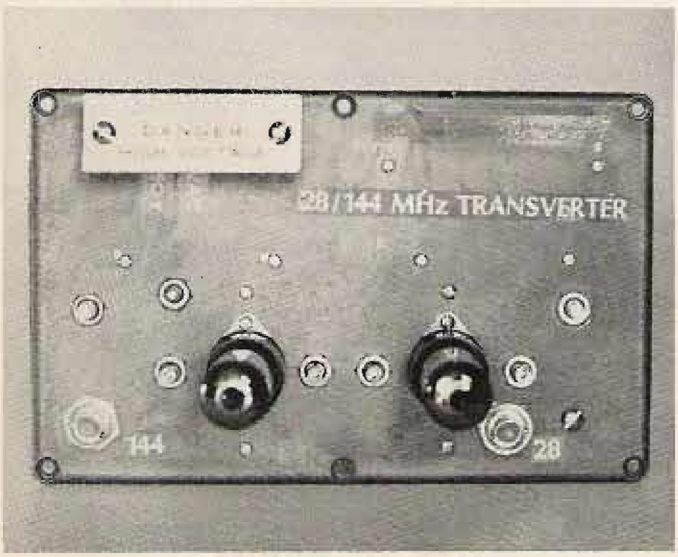
Table 3. Experiments that can be performed using the transponders and telemetry system aboard AMSAT-OSCAR 8.

Fred J. Merry W2GN
35 Highland Drive
East Greenbush NY 12061

Build An OSCAR 2m Transverter

-- make QRP days a success!

There are in use on mode B of OSCAR 7 possibly 200 28-432 MHz transmitting converters made originally by the Carmichael Communications Co. and more recently by the Amateur Radio Component Service. Using an antenna system with a modest gain, with 4 to 5 Watts output on 432 MHz, these converters seem made to order for low power satellite operation. There are many mode B users who will attest to their performance. W1NU, for example, made about 200 QSOs on mode B with this converter and a mediocre antenna during his 1976 Bermuda jaunt. Considering the successful track record of this converter on 432, its SSB capability and the improved tube performance on 144, the idea of building a 2 meter version was attractive.



The complete transverter.

The circuitry of the two meter model, shown in block form in Fig. 1, is the same as the 432 model except for the elimination of one stage in the LO chain and the appropriate changes in the LC elements.

The schematic, Fig. 2, illustrates the simple straightforward design characteristic of this converter. A voltage doubler circuit off the 6.3 V ac line provides the voltage for both the 2N4126 and the 2N3866 stages and also the adjustable bias for the 6939 amplifier. Zener regulation is used for the amplifier screen and for the crystal oscillator. The mixer is cathode biased. Input jack J1 is terminated with a 62 Ohm resistor, which may be disconnected if the drive is too low with it in place. A 58.9 MHz crystal may be used if the available driver does not have 29.5 coverage. This will give a mixing frequency of 28.1 MHz for an output on 145.9 MHz.

Construction details are shown in the photos. The unit is built on a Bud CU247 cast aluminum chassis, using the top as a mounting base. A brass partition lengthwise isolates the LO chain, which is built on a circuit board. The mixer and amplifier shielding is provided by two lateral partitions. Five small brass tabs on the partitions provide a connection to the bottom of the chassis to complete the shielding when the unit is placed in the case. Although the construction is a bit fussy, experienced builders will have no difficulty in duplicating either the 2 meter or 70 centimeter converters. For those interested in building, a complete set of information, drawings, and photos covering the two meter converter (and its 220 MHz and 432 MHz counterparts) is available from ARCOS, PO Box 546, East

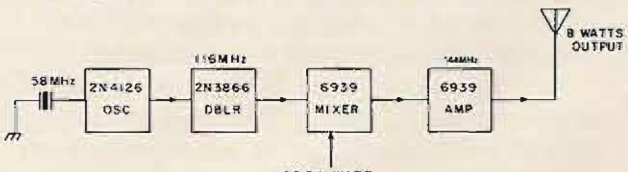
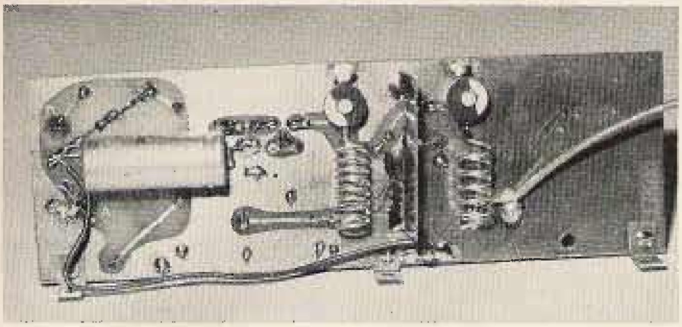
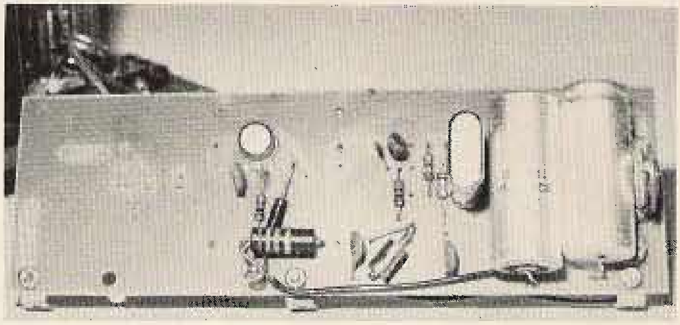


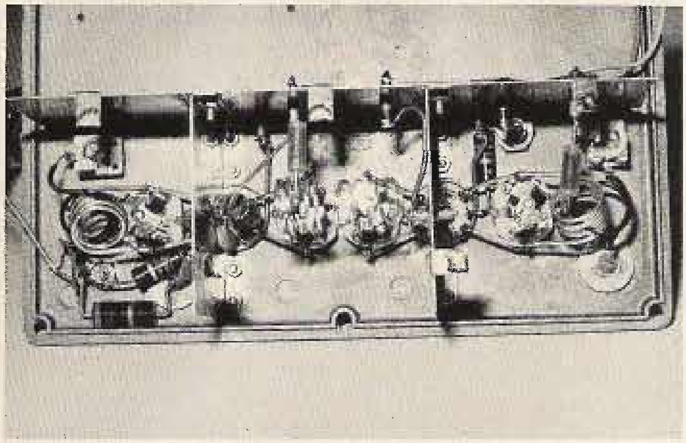
Fig. 1.



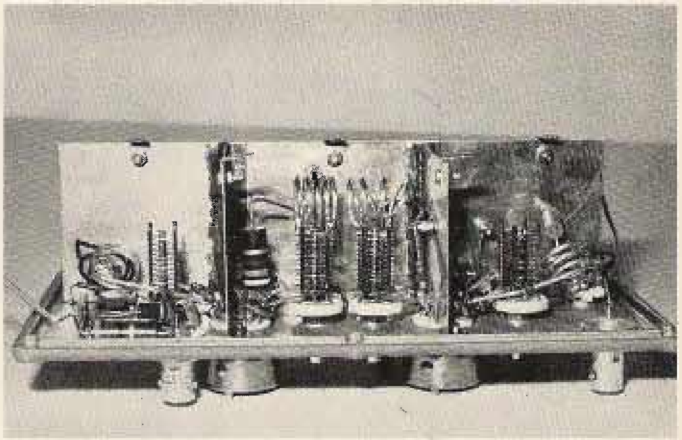
Foil side, local oscillator board.



Parts side, local oscillator board.



Underside of the amp and mixer.



Transmitting converter amplifier and mixer. Note intercompartmental shielding utilized to insure stability.

Greenbush, NY 12061, for $5 (to cover costs and postage). These converters are also sold by ARCOS as assembled and tested units.

For alignment, an output indicator of some kind is needed, and it is best to also have a two meter receiver tuned to the output frequency (observing the S-meter as a tuning indicator). The oscillator and doubler stages may be tuned using an rf probe and meter to maximize output. A counter, if available, coupled loosely to L2 will confirm that the mixing frequency is correct. The rf voltage at the point of connection to the output coax from the circuit board should be 5 or more volts ac. The mixer and amplifier stages of the two meter version of this converter do not appear to have any instability problems, although there is a tendency to oscillation if the mixer grid circuit is mistuned to approach the operating frequency. Spurious outputs, with proper alignment, appear on the Tektronix L-20 to be over 40 dB down. At this low power level, interference with other two meter operations is unlikely and, at least in the Albany NY area, has not been experienced. (More than we can say for some commercial units we have tried to use for satellite work.)

If you haven't yet tried low power, there are still some surprises ahead for you in satellite operation. ■

Coil Data

L1 – 9T – tap at 2½T – ¼ in. diam. – #18 wire – 3/4 in. long
L2 – 5T – tap at 1T – ¼ in. diam. – #18 wire – 3/4 in. long
L3 – not used for 144
L4 – 1½T ½ in. diam. – ½ in. leads – #22 insul. wire
L5 – 3½T ½ in. diam. – 1 1/8 in. leads – #16 wire
L6 – 5T – ½ in. diam. – ¼ in. leads – #16 wire
L7 – 4T – 3/8 in. diam. – ¼ in. leads – #16 wire
L8 – 3½T – ½ in. diam. – 1 1/8 in. leads – #16 wire
L9 – 1T – ½ in. diam. – 3/4 in. leads – #22 ins. wire

Variable Capacitors – Air Type

C1, C6 – 1 to 6 pF
C2, C3, C4, C5 – 2 to 11 pF butterfly type

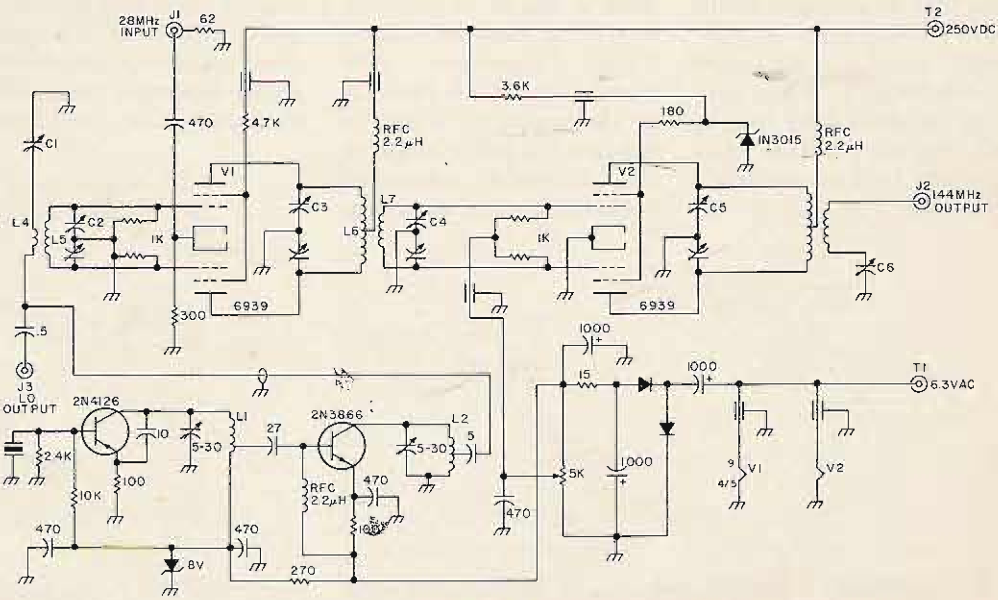


Fig. 2.

Pat Gowen G3IOR
17 Heath Cres.
Hellesdon
Norwich NR6 6XD
Norfolk
England

Predicting OSCAR Propagation

-- not always simple

The earliest case of unexpected radio propagation from an artificial satellite took place in early October, 1957, soon after the launch of SPUTNIK 1. Radio amateurs observed good copy of the world's first man-launched satellite on 20.005 MHz when it was on the opposite side of the Earth to the listener, but not always when it was to be expected, coming up over the horizon. Those observations made during the relatively short life of the spacecraft tended to indicate that good conditions, e.g., a high MUF, were coincident with both of the noticeable effects. Sub-F2 layer reflections during the high sunspot years with the consequent high level ionization were apparently responsible for the antipodeal signal, with the attenuation of lower layers limiting the signal at low angles when the maximum density path was between the beacon and the listener.

A similar effect was apparent on some of the earlier ten meter beacon OSCAR spacecraft.[1,2] With the advent of the OSCAR 6 and 7 Phase II spacecraft in high orbit, well above the maximum possible F2 layers and launched during low sunspot years, similar happenings could hardly have been predicted. Although infrequent, such abnormalities have been evident.[3,4,5,6]

Evidence of beyond-the-horizon audibility of both the 145 and 435 MHz beacons is very rare, but early hearings and late losses have been reported, although rarely for more than three minutes from the calculated AOS or LOS time. One would hardly expect effects like forward scatter to be evident when the signal source is of less than one Watt erp due to the attenuation placing the small signal source well below the noise level at the receiving end.

There is, however, considerable evidence of the two meter uplink of OSCAR users accessing the satellites for up to seven minutes after the time when, according to path theory and calculation geometry, the signal should have ceased to be transponded by the spacecraft. They, regrettably, fell far short of the thirty minute extra presence of the 29 MHz

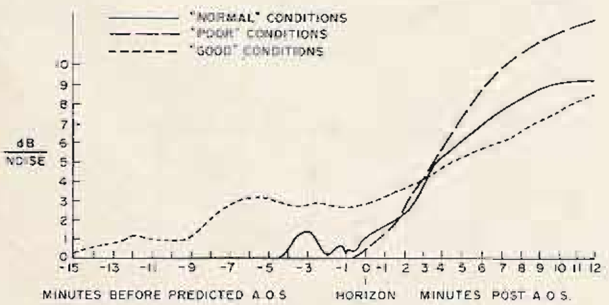


Fig. 1. OSCAR 7 29.502 MHz beacon downlink strength through time in typical different conditions (HF).

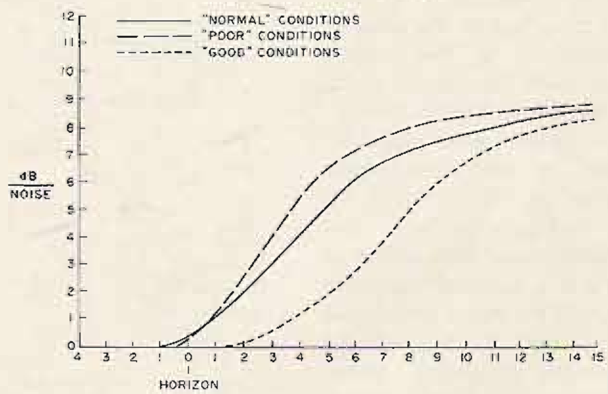


Fig. 2. OSCAR 7 returned (145.95 MHz) signal on 29.5 MHz downlink in typical different conditions (HF).

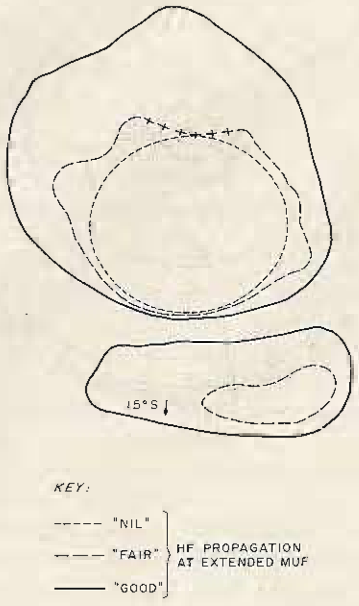


Fig. 3. Contour mapping of maximum distance AO-6 and AO-7A 10 meter detection on polar equidistant projection. Polar areas of no subsatellite points are marked "+" as these are non-definable. Note the distortion of horizon radius circle. This is an effect of using an equidistant projection centered on the pole axis. A stereographic projection would show a true horizon circle, but its center would not be at the observer's specific QTH. A great circle map centered on the observer's QTH would form a true circle with location center, but would further distort distant contours.

downlink, though, and rarely accessed both at the same time.[5,6]

Equally unfortunate is the fact that rarely does the 432 MHz uplink seem to exceed the line of sight by more than about one-and-a-half minutes, within the limitations of my experience.

What appear to be anomalies between the various frequencies' behavior patterns and the apparent contradictions to currently accepted textbook theories may be the subject of a future article when a sufficiency of data has been gathered to give a reasonably statistically sound degree of collated evidence. Already the information obtained and its relationships to other phenomena of interest to the radio amateur are enough to show the value of the OSCAR satellites in fields other than those of through-satellite communication alone.[7]

The following associations between what can be found by listening and using OSCAR for two-way communication, and what may be forthcoming by way of HF, VHF, and UHF (including the effects of aurorae, tropospheric and sporadic E in communication conditions), will be evidenced in an attempt to show that the amateur radio satellites can give a valuable pointer to assist those keen to exploit the improved, and in some cases impaired, propagation that is effected.

The Standard

Many means of extrapolating the precise crossing times of the satellite over one's horizon, calculated from the equatorial satellite crossing time and position, now exist.[8,9,10,11,12,13,14] The relationships that I shall use are those related to my own QTH/QRA, just North of Norwich, Norfolk, Eastern England, at 52° 40' N, 1° 10' E. For fine precision, albeit marginal in the wide field employed, the station's height above sea level plus the antenna height is given as 160 feet. With no hill higher than my elevation within the horizon curve, we may evaluate an addition as: $H = 1.42\sqrt{E}$, where H is the horizon extension in miles, and E is the elevation above sea level in feet. In my case $H = 1.42\sqrt{(95 + 65)} = 18$ miles. That is neither here nor there in terms of the 3000 mile slant range of OSCAR at horizon, but could add considerably to those in mile high cities like Denver and Mexico. Any blocks to true horizon may be found by the examination of contour maps and plotting out the height against distance on graph paper to find the true contours of the radius of true horizon around one's QTH. (Fortunately, flat old Norfolk suffers from no high hills.)

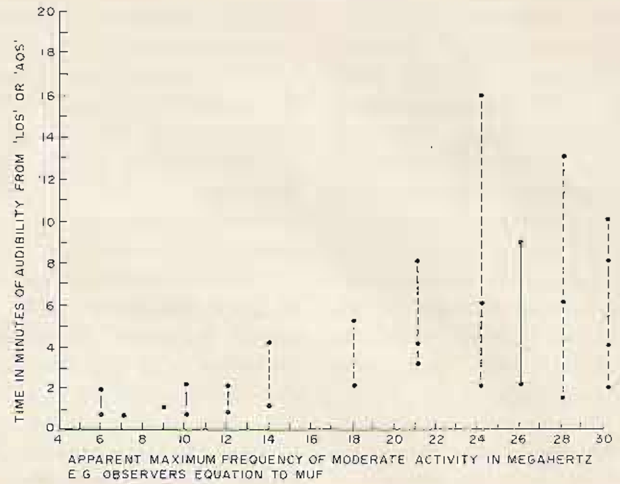


Fig. 4. Plot of all values of extension to horizon to MUF apparent.

We now have a means of finding the precise time, say plus or minus 15 seconds, when the satellite comes into our capture. If there is no barometric lift, minimum solar activity, and it is well into the night, OSCAR will appear exactly on schedule, almost simultaneously on the 29.502, 145.971, and 435.1 MHz beacons. One's 432.125-175 or 145.900-146.000 (OSCAR 6) or 145.850-950 MHz (OSCAR 7 mode A) uplinks will appear as transponder output at almost the same time. Any deviation of these times, relative to each other or to the calculated, will indicate an anomaly and show an alternative to "no propagation" conditions.

High Frequency Conditions

Although the variation on calculated AOS and LOS times is not always consistent, the general and average effect may be seen on the graph values of Figs. 1 and 2. At this point let me say that I do not feel that a sufficient number of measurements have been taken to fully substantiate the effect, as time, particularly during daylight hours, is very limited. Furthermore, a number of specific variables need to have attention, e.g., the path preference of normal HF communication at the time of measurement, the skip distance, and a further relationship to the time of year. It did seem that ultra-distant OSCAR audibility was more consistent with short skip conditions, i.e., ionization of the lower layers, than with long skip propagation associated with the F2 layers. But more work needs to be done on this subject. What was apparent from the orbits sampled was threefold:

1. The higher the apparent

usable frequency was, the weaker the OSCAR downlink signal was on 29.502 MHz prior to horizon loss of signal predicted time, and the weaker it was at post-horizon at acquisition of signal times.
2. The increase of maximum usable frequency for HF communication was indicated also by the strength of the downlink signal prior to expected AOS and after expected LOS.
3. The high frequency propagation possibilities tended to coincide with an increase of the time for which the ten meter downlink and beacon were audible both before official AOS and after its LOS.

A further factor is the increase of noise, both on the downlink frequency band itself, and upon the transponder's own downlink.

At this point, two requirements must be pointed out. The first is that the observer must be equipped with a reasonably high antenna, preferably with some gain, as high gain at low angle is an essential to observe these proximate-to-horizon effects. It is assumed that the keen DXer will have this requirement. Second, it is normal to copy reasonably good signals both before and after the above-horizon transit for up to three minutes if the path is in daylight. In low MUF dark path conditions, the signal will normally extinguish promptly at the predicted LOS and arise promptly at AOS. We may summarize by saying that the longer and slower the beacon signal decays, the better the predictor value for favorable HF conditions.

Fig. 3 shows the contour lines found at this QTH with the extra path OSCAR detection, i.e., anything observable above noise in three sets of subjective HF propagations. These are grouped into "good," shown by the continuous contour, "fair," as shown by the dashed contour, and "nil," as shown by the dotted line, which equates the line-of-sight path to the satellite.

While we are dealing with HF conditions, let us mention that curse to the HF man, and the blessing to the VHF enthusiast — aurorae. The period leading up to an aurora will commence with an elevation of the symptoms of good conditions, with an added symptom of greatly increased noise and a marked deterioration of the quality (to use another subjective term) as the satellite nears the polar areas. Immediately preceding the actual event, transponded signals will be all but wiped out by noise and suffer from severe particulate modulation sounding like an old spark transmission. The signals may still be heard post-horizon in the noise for up to several minutes before total loss. More will follow on this subject in the VHF context.

Very High Frequency Conditions

The main indicators of VHF openings are:
1. A severe attenuation upon one's own returned signal, with marked fluttering and very rapid QSB at high maximum to low minimum values when the satellite is at low elevations, i.e., just over the horizon at both AOS and LOS times.
2. A marginal sub-horizon access with the signal popping up suddenly for very brief periods prior to and post the expected path times.

The beacon at these times is marginally affected also, but not to anywhere near the extent of the uplink signal. With increasing elevation, the evidence decreases proportionately. At high altitudes, the effect is virtually unnoticeable, and a normal access proceeds. To differentiate between the HF effect and the VHF effect, which do not always go together, it is necessary to alternately monitor one's own returned signal, and relate this to the beacon for comparison. To the observer, the transponded signal, even in good VHF openings, will rarely be heard more than two to three minutes at best on the downlink at extra horizon times, although other observers closer to the downlink have reported continuing copy for up to seven minutes after

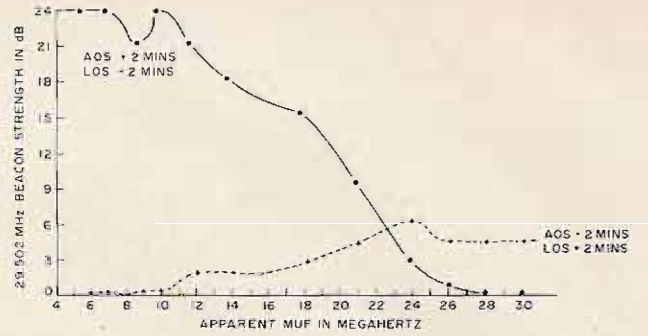


Fig. 5. Mean average signal strength of beacon to apparent MUF of same values.

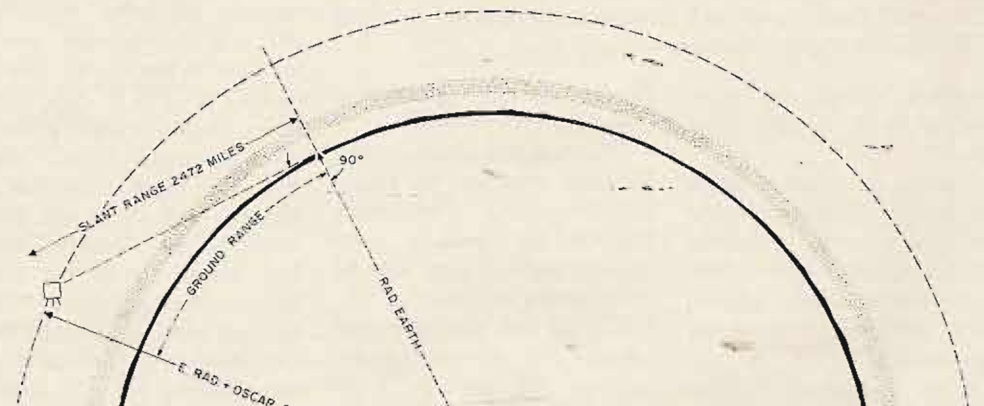


Fig. 6. Horizon geometry. True line-of-sight path calculations and structure for control use. For ground range (subsatellite point to observer) (for use on great circle map), multiply Earth radius by angle formed by it and OSCAR radius in radians. This angle = Θ = $\cos^{-1}$ of Rad Earth/Radius OSCAR = 3964/4884 = 0.8116298 = cos Θ = arcos of 0.81163 in radians = 35° 45' = 0.6238 radians. 0.6238 x 3964 = 2472.7432 miles on great circle + extra horizon.

For horizon crossing point (by Pythagorus): Draw line from Earth's center to surface = Earth radius = 3964 miles (mean). Draw line from Earth's center to OSCAR = satellite path radius = 3964 + 920 = 4884 miles, which is the hypotenuse of the right angle triangle with 90° at the observer's point when "seeing" the satellite at horizon. $H^2 = A^2 + B^2$ ∴ rad. OSC^2 = rad. $Earth^2$ + slant $range^2$ ∴ rad. OSC^2 - rad. $Earth^2$ = slant $range^2$ = 4884^2 - 3964^2 = 23853456 - 15713296 = 8140160 miles. $\sqrt{8140160}$ = 2853 miles = slant range.

official extinction. It is also apparent at times of good tropospheric conduction that the predicted beam path is not always true. A swing of the beam carrying the uplink signal will often improve the downlink strength considerably by up to a 20° variation in azimuth and some 30° in elevation. The normal polarization preference roll pattern[15,16,17,18] is broken, with quite rapid changes in the preferred linear horizontal or vertical normal pattern that is usually serialized.

The above effects mainly apply to characteristic behavior indicating tropospheric openings.

With sporadic E, the effects are similar, but, instead of the usual evening effects, are more normally present in the central day periods. Now the flutter and rapid fading is far more intense and takes place when OSCAR is at quite high elevations. Sudden extinction and pop-up of the uplink signal is far more evident. Observation of the VHF beacon also shows a similar pronounced effect, which, like the VHF uplink, is also subject to irregular polarization fluctuations at high elevation angles.

Aurorae produce a degree of degradation on the stability and tone of the VHF beacon as the satellite nears the auroral zone. But what are far more distinctive are the isolated uplink returns, which may be quite separately effected with a tone "A" return on the ten meter downlink.[19,20] Often under auroral conditions, even separate GM stations have been observed with the characteristic auroral note, while other northerly stations have been virtually free and other more southerly stations totally free. This indicates that aurorae can be quite specific to a relatively small area, which is surprising, but readily and frequently observed. OSCAR gives a means for the early detection of forthcoming auroral openings prior to the spread to one's parochial observance area on the direct path. An even earlier indication can be given by the follow-on of a period of high MUF conditions due to enhanced solar activity by following the post-horizon ten meter signal, followed by northerly scintillation and tonal degredation.

Ultra High Frequency Openings

Ultra high frequency openings are difficult to detect by the exclusive use of OSCAR, but some small extension to the normal line-of-sight path can be detected for periods of up to one minute. What is more noticeable is the slow rise of the transponded uplink signal returned down on the two meter band, as distinct from the more usual sudden arisal of the downlink. When openings are imminent, rapid flutter coupled with some difficulty of access at very low angles is observable. Possibly a better method is to calculate when stations in the workable area will be beaming at low angles over the top of your QTH as they track OSCAR, and place your receiver on that frequency corresponding with the appropriate uplink frequency on the 432.125 to 432.175 MHz input to that of the 145.875 to 145.925 MHz downlink upon which you are hearing them, allowing for the Doppler shift.[21] It is quite amazing how many openings occur at 432 MHz when no QSOs are evident upon the normal direct path frequency range. It seems many listen, but few transmit, so everyone assumes the band to be dead. OSCAR

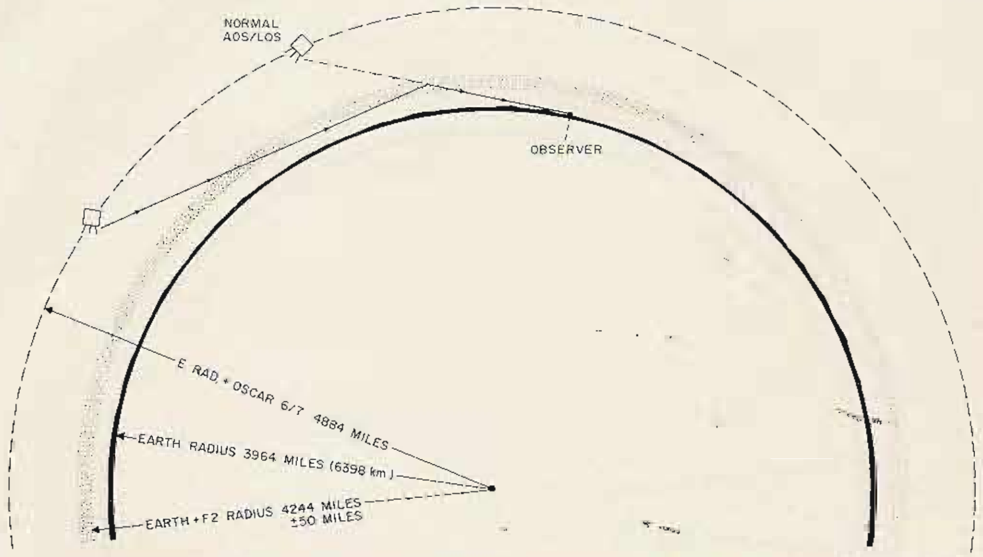


Fig. 7. Possible theory for sub- or post-horizon audibility: At high MUF (dense ionospheric layer) times, the OSCAR signal may enter via less ionized areas according to solar-radiation points. This is thought to be unlikely as its observed signal strength is greater than that expected by such a path.

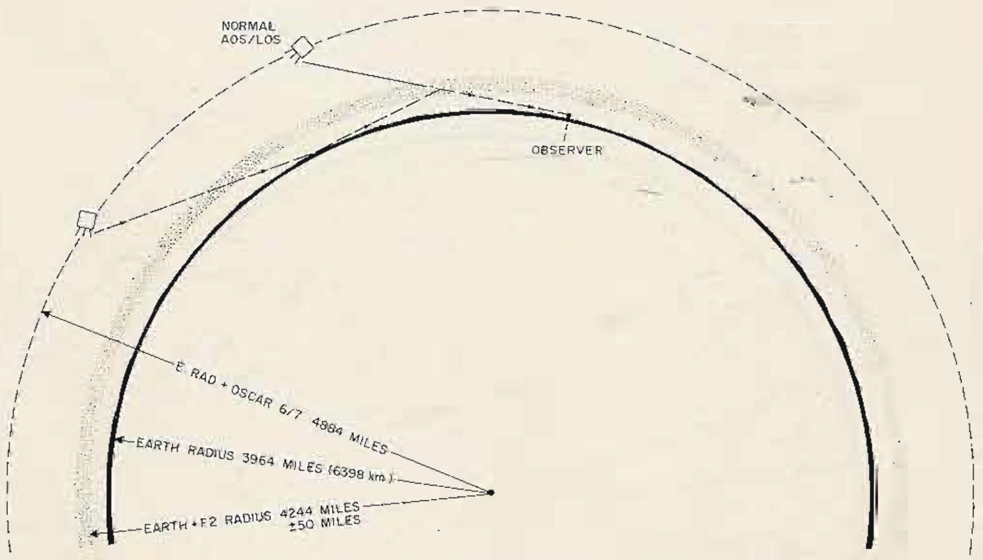


Fig. 8. OSCAR signal may enter through a low ionized area, reflect from Earth, and then return to a reflective F2 area to be returned to observer. This is highly unlikely as signal strengths are far in excess of those expected (if any).

produces known activity on known frequencies with known beam directions and gives a valuable guide to the state of the band.

The theories that may be advanced for the particular effects found can be numerous and complex. The number of variables are considerable, and an insufficiency of observations have taken place to fully define any one single cause, let alone the multiple associations probable. It is hoped that perhaps someone with the time and equipment available may wish to take the investigations over. Ideally, he would be equipped with ionospheric sounding equipment, fine Doppler measurement for determining position and path, and narrow beam antennae. This article is intended to stimulate this approach, as well as to show readers that, whatever their field of interest within the wide framework of amateur radio, the AMSAT-OSCAR spacecraft are a valuable potential asset to their particular aspect. ■

References

1. *QST*, October 1970, p. 74, "Australis Oscar-5 Ionospheric Propagation Results," Ray Soifer K2QBW (now W2RS).
2. *CQ*, May 1970, p. 60, "10 Meter Anomalous Propagation with Australis Oscar-5," K. J. Doyle.
3. *Space Communications*, ARRL Technical Symposium, p. 85-91. "Oscar 6 over Western Europe," Pat Gowen G3IOR, September 1973.
4. *AMSAT Newsletter*, Vol. VI, No. 2, 1975, "Abnormal Reception of Oscar 6 Signals on Ten Meters," report by VU2UV.
5. *AMSAT Newsletter*, Vol. VII, No. 4, December 1975, report of SDX QSO by Bud Schultz W6CG.
6. *AMSAT Newsletter*, Vol. VIII, No. 1, March 1976, report of same SDX QSO by Pat Gowen G3IOR.
7. *CQ-DL*, No. 2, 1976, "Uberreichweiten bei OSCAR-Satelliten im 10-m-Band," Dr. Walter Eichenauer DJ2RE.
8. "Keeping Track of Oscar," booklet published by R.S.G.B. from article series in *Radio Communication* by Bill Browning G2AOX.
9. "Oscalator 6, QSL Card Orbital Calculator," Torsti Paatero OH2RK, *OSCAR News* No. 2, January 1974, p. 21.
10. "The Walland Calculator," *OSCAR News* No. 8, December 1974, p. 17, Dave Walland.
11. "The OSCAR 7 Look-up Chart," *OSCAR News* No. 12, September 1975, p. 21/22. Table plotter by Rudi Schoenberger DL8DF.
12. "Oscar Prediction Look-up Tables," AMSAT-UK Handout, Tony Bailey G3WPO.
13. "Oscar Tracking Computer Programmes," Jack Colsen W3TMZ, David Walland, and Martin Sweeting G3YJO.
14. *AMSAT Newsletter,* Vol. VIII, No. 1, March 1976. "Shoot Oscar with a Satellite," p. 6-14, Kazimierz Deskur K2ZRO. (First published in *73 Magazine.*)
15. *OSCAR News* No. 8, December 1974, p. 5-7, Graphed Roll Patterns by G3IOR and G3PEJ.
16. *OSCAR News* No. 11, June 1975, p. 15, AO-7 Graphed Roll Patterns by G3IOR.
17. *OSCAR News* No. 12, p. 18, September 1975, "Polarization roll graph," G3IOR.
18. *CQ-DL*, No. 2, 1976, "OSCAR-7-Auswertung der Teletype-Telemetrie" Hermann Luer DL3SK, p. 38, 39.
19. *OSCAR News* No. 15, June 1976, p. 3. "General News."
20. *AMSAT Newsletter*, Vol. VIII, No. 1, March 1976, p. 27, Part of GE3IOR letter.
21. *OSCAR News* No. 8, December 1974, p. 12, "A calculator for finding Frequency Relationships, with positive and negative Doppler Shifts," OH2RK.

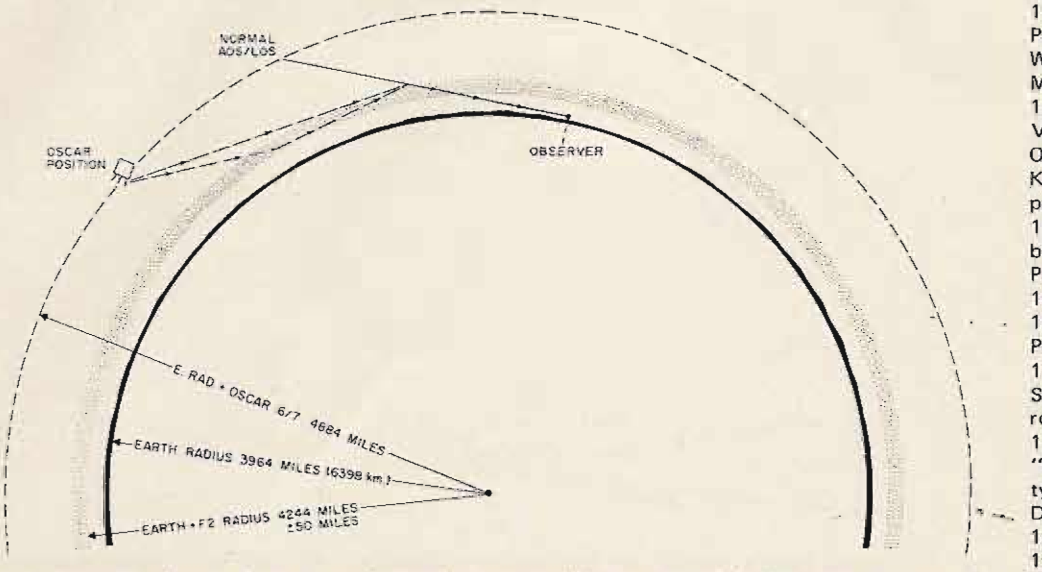


Fig. 9. Possible theory for sub- and post-horizon audibility: At critically ionized areas, the OSCAR signal may enter as a conduction signal upon an "open-ended" duct at the dusk daylight attenuator, hence "conduct" to permit the observer to hear re-radiated signal from the scattering ionized belt.

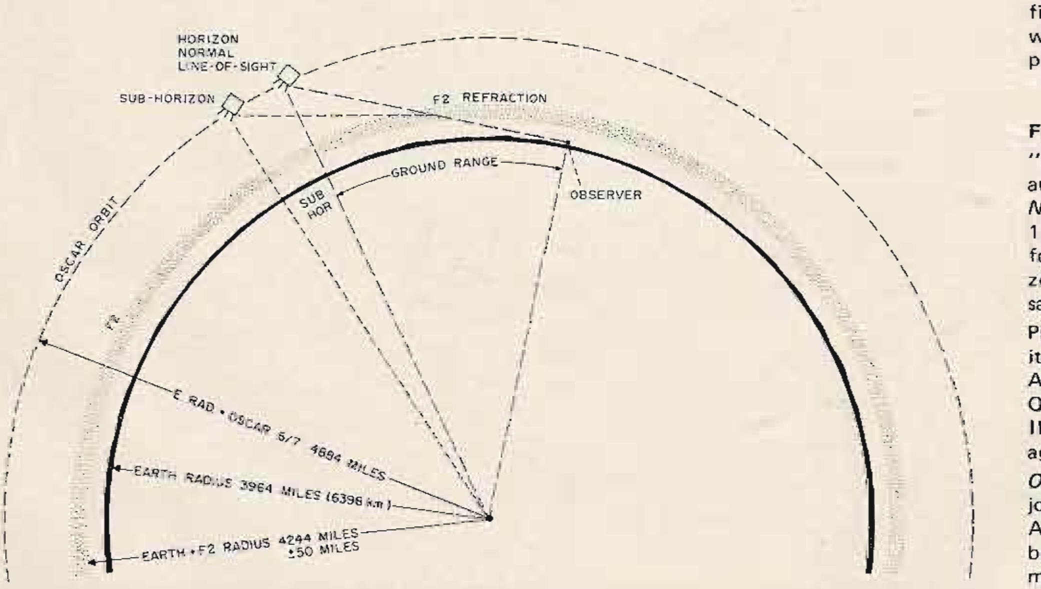


Fig. 10. Possible theory for sub- or post-horizon audibility: simple refraction occurring due to angulation of signal as it transmits an area of higher ionic density.

Further Reading

"OSCAR Anaprop ... Theory and Practice," G3IOR, in *OSCAR News* No. 5, August 1974. Pages 15-18 give the mathematical formulae required for true horizon slant distances and subsatellite ground distances.

Photocopies of *OSCAR News* items may be obtained from the AMSAT-UK librarian, G8KME, QTHR, at 3p. or equivalent in IRCs per page and postage coverage.

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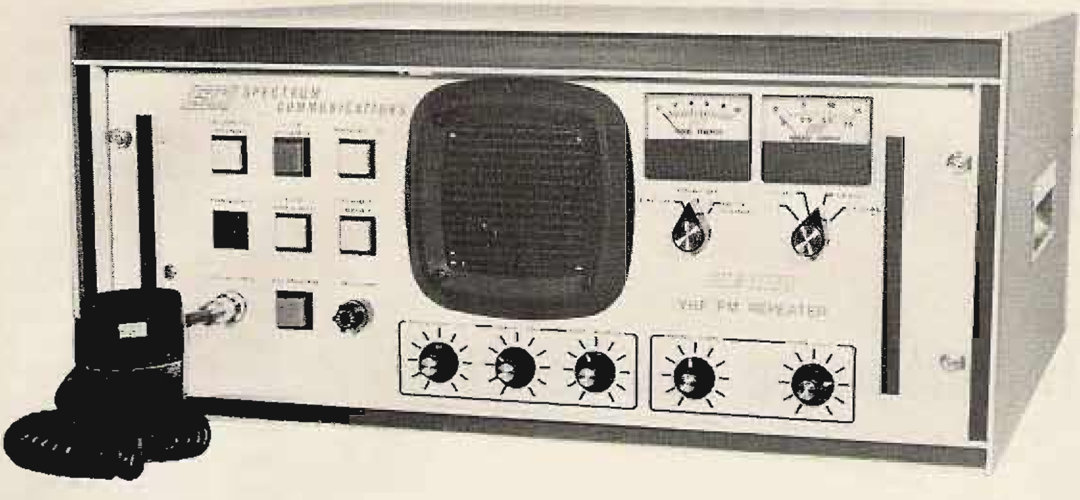

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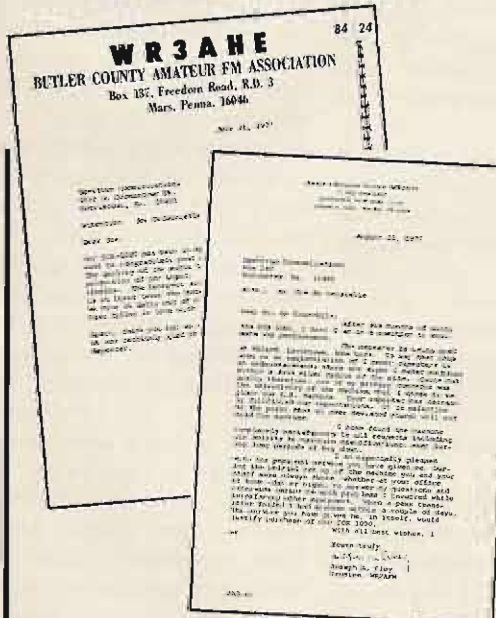

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The availability of amateur radio communications via satellite has opened up an entirely new medium for reliable, long or short distance vehicular communications. The amateur radio mobile station equipped for satellite communications is no longer limited by the range of terrestrial FM repeaters, location, or HF propagation vagaries. For example, K8MYN, using the simplest equipment in his vehicle, was able to maintain consistent contact with the USA via the OSCAR 6 satellite from northern Canada and Alaska, when poor propagation conditions in that area rendered the HF amateur bands useless. Other amateurs have successfully used the satellites to communicate from a boat in the Florida Keys, from an airplane over the Pacific, and from various automobile installations. The purpose of this article is to discuss how the OSCAR satellites may be used from a vehicle and give some examples of equipment arrangements and antennas which have been found workable.

Fig. 1 illustrates the basic concept of mobile to base station communication via satellite. The uplink and downlink frequencies are widely separated, yielding, without filters, a built-in duplex operation. You are, therefore, able to hear not only the signals of the station you are talking to, but your own signals as well – giving a continuous indication of how well you are accessing the transponder in the satellite.

The current OSCAR 6 and 7 satellites are in approximate polar orbits at 900 miles above the earth. Both complete their orbits in about 1 hour and 55 minutes, advancing about 30 degrees of west longitude with each south to north equator crossing. For each *overhead* orbit, they are in good signal range of the relatively limited capability of simple vehicular antennas for about 15 minutes. There will also be about 10 minutes of good signal strength on the orbits two hours before and two hours after the overhead pass.

Thus, for OSCAR 6 and 7, there have been three usable orbits in the evening for the south to north equator crossings and three in the morning for the north to south crossings. This yields for both satellites about two hours total communication time for a 24 hour period. The overhead orbits occur about 9 am and 9 pm local time. There are some variations to this pattern which we don't need to go into here. A vehicular station in the polar regions will access the satellites on every orbit.

To know what time to use the satellites at your location, you keep in the vehicle a table published by W6PAJ showing the time of the equator crossing and the west longitude for every orbit for every day of the year. To the equator crossing time, you add the time for the satellite to come within range. For example, at Albany NY, for an overhead or nearly overhead pass, 4 minutes are added to the published equator crossing time for the evening passes and 34 minutes to the morning crossing time. These times, from experience, allow the satellite to get high enough in the sky to be readily

Today's equipment – 3 transceivers: 2m, 70 cm and low band. The 2m FM is in the upper left. Solid state amplifiers for the 2m and 70 cm are in the trunk. Antennas: 5/8 wave for 2m and 70 cm; Hustler for 10m and other low bands.

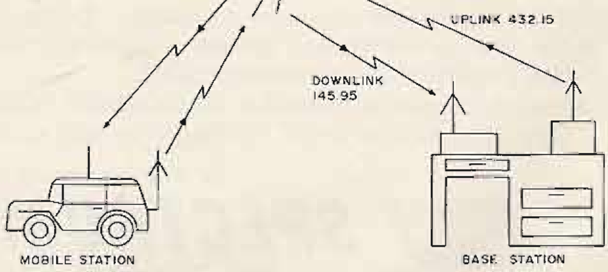
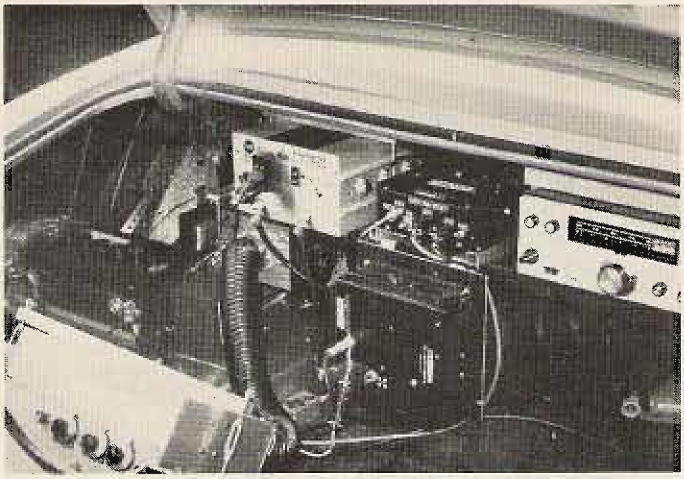


Fig. 1. Mobile to base station operation via satellite.

Transceiver as in Fig. 3 showing the tunable receive converter on top of the FT101.



Power amp on 432 as in Fig. 3. There are 2 power supplies — 12 V dc to 300 V dc and 12 V dc to 1600 V dc — and a 12 V to 115 V ac converter. That's a lot of equipment to generate a 100 Watt plus SSB signal on 432.150.

accessible from the car antennas.

The conservative range over which you can "see" or access the OSCAR 6 and 7 satellites from a vehicle is a circle centered on your location about 2000 miles in radius. If your location is free from obstructions, you will be able to hear your own signals return from the satellite at this range and be able to communicate with any station having an overlapping range during the period of the overlap.

With regard to the mode of transmission, the linear transponders in the satellites will retransmit any mode that is offered. To conserve power and bandwidth, SSB and CW (Morse code) are the preferred modes.

OSCAR 7 Mode B has produced outstanding vehicular communications. Based on calculations by Perry Klein of AMSAT, Table 1 shows the link calculations for Mode B using experimental equipment in my car as an example.

With this brief background of how vehicle communications are established through the OSCAR 6 and 7 satellites, we now describe some equipment arrangements in the vehicle which have been used successfully.

In March of 1973, a few months after OSCAR 6 was launched, the equipment shown in Fig. 2 was installed in my automobile. For the uplink, the equipment consisted simply of a regular amateur type 10 Watt FM transceiver, equipped with a couple of crystals in the uplink passband and arranged for keying the driver stages. An 80 Watt solid state amplifier was located in the trunk. A standard 5/8 wave base-loaded whip was the antenna.

For the downlink, a common amateur band transceiver tuned to the downlink frequencies around 29.5 MHz and a loaded whip cut to this frequency did the job very well.

The first use of OSCAR 6 from a vehicle was made with this simple setup. Over a two year period of operation on the road in various states here in the East, it was very effective, accounting for hundreds of contacts with other amateur radio operators all over the USA and Canada, as well as a few contacts with Europe. The excitement of these early operations with OSCAR 6 will be long remembered by those who participated. This operation was all done with a telegraph key — not the best mode from a moving car. Practically all operation was, in fact, done with the car parked. As mentioned previously, this type operation was also accomplished by several other amateurs, using similar equipment setups readily available from suppliers of amateur radio equipment.

During March, 1975, after a few months of experience with the then new OSCAR 7, it became apparent that the outstanding signals from the Mode B transponder would provide a new level of performance from a vehicle. The first experiments used a transceiver arrangement as shown in Fig. 3.

The uplink starts with the same regular amateur band transceiver as was previously used for receiving OSCAR 6. This is in the front of the car, so the transmit frequency can be controlled from the driver's seat. A low power output (1 Watt) available from this particular unit is cabled to the trunk, and connected to a transmitting converter (28.150 to 432.15 MHz). This converter

Uplink (at 432.150 MHz)	
Transmitter power x antenna gain = EIRP = 100 Watts	+50 dBm
Free space path loss (at 2000 mile range)	-156 dB
Polarization mismatch (linear on ground, circular at satellite)	-3 dB
Net nominal receiving antenna gain at spacecraft	0 dBi
Received signal at input to spacecraft transponder	-109 dBm
Downlink (at 145.950 MHz)	
Satellite transponder output power (with -109 dBm input signal)	+30 dBm
Net nominal transmitting antenna gain at spacecraft	0 dBi
Free space path loss (at 2000 mile range)	-146 dB
Net nominal automobile receiver antenna gain (including transmission line loss)	+2 dBi
Polarization mismatch (circular at satellite, linear on ground)	-3 dB
Received signal at input to automobile receiver	-117 dBm
Receiver noise (bandwidth = 2.4 kHz, noise figure = 3 dB)	-137 dBm
RECEIVED (S+N)/N	+20 dB

Table 1. Note: At a range of 1000 miles (satellite overhead), the (S+N)/N should be 26 to 30 dB. From these figures it can be seen that very effective communication is possible.

W3TMZ was first QSOed from the car via OSCAR 6. The other cards are from the first few days of operation.

develops about 3 Watts on the uplink frequency. A strip-line tube type power amplifier brings this low power up to the 100 Watt level. A short run of RG-8 cable to a ground plane antenna mounted on top of a standard mobile whip completes the uplink equipment. A rather involved power supply was required to supply all the various voltages required by the tube type uplink equipment in the trunk.

The downlink receiving equipment, since this was to be a transceiver installation, required a special receiving converter to convert the 145.950 MHz passband downlink signals to 28.150 (± 25 kHz) for the transceiver. The crystal in this converter had to be on the high side of the signal to restore the frequency inversion created by the satellite transponder. The crystal also had to be offset to adjust for the small frequency translation irregularity in the satellite transponder and to provide continuous tuning to adjust for the Doppler effect. A crystal tuning capacitor equipped with a vernier dial was employed to facilitate this adjustment. The antenna for the downlink was the same 5/8 wave base-loaded whip previously used for uplink in the OSCAR 6 experiments.

This array of uplink and downlink equipment was tested out thoroughly on the bench by actually communicating via the satellite. The car installation called for a lot of head scratching on equipment location – particularly for the various power supplies.

Murphy must have been looking the other way, because when I finally tried the installation out from my driveway on the first available orbit, I was rewarded with a solid SSB conversation for over ten minutes with W2BXA in New Jersey.

Other than a minor problem in the high voltage power supply, this installation was in troublefree operation for more than two years with impressive results. Particularly on the morning passes, when the 7B transponder was lightly loaded, the return SSB signals were very strong. It was easy to work European stations as well as all of North America and the Caribbean.

Operation in motion is quite practicable with no observable difference from parked. On one occasion, a special test was carried out where the car was kept in continuous motion while the mike was kept continuously active for an entire orbit. The signals from the car were copied by many stations all over the East and Midwest with exceptional clarity. In-motion operation does have a little problem with two-way

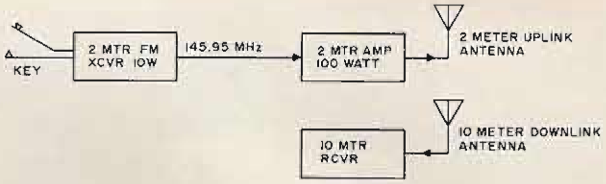


Fig. 2. Simple equipment for vehicular satellite communications.

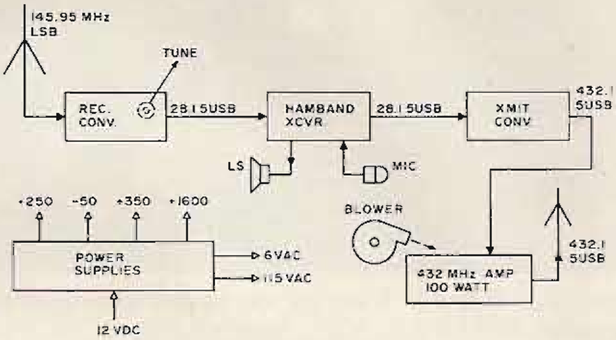


Fig. 3. Transceiver type equipment used in W2GN mobile for SSB communications via OSCAR 7 Mode B.

contacts due to the need for frequent adjustment of the receiver to account for the Doppler shift. One hand on the steering wheel and one on the tuning dial leaves the mike in midair.

A 2 meter sideband transceiver was next installed to supplant the receiving converter described above. This yields the convenience of being able to hear your own downlink signals, an interesting and important aspect of satellite operation. In this setup, the transceiver used to generate the SSB signal on 28.150 was installed in the trunk, taking all the clutter out of the front of the car.

A number of successful demonstrations were conducted at various hamfests and meetings here in the Northeast. The SSB voice signals coming down from the OSCAR 7 Mode B translator invariably gave good loudspeaker copy to large groups by extending an audio line from the car to the meeting hall.

432 MHz SSB transceivers and linear amplifiers became available during 1975, so we continued the equipment saga, and, in early 1976, installed a 432 transceiver alongside the 144 unit in the front of the car and solid state linears for both bands (2m and 70 cm) in the trunk – going whole hog, so to speak.

A regular ham band transceiver plus the usual FM unit provides a capability for all satellite and nearly all regular modes of operation on the ham bands. The antennas continued the same – base-loaded whips on 2m and 70 cm and center-loaded whip for ten meter downlink. We have come a long way in the equipment department since OSCAR 6 was launched in October of 1972. All of the gear mentioned takes up little space in the vehicle. The availability of satellite communications has helped to stimulate this development.

As the AMSAT program for future satellites unfolds, we can expect mobile operation via satellite to be a regular part of the day-to-day ham operation. Continuous coverage via satellite must be held as the ultimate goal, either through use of high altitude satellites or by operating several satellites properly spaced at a lower altitude.

Once that is accomplished, there will be no barrier to communication by amateur radio from any point on the Earth at any time. ■

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Noblesville IN 46060

Tic Tac Touchtone

-- a new method!

Between the looks of the push-button pad arrangement of the Touch-tone™ and the hit-and-miss aiming technique I had been running until recently, the title seemed a likely one for the circuit block diagram in Fig. 1. What the circuitry allows you to do is tape record (or manually enter) TT tones that are then entered into a decoder for a one-of-ten number choice. These tones are changed to TTL levels, and from one-of-ten code to BCD. A set of storage latches allows you to enter a six-digit number sequentially, and yet store it as six sets of parallel BCD data. Now, what can you use it for?

As described, I use it to record (or enter manually) azimuth (3 digits) and elevation (3 digits) information on convenient cassette audio tape for a given OSCAR pass. Depending on how you do the recording and playback, you have enough time on one side of a 60-minute cassette to record even the longest 24- to 28-minute pass in real time. At real time, you would start your recording with the starting position coordinates for your antennas, and then enter new information from your calculated data (or Satellabe™) every one-half minute or so, with the tape always running. Two drawbacks! One, this can eat up a lot of tape. Two, it takes as long to record every pass as the pass really takes! I record and play back mine a bit differently. By using a circuit very similar to Fig. 7 (R-S flip-flop wired gates) to control the tape recorder run/stop circuit via the microphone third wire, I waste no tape. You build a second Fig. 7 leaving off Rs, Cs, Rg, Cg, and both switches, since the tape control inputs will be TTL levels. The relay contacts are then wired as in Fig. 7(a) to control the tape recorder run/stop circuit. For inputs to this added IC, refer first to Fig. 2. IC5-11 shows a lead going off to tape. Attach this lead to the new IC pin 13, taking the place of the hold switch of Fig. 7 and forming the tape stop command. Whenever a # is decoded from the tape or direct command, the tape stops. To start the tape, any TTL-compatible pulse from high to low into pin 9 of the new IC will start the tape. The relay will close and the tape will run. To record using this method, let the pulse (from timer or electronic

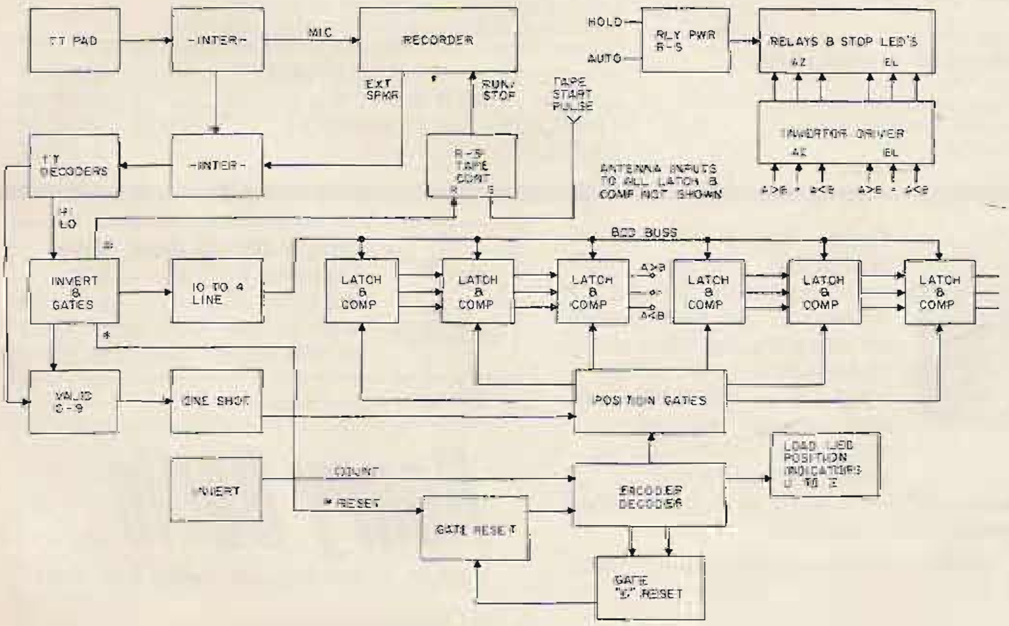


Fig. 1. Block diagram.

clock at 1 or 2 per minute) start the tape on playback, and use a momentary low on pin 9 to start the tape when you are ready to enter new data for a pass when recording. You enter your data in 6-digit format shown by this example for an azimuth heading of 163 degrees and an elevation of 45 degrees: Enter by pushing the TT pad buttons 1, 6, 3, 0, 4, 5, #, for a 163045# sequence. When you hit the # key, the tape will stop, but the tone will be on the tape. Start the tape with a pulse again, and after 2 to 3 seconds, enter the next headings, followed again by #, and so on. When the timer plays back the tape, one 6-digit number and stop tones will be played back for each timer pulse, so be sure to enter data for every minute if a one-per-minute timer is used, or data for every one-half minute if a 2-pulses-per-minute is used, etc.

The interface shown between the TT pad and the recorder is a combination of the TT pad level control, the ALC circuit of the recorder, switches you choose to use, cables and plugs, and so on. Nothing fancy, and not included here due to the many types of pads and recorders. The same goes for the interface shown between the recorder and the TT decoders in the playback mode. It can be any ALC, or the recorder playback volume control, or anything to hold the tone levels to about 50 to 100 mV (if you are using PLL decoders). The TT decoders are also not shown, as they have been in many forms, in many magazines. It's your choice, just as long as the output goes from about +4.5 V dc to ground on the output line when that tone is received.

Taking it from the output of the TT decoders, the high and low tone group outputs (lows) are fed to an inverter so that both high and low are available for each output. Then the inverted forms are fed to gates to decode a single number for any tone pair received. Output from these gates is fed to a 10-line to 4-line converter IC. This 74147 IC happens to accept a low on the 0 to 9 input line side, and outputs $\overline{\text{BCD}}$ code equivalents of the digit that was entered. This inversion doesn't bother us, as the $\overline{\text{BCD}}$ is inverted again in the 7475 latches by using the $\overline{Q}$ outputs. The then BCD code is fed to a 7485 comparator IC to compare it with the BCD code sent down from the antennas. That covers the signal path, which is really easy. Now for the controlling part!

Going to Fig. 3, all lines that enter each half of IC17 are normally high during no tone. When any valid TT tones are received, one input line of one half of IC17 (pin 1, 2, 4, or 5) and one input line of the other half of IC17 (pin 9, 10, 12, or 13) will go low (for the numbers 0 to 9, but more on that later). Since IC17 is a 7420 4-input NAND gate, all 4 lines of either half input must be high for a low output. When the tones cause these IC17 outputs to go high, IC28-3 goes low. This causes the one-shot IC18 to fire for approximately 5 ms. The one-shot IC18 output enables half of IC19 and IC20, 7408, and gates. The other half of only one of these gates at a time is enabled by what line (U, V, W, X, Y, Z) is also high. If we are in the first digit position, for example, the counter 7490 (IC15) and decoder 7442 (IC14) would be in the zero (reset — 1st digit) position. IC14-1 will be low, and when inverted by IC13-1 to IC13-2, a high results, enabling IC19-3 to a high. This high turns on the latch enable line of IC7-4 and IC7-13. The BCD data for the first digit present on the common BCD bus in Fig. 2 are transferred to the output side of *only* that latch. It is then compared by the 7485 (IC21) with the current antenna BCD read down to the other side of the 7485.

Going back to Fig. 3, the same low for a valid TT tone at IC28-3 that keyed the one-shot IC18 is also fed to IC16-12 and IC16-13, causing a high at IC16-11 and IC15-14. This low to high transition when tones are received does nothing at the counter input IC15-14; however, when the tones stop, the condition reverses (high to low), and the counter advances one position and is ready for the next number. You can follow through the counter (IC15) and decoder (IC14) up through IC14-2 to IC13-1 to IC13-4 to IC19-5, and see that the next position is then half enabled and needs only the one-shot pulse from IC18 when the next tones come along to load the second position latch (IC8) with second digit BCD data.

It should be noted at this time that the TT pad * key can be used to reset the counter and latch positions. IC16-4 and IC16-5 are used in upside-down gate fashion, much like IC28-1 and IC28-2, in that if either high goes away from the inputs, the output goes high and resets the counter. IC16-5 is also used to reset the counter when position "6" is reached in the 7442, so the counter does not rely on the * to reset. The position "6" reset is detected as a BCD 6 by IC16-1 and IC16-2 to IC16-3 to IC15-5.

Referring to Fig. 3 and IC17: The inputs to these gates were originally wired to detect all valid TT pairs, but this leads to both limited and confusing control. By using

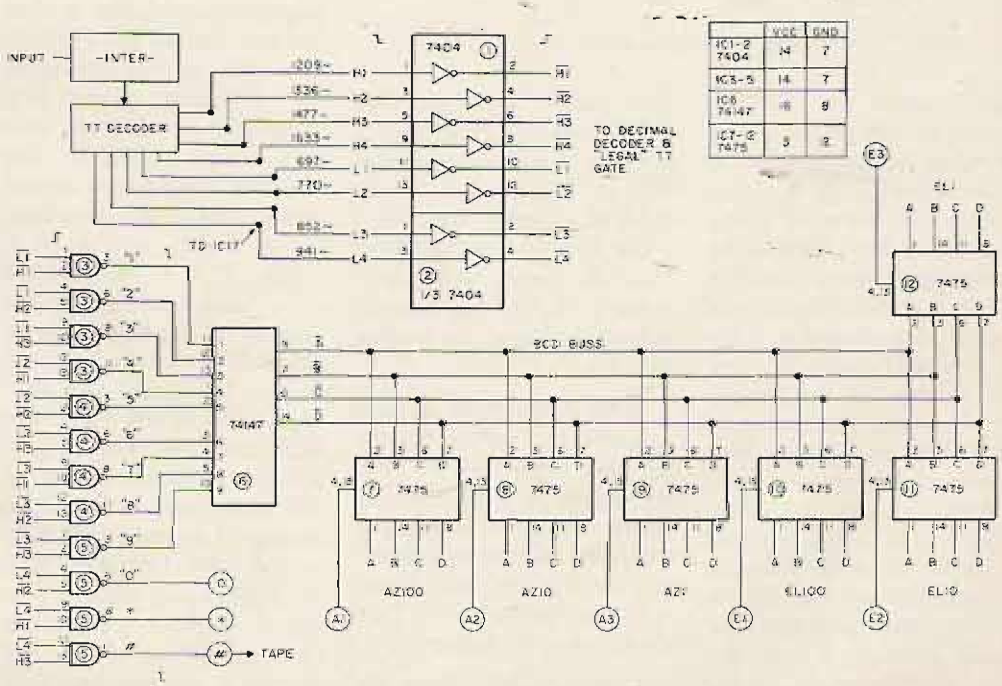
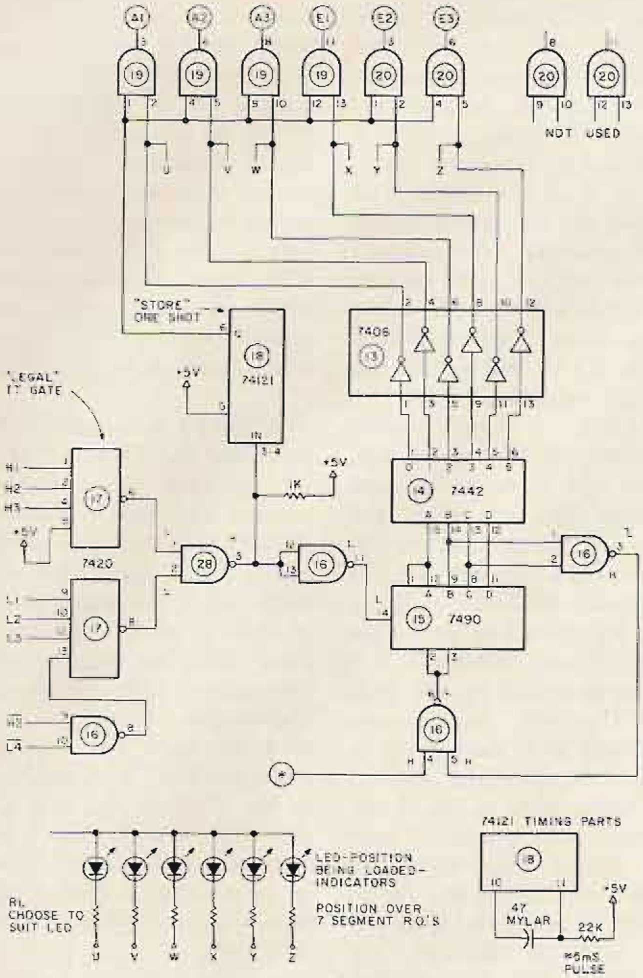


Fig. 2. Decode and store diagram.



IC #	Name	Vcc	Gnd
13	7406	14	7
14	7442	16	8
15	7490	5	10-6-7
16	7400	14	7
17	7420	14	7
18	74121	14	7
19	7408	14	7
20	7408	14	7

Fig. 3. Control unit.

pin 5 wired to +5 V dc instead of H4 where it was, we delete the decoding of the entire H4 group (A, B, C, and D letters on some TT pads). This allows their detection by NAND gates wired like IC3, 4, and 5, without causing any counter or latch action. After all, you never want to enter this as data to the number latch anyway, but you may want them for tape or local control signals (future use!).

Also, in the low tone group inputs, a gate is added to the L4 input. By doing so, we set up the low tone half of IC17 to only recognize 0 of the L4 group (*, 0, #, D) as a valid number to be loaded into a latch when received. This occurs when the tone pair for zero (H2 and L4) are inverted in IC2 and appear as $\overline{H2}$ at IC16-9 and $\overline{L4}$ at IC16-10 as highs. This causes a low at IC16-8 and a high at IC17-6, and with both outputs of IC17 high, a valid number is "seen" for loading the latch.

Both * and # are L4 tone numbers, but neither has the H2 high tone, so they both are ignored by IC17. Thus, by wiring the IC17 high group correctly, and adding a simple gate to the low tone group, only the numbers 0 to 9 are used to load the latches.

I believe that covers the line by line, so let's examine the 163045 example given earlier, as it progresses through the digital hardware. The 1, of course, was decoded and stored in latch IC7. Then the 6 is put in, decoded, and stored in latch IC8, the 3 is put in latch IC9, the 0 in latch IC10, the 4 in latch IC11, and the 5 in latch IC12. Going to Fig. 4, you can see by the "numbers" shown in ICs 7 through 12 just what is stored where.

If the relay power is in the automatic rotate mode of Fig. 7, IC28, then the antennas will begin to move the instant the first digit is received, decoded, and latched, if it differs from the antenna position in that digit. Fig. 4 also shows the output relay control lines of the 7485s under "other 7485 connections." The 7485 has cascade inputs available at pins 2, 3, and 4, and these pins are used. The overall output of the 7485s seen by IC27, pins 1, 3, and 5 for azimuth, and 9, 11, and 13 for elevation, can be in only one state at a time – either A > B, A = B, or A < B. These overall outputs are in whatever state the 100 IC21 commands until A = B in that IC. IC22 then takes over, followed by IC23 (azimuth example). For instance, if we started the beams mechanically at 000 degrees (north) for azimuth, and 000 degrees elevation, the following would take place after the data was all in and stored (163045), and then the relay power applied with the "auto-rotate" button: IC21 says A > B, output A > B, and the CW relay pulls in to increase degrees azimuth on beams (increase B data) until 100 degrees is reached and IC21 says A = B in this digit. Then IC22 takes over with its own A > B, output A > B, and the CW relay stays in until 160 degrees is reached and IC22 says A = B in that digit. Then IC23 takes over with its own A > B, output A > B, the CW relay stays in until 163 degrees is reached and IC23 says A = B, the azimuth stop LED comes on, and the CW relay drops out.

The same thing happens independently in IC24, IC25, and IC26 for elevation. In our example, IC24 immediately sees an A = B (0 = 0) and transfers control to IC25 until 40 degrees elevation is reached and an A = B condition is reached in IC25. Then IC26 takes over with an A > B command until 45 degrees is reached when the up relay (energized until now and driving the beams upward) drops out and the elevation stop LED light comes on. The system is then at rest, and remains so until further data streams are received from the tape-timer or by manual entry.

While on the subject of the relays, Fig. 7 was added so that data commands could be entered when in the hold (no relay power) mode without actually turning on the antennas. It is a handy override, because if you want to stop the antennas at any time, you can do so with a push on the "hold" button. Hitting the "auto-rotate" button returns control to the latches of the TT controller system. This also means that you can cancel a taped command by overriding it with the hold button, enter a manual command, and return to automatic by pushing the auto-rotate button.

I included a panel layout (Fig. 6) to give you a starting point. Laid out this way, it is functional and not confusing. I used orange plexiglas over the BEAM 7 segment displays, and ruby red in front of the DATA entered readouts to avoid mix-ups. The hold LED is red, the auto-rotate green, and (in my case) the CW, CCW, Dn, and Up LEDs are all yellow. The az and el stop LEDs are, of course, red. The panel is gray, with black TT keys with white lettering, so it makes a nice addition to my Drake equipment. In fact, I used a Drake speaker cabinet (MS-4) and had tons of room left over, both on the panel and in the box.

This system replaces the earlier Autotrak* at my QTH, but to each his own. If you have the RTTY gear, the earlier system was okay, but required a lot of hardware to get from Baudot to BCD and the like just to have the advantage of pre-stored tape (paper tape in that case). The advantages of this newer system override any drawbacks of not having a hard copy printout, and careful labeling of the cassettes should eliminate any problems.

With the average OSCAR antenna setup, having tapes for every 5 degrees of longitude seems to be more than adequate, amounting to some 15 to 20 pass combinations, worst case. All this fits nicely on 2 cassettes in my non-real time system. You can get sneaky as you record by using a pass "code" information right on the tapes. Let me show you by example. Since azimuth information is the closest to longitude or surface information, I chose to use those readouts to locate a point on a tape containing some 4 to 6 passes. When recording, ahead of each sequence of pass information enter the following "code":

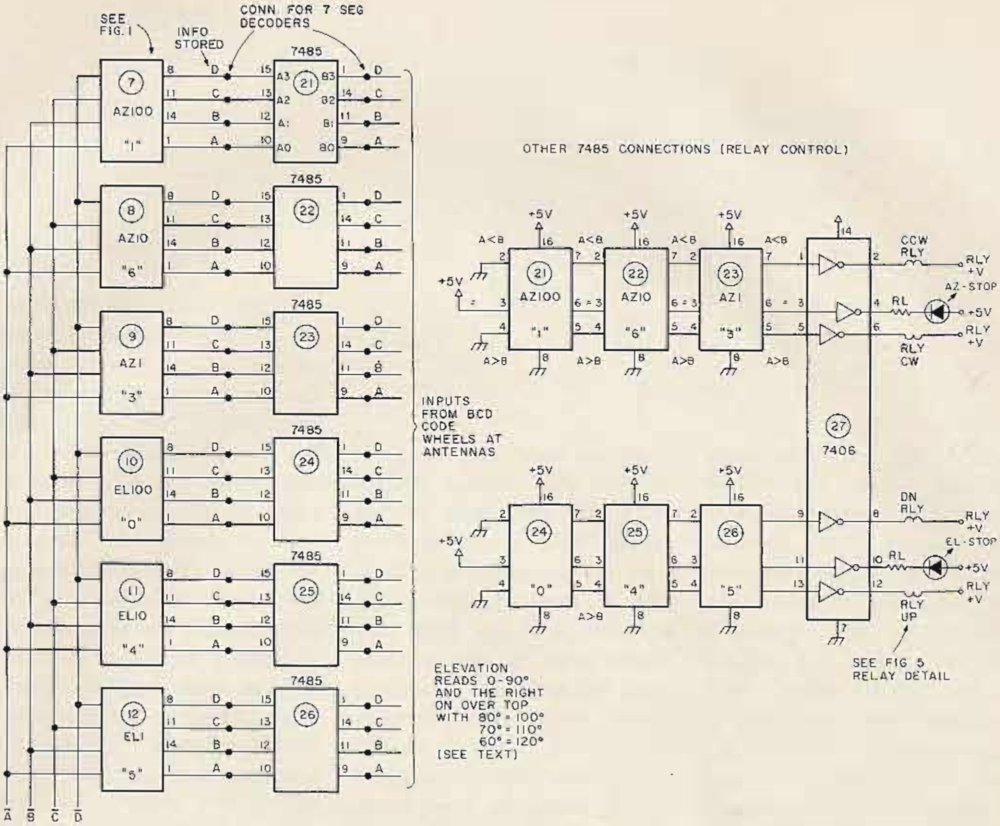


Fig. 4. TT controller.

Push *, then whichever of the A through D keys you want to use for this function, then the longitude of the equator crossing for that pass you are about to enter next as a 3 digit number, then 0, then 0, then 0, then the A to D key you chose above again, then wait 10 seconds, then push the * key to clear the register (counter), then wait 5 seconds, then begin entering your data for the pass as shown before.

By opening the antenna circuit with the hold key, and defeating the tape stop command by closing the defeat switch in Fig. 7, you can go down about 30 minutes ahead of the pass. While letting the gear warm up (*please!*), you begin playing the proper tape back. Example: An overhead pass for me is 72 degrees crossing at the equator, so I take my 52 degree to 77 degree tape (I go in 5 degree increments on either side of an overhead pass here) and put it on the recorder. The pass I am looking for is the fifth one on this tape. When the tape begins playing back, the first information I get is a *, to clear the counter to position one regardless of where it came on when power was applied. Then the D tone is in my case decoded and wired into an audio monitor (NE555s and a speaker) to form a 1000 Hz warning tone that in this case means that longitude information is about to be presented on the data readouts. Next, the tape decodes and displays the digits 052 000 on the data readouts, telling me that the information that follows is for a pass having a 52 degree equator crossing. The audio warning is repeated. Then the decoded * clears the data counter to the 1st position (it should be there due to a detected 6th digit position after the last 0 was entered — but why risk it?). The information that follows is pass data, and the # does not shut off the tape, since you defeated that circuit. When the tape reaches the next "code" information, the above is repeated (in my case: clear, tone, 057000, tone, clear), so that you stop the tape manually right after the equator crossing you want (072000). You would then push the defeat switch to normal and the auto-rotate button, and set up your timer to control tape starts. For the exact time of the crossing, I

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*"Introducing Autotrak!", W9CGI, *73*, July, 1977.

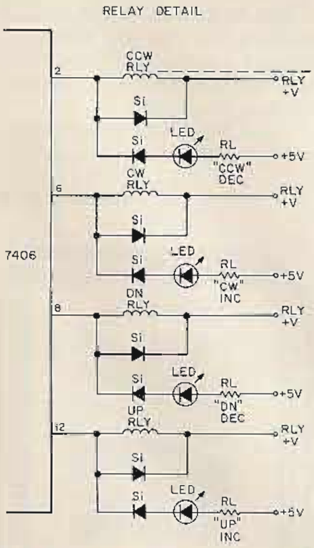


Fig. 5. Si = silicon diode, 50 V, 100 mA. All RL chosen for LED used.

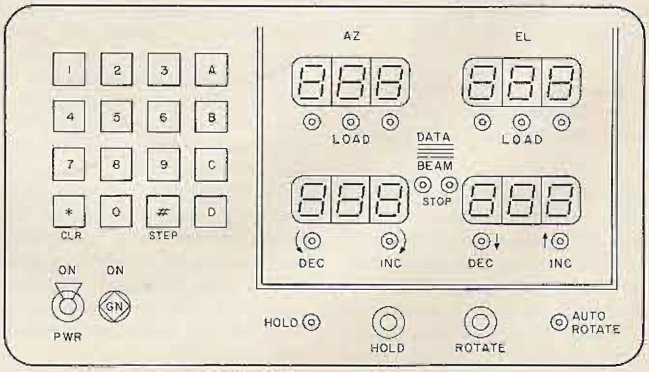


Fig. 6.

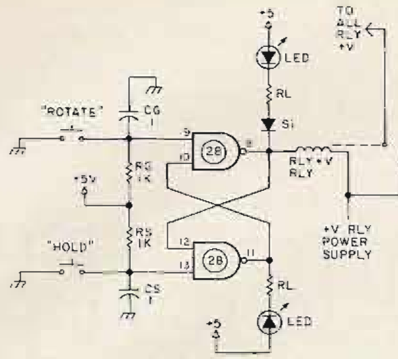


Fig. 7(a).

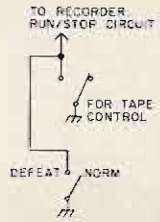


Fig. 7(b).

enter the approximate azimuth from the Satellabe™, and an elevation of 000 degrees. Two reasons: One, I can start all runs with the published crossing time, even though the satellite is out of range — it is not always out of range! Two, this gets the antennas into approximate position for your AOS position anyway, so you don't have to wait on them coming around. I use an automatic call sender that keys off the same high to low transition from the timer that starts the tape, so I listen for myself even before normal AOS and then turn off the sender. This all makes every pass a very repeatable situation — they all start at the equator, and the first tape information is for equator plus 30 seconds. I run the beams around to the equator start point with a manual entry from the keyboard, just before doing the timer setup. This way, I have *one* manual function to do concerning the antennas when the satellite crosses the equator — pushing the "go" button on the timer to start the first thirty second period. Thirty seconds later, the timer sends a pulse to the controller — tape start — and the T + 30 data is read in and the beams run to that position. At 40 degrees latitude, this is always the same as what you manually loaded, so you could include it on the tape and let the tape read in the initial condition by turning the normal defeat switch from defeat to normal (*after* the longitude figures you want are read and clear themselves, but *before* the first data coordinates are picked up off the tape — we left about 5 seconds). This way, the decoder picks up the first tape stop #, and would wait there until the timer T + 30 pulse — putting you right back in sync.

That sums up the theory and the how-to-tape information part. It works great, and allows me to concentrate on the receiver instead of growing a third hand for the antennas. No doubt you will find your own uses and probably some variations, and that's good — write them up! I have no beef with anyone who starts with my idea and improves on it — chances are I'll add it to my system, too.

Please include an SASE if you need help. The letter load has increased with the increase in my "articles published" count, but same day answers are usually still possible if you make your questions clear and concise. Adaptations and modifications by you take a while longer, since I like to try what you did on the hardware here and see what really happens. ■

LETTERS

from page 16

of '76. In January '77, I flunked my first time on the General, but then went in February and passed it. Then 3 months later (May), I passed my Advanced; 2 weeks later in June, and during the last week of school, with all the final exams, yea, I walked away with the Extra on my first try. Same day I sent away for my 1 x 2 call. Youngest ham to get (or have) a 1 x 2 call?

I guess if you show this letter to some of your local CBers, it'll get 'em off their tails and show 'em how easy it is.

How did I do it? Naw, I'm not a "child prodigy" and my marks in school aren't too good. It took a lot of time and energy and staying away from all the wild women. And if you wanna speak to me, I'll probably be on the bottom of 20 meters CW (or where I am now, relegated to 2 meter FM with a borrowed HT because of antenna problems). And I'll talk to anyone.

Howie Goldstein WB2IWX
Brooklyn NY

PLUGGED IN

Right on, Mark Clark WB4CSK, "Letters," September issue of *73!*

Through studying and a conscientious effort, I earned my license (Advanced). Because of that, I have a certain sense of accomplishment and pride in being part of the fraternity of ham radio. Also, because of that, I would not knowingly do anything to jeopardize its existence.

For those who subscribe to the quantity theorem for getting newcomers into ham radio, I propose that you listen to Ch. 19 CB for a couple of days, then ask yourself, "Do I want to listen to that on the ham bands?" There are too many appliance operators in our ranks as it is now.

For those existing amateurs who believe in easier upgrade privileges, take another look. Maybe you are one of those appliance operators.

Richard L. Miller WA4OET
Ft. Belvoir VA

UPDATE

We were indeed happy to see your three-page coverage of TEN-TEC modifications to the Argonaut in the August, 1977, issue of *73*. The only problem that we see is that it was not pointed out anywhere in the article that the modifications described were performed on our old Model 505 Argonaut, which was replaced in June of 1975 with the Model 509. The Model 509 indeed incorporates the modifications shown in the article with the exception of the disconnect socket on the speaker. The reverse polarity protection and the drive control on the front panel are incorporated in the Model 509 and always have been. I would appreciate it if you would run this information in your letters column so that owners of the Model 509 do not feel that modifications are desired or necessary with their units.

The only statement in the article that we take exception to is the one where it is intimated that TEN-TEC had a prepackaged kit of parts for repairs to units that were connected up reverse polarity. I know of no such prepackaged kit, but the usual damage was to the switching transistors on the control board, and possibly the large electrolytic capacitor across the dc line.

TEN-TEC, Inc.
Daniel J. Tomcik
Executive Vice-President
Sevierville TN

GUD QSO, OM

Most hams have listened to something like this: "We are a doctor here and have a patient due in our office in ten minutes, so we will have to say 73 for now," etc.

I have been a ham for over 25 years and have heard "we" used to denote a

Continued on page 75

Michael J. Di Julio WB2BWJ
97 Woodside Road
Maplewood NJ 07040

Visual OSCAR Finder

-- nice side effects!

A very unique OSCAR-locating aid appeared in *QST* in May, 1974, described by WØCY. It consisted of a rotating globe with several LEDs around it, sequentially turning on and off to simulate the position of OSCAR. The project used several gearing arrangements, entirely too many LEDs, and a 115-position rotary switch to accomplish its task. I felt this to be too costly and mechanically complicated, and I was prompted to simplify this otherwise excellent article.

Completed OSCAR finder.

The only mechanical device in my locator is a 24-hour clock movement, obtained from a Master Crafters 24-hour world clock. This clock was popular with hams in the 1960s and can be found at hamfest flea markets. Mine had been retired years ago, when I built a digital station clock. The movement and all hands are removed from the clock, and the back cover is removed from the movement to expose the gears. For this project, it is necessary to reverse the rotation of the clock. The motor will go in any direction in which it is started, but there is a ratchet underneath the only yellow nylon gear in the movement that forces the clock to turn clockwise. This ratchet is removed by drilling out the rivet holding it. Now the clock will turn in any direction in which it is started.

The globe used was bought in a five-and-ten-cent store, and it is made by the Ohio Art Co. It was originally intended to be a bank, so the base on it must be removed. This is easily accomplished by pulling the base straight out from the globe. Next, a ¼" hole is drilled in the south pole, and the outer ring, salvaged from the hour hand, is soldered to the globe at the south pole, after removing the paint from the globe and the ring at the point of attachment. The globe will now fit snugly on the outer shaft of the movement, as the hour hand did. On the globe, a 2500-mile-radius circle, drawn to scale, is centered around your QTH and drawn with a marking pen. This indicates the area within

Parts List

ICs
1 7493 Lafayette 32P06919V
1 74154 Radio Shack 276-1834
3 NE555 Radio Shack 276-1723

Resistors
3 10k ¼ Watt 10% all Radio Shack 271-1300
2 1k ¼ Watt 10%
1 2.2k ¼ Watt 10%
1 1 meg ¼ Watt 10%
1 68k ¼ Watt 10%
1 360 ¼ Watt 10%
1 1k ½ Watt 10% Radio Shack 271-000
1 10k 10-turn trimmer pot R1

Capacitors
2 0.01 uF disc ceramic: one at 200 V Radio Shack 272-131 and one at 25 V Radio Shack 272-131
1 3200 uF 6 V electrolytic Radio Shack 272-1021
1 3200 uF 10 V electrolytic (can be smaller — see text) Radio Shack 272-1021 C1
1 1 uF 5 V electrolytic Radio Shack 272-1406
1 10 uF 10 V electrolytic Radio Shack 272-1002
1 0.05 25 V disc ceramic Radio Shack 272-134

Other Semiconductors
16 LEDs miniature or subminiature Radio Shack 276-042
4 1N4001 Radio Shack 276-1101
1 2N3906 Radio Shack 276-2021
1 5.1 V 1 Watt zener 1N4733A Lafayette 32P08691V

Miscellaneous
1 8 Ohm miniature speaker Lafayette 99P60360V
1 SPST switch Radio Shack 275-612
1 normally-open push-button Radio Shack 275-1547
1 117 V to 6.3 V transformer 300 mA Radio Shack 273-1384

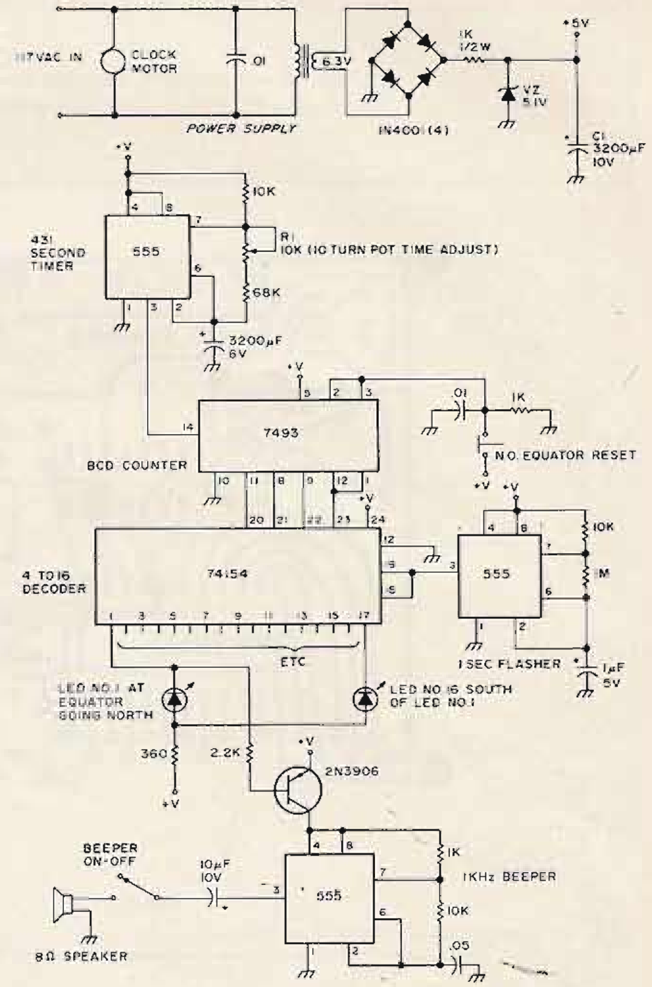


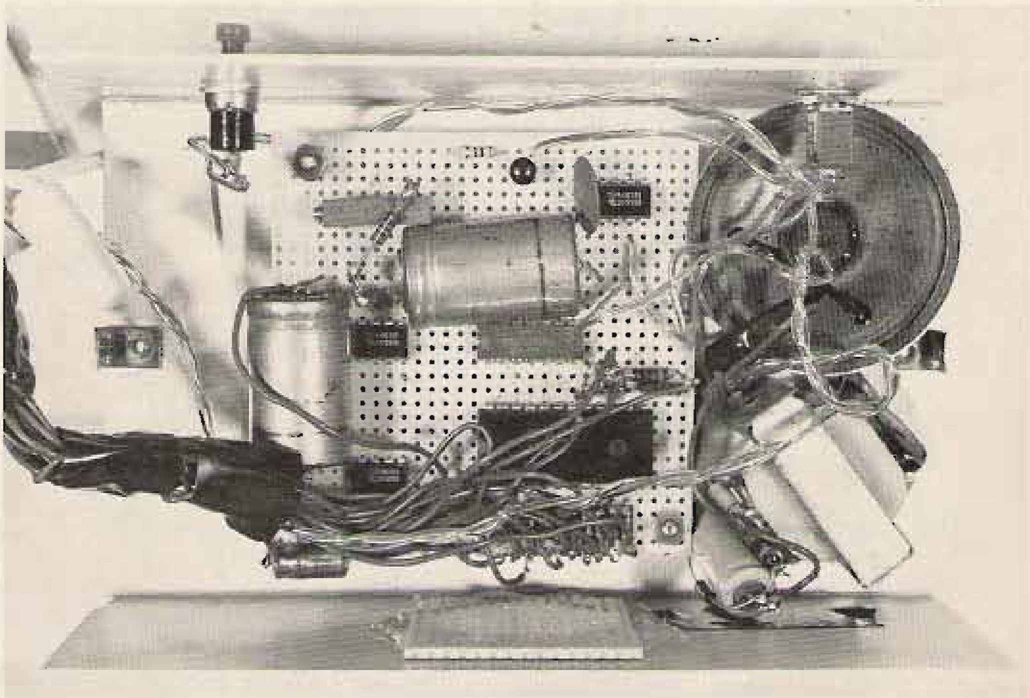
Fig. 1.

which the satellite may be worked.

The 16 LEDs are soldered to a piece of bus wire shaped in a 5" diameter ring, to simulate the satellite's orbit. Separate wires are run from the cathodes to the appropriate pin on the 74154 chip. Small pieces of plastic tubing are used between the LEDs, covering the bus wire and connecting wires. The LEDs are spaced so that one is placed at each of the poles and at the equator on both sides, and three are evenly spaced between each of these. The ring is held to the cabinet with a cable clamp and adjusted to an angle of 102 degrees for the OSCAR 6 orbit.

A 555 timer chip is connected for astable operation with a period of 431 seconds (114.9946 min./16). The exact time is set by adjusting the 10k 10-turn pot, which is in series with the 68k resistor. The output from this clock goes to the input of a 7493 BCD counter. This device gives the appropriate 4-bit BCD code for the number of transitions that occur on pin 14. After reaching 16 counts, the counter resets to the 0000 state. There is also provision for externally resetting the counter for setting the device up initially.

The four lines from the 7493 drive the inputs of a 74154 4-to-16-line decoder. This device has four lines in and sixteen lines out. All outputs except one are normally high. The output that



Suggested parts placement for OSCAR finder

PC boards are available from the author for $6.00 plus $1.00 for postage and handling.

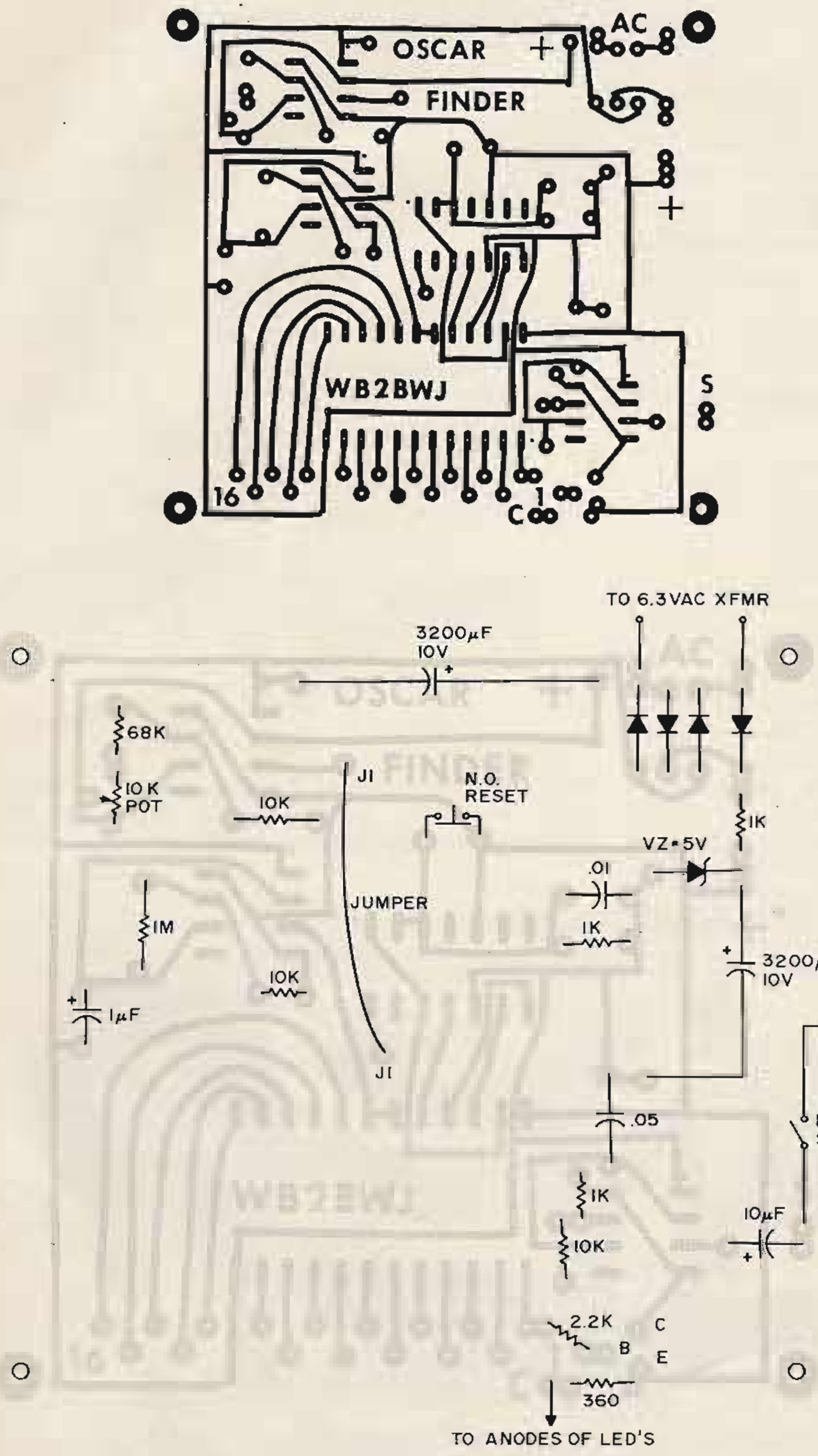


Fig. 2. PC board.

goes low is the one whose BCD code has been addressed at the input. For example, if the four lines in are 1010, the tenth output goes low (pin 11). These output lines directly drive the appropriate LEDs through a current-limiting resistor.

LED number one is placed at the equator going north, and the other LEDs follow it sequentially. To make the LEDs more visible, they are made to blink on and off. This is done by driving the strobe inputs of the 74154 with another 555 astable set at about 1 Hz. When LED number one comes on, it turns the 2N3906 transistor on, which, in turn, activates a third 555 astable which oscillates at about 1 kHz. This chip drives a small 8-Ohm speaker, when the LED at the equator is on, with a beeping tone. This alerts the operator that the satellite is entering the Northern Hemisphere. A switch is provided to turn the beeper off, if it becomes annoying.

The power supply is conventional and adequate, and it should be noted that one does not really need a 3200 uF filter capacitor. I used it because I had an extra one in the junk box. Use one large enough to give a clean tone, free from hum, in the loudspeaker.

I found the accuracy of the 555 timer used as a clock entirely adequate. However, greater accuracy can be obtained by using a smaller capacitor of the tantalum or polycarbonate variety and using a larger value precision resistor. This might buy some thermal accuracy, but, within the box, we find a thermal equilibrium, due to the heat produced by the clock motor, transformer, and chips. As long as the shack's temperature doesn't change too drastically, the clock averages quite well. For the real perfectionist, I suggest a crystal oscillator with an appropriate divider chain.

To align the unit, the 10k pot must first be set so that the period of the clock astable is 431 seconds. This is a somewhat lengthy process, but it must be done as accurately as possible to insure correct tracking of the satellite. Allow the unit to thermally stabilize itself before finalizing the adjustment.

To set the satellite's position, the following should be done. Use an OSCAR locator or similar device to determine an equator crossing on the day that you are setting the OSCAR finder. Determine the local time of the crossing and the degrees of longitude. Remove the globe, and observe if the second-hand shaft is turning counterclockwise. If it isn't, take a pair of needle-nose pliers and force the shaft to turn counterclockwise. Replace the globe, and set the globe by turning the time-setting knob until the number one LED is at the correct crossing point on the equator. This globe is marked at every 15 degrees of longitude, so it is easy to estimate the correct point. Press the zero-degree start button, and wait until the beeping stops. At this instant, press the reset button again. This will insure that a complete cycle is started. Readjust the globe so that the LED lines up with the crossing point. One must use good timing to insure that this process can be completed by the time that the pass is to occur.

Periodically check the accuracy of the OSCAR finder with an OSCAR locator or similar device, and recalibrate it by turning the globe, if necessary.

Whenever an LED appears within the circle on the globe, OSCAR is within range. Although designed for OSCAR 6, the OSCAR finder can be used with any satellite by adjusting three things: angle of orbit, period of orbit, and radius of circle on globe, which is related to the altitude of orbit, which is related to the period. Finally, any 24-hour movement or globe that is available can be used, and most of the other parts are readily available, as listed in the parts list, from local stores as well as from the mail-order houses. Good luck on OSCAR hunting! ■

FCC

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the matter of

Dismissal of six Petitions for Rulemaking in the Amateur Radio Service

RM-1455, RM-1536, RM-1703, RM-2080, RM-2797, RM-2907

ORDER
Adopted: August 24, 1977
Released: August 26, 1977

1. The Commission, by its Chief, Safety and Special Radio Services Bureau, acting under delegated authority, has under consideration the six petitions for rulemaking listed above, each of which was submitted in accordance with the Administrative Procedure Act, 5 USC 553(e), and Section 1.401 of the Commission's Rules. The petitions we are considering each request certain changes in the Commission's rules or policies governing the assignment of station callsigns in the Amateur Radio Service. Petitioners' specific requests are as follows:

a. *RM-1455*. Mr. Wayne Green requests amendment of Section 97.53 of the Rules to permit a licensee moving from one callsign area to another to obtain a "counterpart" callsign upon modification of his station license. (A "counterpart" callsign is a callsign with a suffix identical to the suffix of a callsign held in another callsign area.)

b. *RM-1536*. The American Radio Relay League, Incorporated (ARRL), also requests that provisions be made in the rules for the issuance of "counterpart" callsigns.

c. *RM-1703*. Mr. Thomas V. Appler asks for revision of Section 97.51 of the Rules to permit the assignment of a specific unassigned callsign to the widow, son, or daughter of a deceased former holder of that specific callsign.

d. *RM-2080*. Mr. Chester L. Smith, Mr. Joseph Santangelo, Mr. Charles A. Walbridge, and Mr. Donald A. Freeland want the Commission to amend its rules to permit the issuance of callsigns containing a special indicator designating the operator license classification of the station licensee.

e. *RM-2797*. Mr. Cliff Ryan requests that the Commission issue station callsigns with a special designator to indicate the state in which the station is located.

f. *RM-2907*. Mr. Robert E. Babb requests the rules be amended to permit the issuance of so-called "one letter" callsigns in the Amateur Service. (A "one letter" callsign is a callsign consisting of one letter, followed by one number, followed by one letter.)

2. We have fully and carefully analyzed petitioners' requests and have concluded that petitioners' proposals have been and are being considered in connection with other rulemaking proceedings. With respect to each of these petitions, we note that in Docket 21135, Notice of Proposed Rulemaking released March 11, 1977, 42 Fed. Reg. 15438 (1977), the Commission proposed to simplify its amateur station callsign regulations by replacing the existing complex rules with a very simple general rule stating that all callsigns shall be assigned by the Commission on a systematic basis. The Commission's proposals in Docket 21135 would, if adopted, preclude granting any of the petitions under consideration, each of which requests the issuance of special format, non-systematically assigned callsigns. In connection with RM-1703, we would also note that the Commission explicitly considered the question of "in memoriam" callsigns in its First Report and Order in Docket 20092, FCC 76-348, released April 22, 1976. In that Report and Order, the Commission eliminated the availability of "in memoriam" callsigns. (Such callsigns had previously been available to qualified amateur clubs and organizations.) Finally, we would observe that the suggestions contained in RM-2080 were considered, and rejected, in Docket 15928, Report and Order adopted August 24, 1967, FCC 67-978.

3. From the foregoing, it is clear that the factors on which petitioners' proposals are based have been and are being fully considered by the Commission in connection with other rulemaking proceedings. Further, petitioners have not advanced any new or novel arguments warranting additional consideration.

4. Accordingly, the Commission ORDERS, by its Chief, Safety and Special Radio Services Bureau, acting under authority delegated to him by Section 0.331 of the Commission's Rules, that RM-1455, RM-1536, RM-1703, RM-2080, RM-2797, and RM-2907 ARE DISMISSED.

Charles A. Higginbotham
Chief, Safety and Special
Radio Services Bureau

Oscar Orbits

Oscar 6 Orbital Information				Oscar 7 Orbital Information			
Orbit	Date (Nov)	Time (GMT)	Longitude of Eq. Crossing °W	Orbit	Date (Nov)	Time (GMT)	Longitude of Eq. Crossing °W
NA 23071 BTN	1	0147:46	91.2	13547 A	1	0100:39	70.0
NA 23083 BTN	2	0047:42	76.2	13560 BX	2	0154:56	83.6
N 23096	3	0142:38	89.9	13572 A	3	0054:17	68.5
NA 23108 BTN	4	0042:34	74.9	13585 B	4	0148:34	82.1
N 23121	5	0137:29	88.7	13597 A	5	0047:55	66.9
NA 23133 BTN	6	0037:25	73.7	13610 B	6	0142:12	80.5
N 23146	7	0132:21	87.5	13622 A	7	0041:33	65.3
NA 23158 BTN	8	0032:17	72.5	13635 B	8	0135:50	78.9
NA 23171 BTN	9	0127:12	86.2	13647 AX	9	0035:10	63.8
N 23183	10	0027:08	71.2	13660 B	10	0129:28	77.3
NA 23196 BTN	11	0122:04	85.0	13672 A	11	0028:48	62.2
N 23208	12	0022:00	70.0	13685 B	12	0123:05	75.8
NA 23221 BTN	13	0116:56	83.7	13697 A	13	0022:26	60.6
N 23233	14	0016:51	68.7	13710 BQ	14	0116:43	74.2
NA 23246 BTN	15	0111:47	82.5	13722 A	15	0016:04	59.1
NA 23258 BTN	16	0011:43	67.5	13735 BX	16	0110:21	72.6
N 23271	17	0106:39	81.2	13747 A	17	0009:41	57.5
NA 23283 BTN	18	0006:35	66.2	13760 B	18	0103:59	71.1
N 23296	19	0101:30	80.0	13772 A	19	0003:19	55.9
NA 23308 BTN	20	0001:26	65.0	13785 B	20	0057:36	69.5
N 23321	21	0056:22	78.7	13798 A	21	0151:54	83.1
NA 23334 BTN	22	0151:18	92.5	13810 B	22	0051:14	67.9
NA 23346 BTN	23	0051:13	77.5	13823 AX	23	0145:31	81.5
N 23359	24	0146:09	91.3	13835 B	24	0044:52	66.4
NA 23371 BTN	25	0046:05	76.3	13848 A	25	0139:09	79.9
N 23384	26	0141:01	90.0	13860 B	26	0038:30	64.8
NA 23396 BTN	27	0040:57	75.0	13873 A	27	0132:47	78.4
N 23409	28	0135:52	88.8	13885 BQ	28	0032:07	63.2
NA 23421 BTN	29	0035:48	73.8	13898 A	29	0126:25	76.8
NA 28434 BTN	30	0130:44	87.5	13910 BX	30	0025:45	61.7

The listed data tells you the time and place OSCAR crosses the equator in an ascending orbit for the first time each day. To calculate successive orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the first crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world, it will descend over you. To find the equatorial descending longitude, subtract 166 degrees from the ascending longitude. To find the time it passes the north pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR when it is within 45 degrees of you. The easiest way to do this is to take a globe and draw a circle with a radius of 2480 miles (4000 kilometers) from the home QTH. If it passes right overhead, you should be able to hear it for about 24 minutes total. OSCAR will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15 degrees from you, add another minute; at 30 degrees, three minutes; at 45 degrees, ten minutes.

OSCAR 6: Input 145.90-146.00 MHz; Output 29.45-29.55 MHz; Telemetry beacon at 29.45 MHz.
OSCAR 7 Mode A: Input 145.85-145.95 MHz; Output 29.40-29.50 MHz.
Mode B: Input 432.125-432.175 MHz; Output 145.925-145.975 MHz.

Orbits designated "X" are closed to general use. "ED" are for educational use. "BTN" orbits contain news bulletins. "Q" orbits have a ten Watt erp limit. "L" indicates link orbit. "N" or "S" indicates that Oscar 6 is available *only* on northbound or southbound passes. Satellites are not available to users on "NA" days.

David J. Brown W9CGI
RR 5, Box 39
Noblesville IN 46060

Cheap Ears For OSCAR

-- an effective satellite antenna

Have you been thinking about trying to work through OSCAR 6 or OSCAR 7? How about even just listening to it? You can perform a valuable service to amateur radio, especially now, if all you do is listen! The OSCAR beacon frequencies on the downlink provide AMSAT with much valuable data on the satellite's health and well-being, and, at the time of this writing, we have an ailing bird up there. Even though by the time you read this the problem may be cured, it has happened before, and we all can help ourselves and AMSAT by listening to and forwarding the telemetry information to them.

This brings us to the need for a 10 meter antenna for receiving the downlink activities. The antenna described in this article will do a fine job for you for a minimum of cash outlay, and it has a few distinctive advantages over even the full-sized beam placed outdoors. First, you do all the aiming and rotating electrically and without rotors. Second, it has the advantage of being indoors in the attic. The second point is nice because there will be no weather wear and tear. It's also nice if you live in a neighborhood that objects to large outdoor antennas because of their appearance and their potential for causing TVI, RFI, etc.

This antenna is only a group of dipoles. Many stations use only a simple dipole or folded dipole for OSCAR, and that is where I began. Once I tried that, I began to wonder what I could do to rotate it to allow for azimuth heading changes (a rotor?) and how to account for polarization shifts as OSCAR tumbles. You may find, as I did, that the polarization makes the mechanical rotation a physical beast, if not impossible to control.

About the time I discovered that, I had been reading an article on electronically steered antennas for the military. Between their thoughts for the initial idea and the physical limitations of my attic, I came up with the following indoor antenna that beats everything I've ever tried outdoors, including a 3 element yagi. I'm sure in the latter case it was a matter of unwieldy steering and not lack of gain.

The antenna is a combination of 4 dipoles, 2 phasing lines, and 3 relays – nothing more. The main reason it works so well is the almost perfect repeatability of the OSCAR pass for any given longitude equator crossing.

Two of the dipoles lie horizontal, or parallel to the attic floor, are oriented east and west at the ends, and are ½ wavelength apart. The other two dipoles are a bit harder to explain. Half of each of them looks like a continuation of the phasing harness running north and south, respectively, on each end where the phasing lines join the first pair of dipoles. The other half of the second pair of dipoles extends straight up, or vertical to the phasing lines/dipole connecting points, or as close to vertical as your roof allows. Mine slope inward toward the center feedpoint (and each other) at an angle of 30 degrees off vertical. Looking at half of the antenna from the east end of my attic, so you are looking west with your eye at floor level, gives you Fig. 1. You are looking at the south half of the array, and the backward "L" is one dipole. The box represents relay 2, and the circle is the other half of the south end pair of dipoles. It extends straight out of the page, half toward you, and half out of the back of the page away from you. Fig. 2 is the view of the north half of the array, viewed from the same place (east of the antenna, looking west, at floor level). The dotted lines in both figures are the vertical portion of the dipoles, which I had to slant toward each other because of my roofline.

Fig. 3 describes how the relays are wired to the antenna to allow changes in pattern (or, in other words, steering). To describe which antenna goes where electrically on the relays, I use the following terminology. The dipoles that lie horizontal and parallel to the floor I call north A and south A. The dipoles that have half of themselves vertical or perpendicular to the floor (or slanted as your roof allows) are north B and south B.

I haven't gone into just what pattern results from what, but I can tell you what the relays are doing as far as the antenna feed. Relay 1 lets

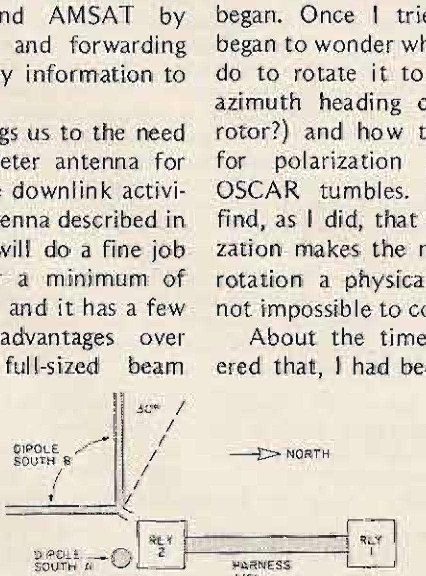


Fig. 1. Looking into the page, you are looking west.

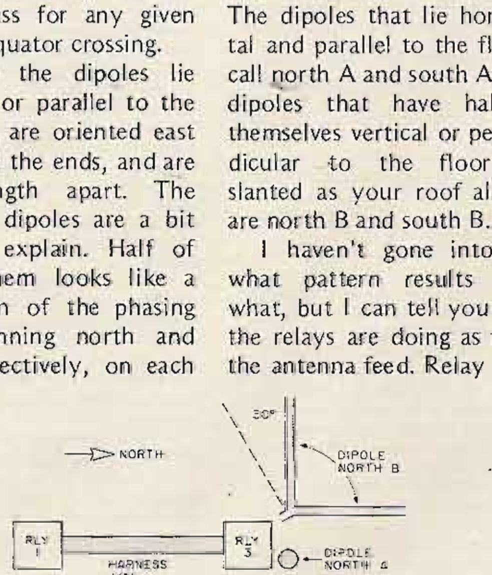


Fig. 2. Looking into the page, you are looking west.

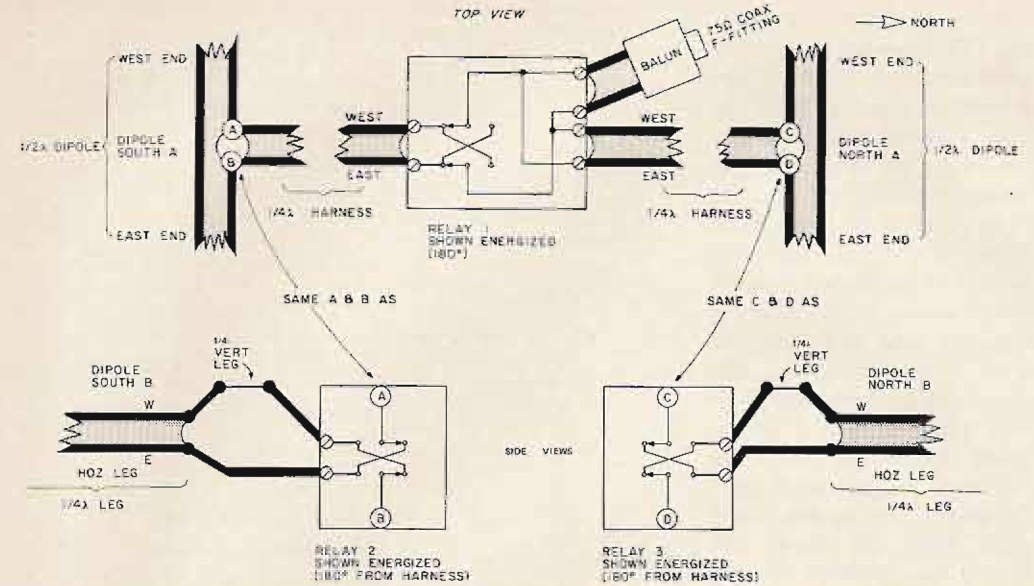


Fig. 3. Allow for strip and tin on all ends of twinlead, i.e., short at outer ends of dipoles, connections to relays, etc.

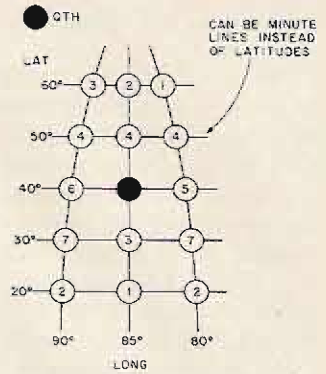


Fig. 4.

you feed the north end pair 180 degrees out of phase from the south end. Relay 2 lets you change the feed phase 180 degrees on south B. Relay 3 lets you change the feed phase 180 degrees on north B. You antenna engineers can drop me a line on just what antenna patterns are supposed to be occurring. I seem to be getting more than the circle of coverage would indicate I should, allowing complete passes of beacon coverage. The beacon is the best indicator, since it does not rely on the other station properly aiming his 2 meter antenna.

Speaking of the circle of coverage you have all seen on maps used for OSCAR tracking, mine now has a slightly different look. It is a grid with small circles at the intersections as shown in part in Fig. 4. The numbers represent the best antenna switch position for the satellite when it is over that map point. After a few runs, and if you determine where the satellite should be by using a Satellabe or equal device, you can find the satellite and form your own chart. You can immediately see there are more than three numbers, representing more than the three individual relays. Fig. 5 shows how I have mine wired to have the following relay combinations: none, 1 only, 2 only, 3 only, 1 and 2, 1 and 3, 2 and 3, and all (energized).

Since I had automated control in mind from the beginning, I wired my relays and switch as in Fig. 6. By using a BCD output decimal display switch, you can choose any of the positions 0 to 7 for any relay combination. Once you learn what position you want and where and when, the BCD switch can become a tape input that is stepped with time during the pass of OSCAR.

I did say automated, didn't I? Well, the tape was good, but the latest adventure seems to be the greatest of all ways! By hooking a 7490 encoder to the 7445 inputs instead of the BCD switch or tape, and driving the 7490 clock input with a variable square wave from a pot controlled VCO (LM 566, etc.), you have much what the military has for a steered antenna for radar, which scans the horizontal plane for targets!

So far I have been limited by the switch speed of the relays in my system, and weather (no heat in attic) has prevented their change to a diode steering scheme. Now come spring . . . hmmm? Since the antenna never handles transmitter type power levels, diodes should be a cinch. If the ideal sampling rate can be found, the antenna will be looking where it should for a long enough time to reproduce enough segments of good audio to sound like it is not switching at all. I believe this to be a rate well above the audio frequencies I can use on the relays, limited only by the ICs (20 MHz?), the diodes, and the other components. Someday I may be able to reduce the total feedline to the attic to just that — the coaxial feedline, running rf power filtered for the switch rate down, and all the switching up.

My first idea was to tie 8 op amps to the agc line of the receiver via some gates to gate them on with the sample switch. Then I would use a voting system to return to the highest agc reading on a sample for .1 second and go back and hold for .9 seconds basis (or 1/sec sampling). If the agc were audio derived and a noise blanker was used, this may still be the best bet. At the very least, this whole thing offers some really nice possibilities. You could use "chain gang" methods of

Switch position	Relays energized
0	none
1	relay 1
2	relay 2
3	relay 3
4	relays 1 and 2
5	relays 1 and 3
6	relays 2 and 3
7	all relays

Fig. 5.

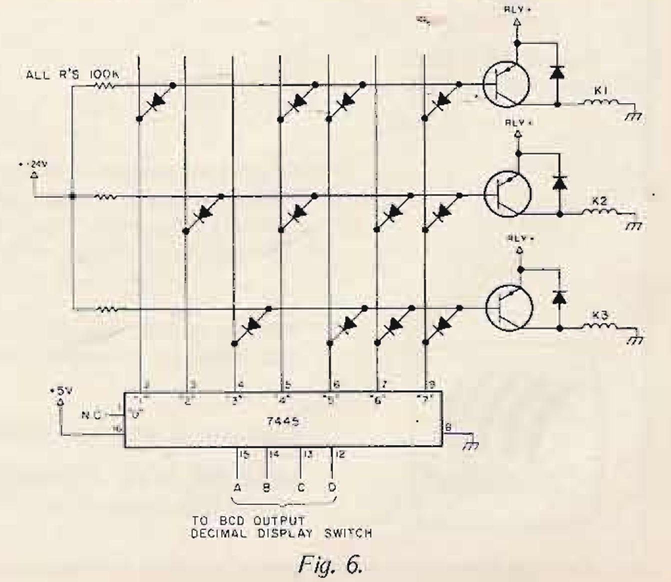


Fig. 6.

7490 connections as blocked out in Fig. 7.

The vco runs the 7490 (B) at antenna switch rate. For the 1 out of 10 sample period, 7490 (C) divides the antenna rate by 10 and only enables the gate ahead of 7490(A) during 1 of 10 periods (1/10 of a total sample to sample period). Position "8" of 7490 (A) and 7445 (A) can be used to do the settling and voting time (half enable a gate, etc.); position "9" would then switch the antenna to that best antenna position decided on in the voting process. A 9 sample period's length of time from 7490 (C) and 7445 (B) later [for example, 7445 (B) positions "0" and "2" through "9"], the process would repeat by 7445 (B) returning to "1" and gating on gate (A). I have tried to block diagram only one of several possibilities. Let your imagination be your guide, as the real intent of this article was the antenna itself.

The antenna (dipoles and harness) is made of inexpensive TV receiver type 300 Ohm twinlead. Since all four dipoles are hooked up all the time (one configuration or another), the north pair in parallel represent about a 150 Ohm feedpoint. The same holds for the south pair. By using a ¼ wavelength harness from relay 1 to relay 2 common poles and relay 1 to relay 3 common poles, the feed looking into each harness from the relay 1 end is about 300 Ohms. When the harnesses are put in parallel by relay 1, the feedline input point looks like about 150 Ohms. Even though it is a mismatch, I attached a 75 Ohm unbalanced (coax) to 300 Ohm balanced balun to this feedpoint with no adverse results. This allows me to use the 75 Ohm RG-59 coaxial cable down the 30 odd feet to the basement and the receiver. I probably make up most of the balun loss, and then some, by running a pretty hot VHF Engineering preamp ahead of the receiver.

As stated before, any ideas on how it works would really be appreciated, and any questions — just SASE. Happy OSCAR times to you. ■

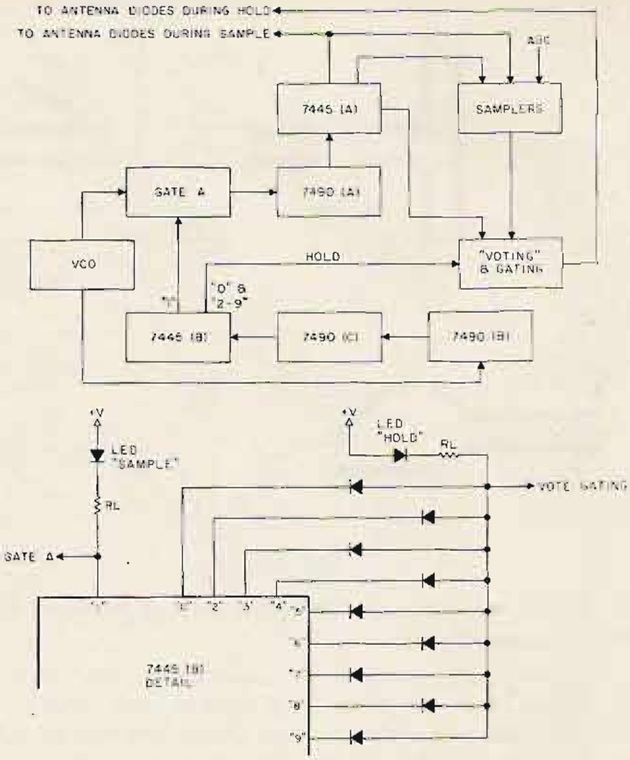


Fig. 7. Voting system.

Track OSCAR With Your SR-52

-- requires the PC 100 option

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4011 College Avenue
San Diego CA 92115

The program listed in Table 1 will do the following for you, while you QSO, have breakfast, mow the lawn, go shopping, etc.: (1) calculate the position of OSCAR 6 or 7 at the time intervals you select; (2) determine whether OSCAR is above the horizon; (3) print out the time (local or GMT) to the minute, azimuth (bearing), and elevation angle to the nearest degree only when OSCAR is above the horizon; (4) do the above for all the passes (northbound and southbound) for an entire day (longer, if desired); and, finally, (5) do this wherever you are in the world.

Item 5 is especially important for those hams operating near the equator or in the Southern Hemisphere. The usual formulas give erroneous azimuth pointing angles when OSCAR is south of the equator. Formula 3 (see below) corrects for this condition. Additional features are that your QTH is stored in registers 98 and 99 (unaffected by "clear memories"), and all OSCAR orbit data is stored in the upper data registers (15-19), so the calculator can be used for other problems without disturbing the OSCAR data.

Let's examine item 5 in more detail. Fig. 1 shows the actual OSCAR track (solid line) for the example given later where OSCAR crosses the equator northbound at 78.1° West, and the apparent track in the Southern Hemisphere (dotted line) of the track for the preceding orbit which results in the 78.1° crossing. The usual formulas (which are good only in the Northern Hemisphere) will make OSCAR apparently change course as soon as it crosses the equator. Thus, instead of continuing in a southwesterly direction after crossing the equator at 243.7° W., OSCAR apparently abruptly turns southeasterly, as shown by the dotted line, and ultimately crosses the equator in a northeasterly direction at 78.1° W., and then abruptly turns and proceeds in the correct northwesterly direction. Of course, OSCAR doesn't really do these acrobatics, but formulas 1 and 2, as usually given,[1] which calculate the latitude and longitude of OSCAR at the selected time intervals, give these apparent positions. And, since these positions are used in conjunction with our own positions on Earth (latitude and longitude of our QTH) to calculate the direction to point our antenna at OSCAR, we will be wrong!

Well, if this is really so, why haven't we hams in the United States noticed this before? Why do the formulas seem to work okay for us? The answer is that we are so far from the equator, and our antennas have broad enough beamwidths (approximately 40° wide at the "3 dB down" points for a so-called 13 dB beam), that the apparent "dogleg" in the path is entirely contained within our beam coverage and goes unnoticed. I have shown a 40° beam pointed from Miami toward the 78.1° W. crossing in Fig. 1. Notice how it encompasses both the true and apparent paths of OSCAR within the "OSCAR horizon" of Miami, shown as the dotted arc centered on Miami. And, of course, the effect is diminished as we are even further north, because OSCAR is in range below the equator for a shorter distance (or not at all), and the antenna beam covers a large area below the equator.

Now let's take a ham in Quito, Equador, whose QTH is at 0.2° S. latitude and 78.5° W. longitude. He is really in trouble if he uses formulas 1 and 2. His calculator will tell him to point his antenna in a southwesterly direction to

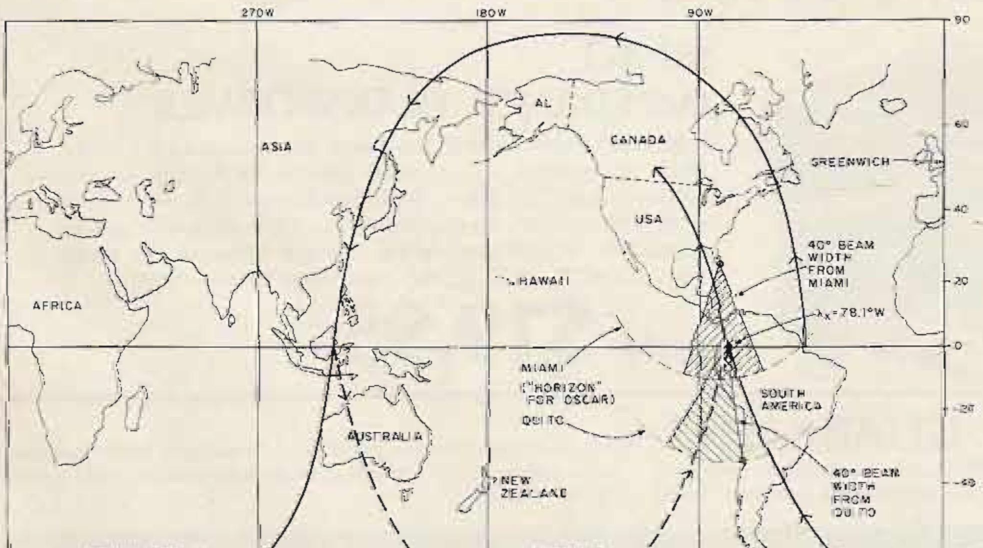

Fig. 1. OSCAR paths, actual and apparent, on the Earth.

pick up the approaching OSCAR, instead of the correct southeasterly direction. Although his antenna may be 40° wide, it is not wide enough to include the direction of OSCAR, as shown by Fig. 1.

In even worse shape would be a ham in New Zealand, for example. The apparent path of OSCAR is south of him, heading east, when in reality it is clear around the world below South Africa.

The part of equation 2 that causes this trouble is the first portion in the brackets:

$$[\text{INV} \cos(\cos \frac{360\,t}{P} / \cos L_s)]$$

When OSCAR is in the Northern Hemisphere, but approaching the equator, it is a trifle less than ½ P, since it is the time since OSCAR crossed the equator going north, and P is the time of the full orbit. Thus 360t/P will be less than 180 (let's say 176.9, for example). The cosine of 176.9° is -.99854. L_s, the latitude of OSCAR from equation 1, is about 3°; its cosine is .99863. The result is the inverse cosine of -.99991 or 179.2°. Now, let the OSCAR go an equal distance past the equator so that 360t/P is 183.1°. The calculator computes the cosine as -.99854 (the same as for 176.9); the latitude is now about 3° S. or -3°, whose cosine is .99863 (the same as for 3°). The result is that the calculator give you the same inverse cosine of -.99991 = 179.2° as before. After all, how can the calculator know that you want an answer greater than 180°? Thus, the OSCAR seems to be backtracking in an easterly direction as it heads south, and gives the apparent track as shown in Fig. 1.

The answer to this problem is simple: If the latitude of OSCAR is positive (north of equator), use the equation as is; if the latitude is negative, subtract the angle obtained from the bracket from 360° (e.g., 360 - 179.2 = 180.8), and use that value of longitude in the subsequent calculations. (In the program listed in Table 1, I have done the equivalent by testing the sign of the sine of L_s to save program steps.)

For those hams with an interest in how and why things work (most of us, I think), here are the formulas used and a brief explanation of their place in the program. 1 and 2 are adapted from reference 1; the other expressions are from reference 2.

1. $L_s = \text{INV} \sin (\sin a \sin \frac{360t}{P})$
2. $\lambda_s = [\text{INV} \cos (\cos \frac{360t}{P} / \cos L_s)] + \lambda_x + t(15)$
3. If $\sin L_s$ is positive, λ_s is as given by 2. If $\sin L_s$ is not positive, $\lambda_s = 360 - [\;\;] + \lambda_x + t(15)$
4. $v = \lambda_s - \lambda_q$
5. $c = \text{INV} \cos(\sin L_s \sin L_q + \cos L_s \cos L_q \cos v)$
6. $\beta = \text{INV} \cos[(\sin L_s - \sin L_q \cos c)/(\cos L_q \sin c)]$
7. If $\sin v$ is positive, $B = 360 - \beta$. If $\sin v$ is not positive, $B = \beta$
8. $EL = \text{INV} \tan [(\cos c - \frac{R}{R+h})/\sin c]$

where (all degrees are in decimal form, e.g., 24.1°):

L_s is the latitude of OSCAR in degrees — positive if north of equator, negative if south;

a is the inclination of OSCAR's orbit in degrees counterclockwise from east;

t is the time in decimal hours from T_x;

T_x is the time of a northbound equatorial crossing by OSCAR, in hours and minutes (GMT or local);

P is the period of the orbit in decimal hours;

λ_s is the longitude of OSCAR in degrees west from Greenwich, England;

λ_x is the longitude of the northbound equatorial crossing (at T_x) in degrees west;

λ_q is the longitude of the QTH in degrees west;

L_q is the latitude of the QTH in degrees — positive if north of the equator, negative if south;

B is the azimuth (bearing) to OSCAR from the QTH in degrees clockwise from north;

EL is the elevation angle to OSCAR from the QTH in degrees, from the horizontal upwards;

R/(R+h) is the ratio of the Earth's radius to the sum of Earth radius and orbit height.

Program steps 000 to 009 initialize the program, fix the decimal point to four places (necessary for accurate time displays later), print the entered time, T_x, convert T_x into decimal hours, store it in register 11, and halt, ready for the next entry. When λ_x is entered on the keyboard and RUN is pressed, steps 010 to 017 store λ_x in register 14, print it, and put a 0 in register 13. Steps 018 to 138 solve equation 1 and store sin L_s in register 63. Steps 039 to 080 solve expressions 2, 3, and 4. Steps 081 to 157 solve 6 and 8. Steps 158 and 159 test the elevation angle and, if negative, skip to step 214, after which Δt (your selected orbital time interval) is added to register 13, and the program repeats, beginning with

70377.0700	PRT	14.	PRT	289.	PRT
18.3800	PRT	22.42	PRT	1.	PRT
78.1000	PRT	301.	PRT	17.50	PRT
18.46	PRT	9.	PRT	69.	PRT
99.	PRT	8.42	PRT	2.	PRT
8.	PRT	31.	PRT	17.54	PRT
18.50	PRT	8.	PRT	45.	PRT
72.	PRT	8.46	PRT	4.	PRT
16.	PRT	48.	PRT	17.58	PRT
18.54	PRT	25.	PRT	22.	PRT
39.	PRT	8.50	PRT	2.	PRT
16.	PRT	95.	PRT	19.38	PRT
18.58	PRT	41.	PRT	126.	PRT
13.	PRT	8.54	PRT	14.	PRT
7.	PRT	148.	PRT	19.42	PRT
20.34	PRT	28.	PRT	99.	PRT
162.	PRT	8.58	PRT	32.	PRT
5.	PRT	168.	PRT	19.46	PRT
20.38	PRT	10.	PRT	43.	PRT
162.	PRT	10.34	PRT	37.	PRT
24.	PRT	4.	PRT	19.50	PRT
20.42	PRT	5.	PRT	8.	PRT
164.	PRT	10.38	PRT	19.	PRT
63.	PRT	350.	PRT	19.54	PRT
20.46	PRT	21.	PRT	355.	PRT
342.	PRT	10.42	PRT	3.	PRT
54.	PRT	310.	PRT	21.30	PRT
20.50	PRT	38.	PRT	194.	PRT
343.	PRT	10.46	PRT	12.	PRT
20.	PRT	256.	PRT	21.34	PRT
20.54	PRT	30.	PRT	217.	PRT
344.	PRT	10.50	PRT	30.	PRT
3.	PRT	233.	PRT	21.38	PRT
22.30	PRT	12.	PRT	273.	PRT
220.	PRT	12.30	PRT	40.	PRT
3.	PRT	335.	PRT	21.42	PRT
22.34	PRT	3.	PRT	314.	PRT
243.	PRT	12.34	PRT	22.	PRT
11.	PRT	312.	PRT	21.46	PRT
22.38	PRT	4.	PRT	331.	PRT
273.	PRT	12.38	PRT	6.	PRT

Fig. 2. Printout of 36 hours of OSCAR 7.

Key	Step	Code	Key	Step	Code	Key	Step	Code	Key	Step	Code
LBL	000	46	INV	056	22	8	112	08	=	168	95
A	001	11	sin	057	32	x	113	65	INV	169	22
fix	002	57	cos	058	33	RCL	114	43	D.MS	170	37
4	003	04	STO	059	42	9	115	09	fix	171	57
prt	004	98	6	060	06	8	116	08	2	172	02
D.MS	005	37	4	061	04	cos	117	33	-	173	75
STO	006	42	)	062	54	=	118	95	2	174	02
1	007	01	INV	063	22	1/x	119	20	4	175	04
1	008	01	cos	064	33	x	120	65	=	176	95
HLT	009	81	+	065	85	(	121	53	if pos	177	80
STO	010	42	RCL	066	43	RCL	122	43	log	178	28
1	011	01	1	067	01	6	123	06	+	179	85
4	012	04	3	068	03	3	124	03	2	180	02
prt	013	98	x	069	65	-	125	75	4	181	04
0	014	00	1	070	01	RCL	126	43	=	182	95
STO	015	42	5	071	05	9	127	09	LBL	183	46
1	016	01	+	072	85	8	128	08	log	184	28
3	017	03	RCL	073	43	sin	129	32	prt	185	98
RCL	018	43	1	074	01	x	130	65	RCL	186	43
1	019	01	4	075	04	RCL	131	43	1	187	01
3	020	03	-	076	75	6	132	06	2	188	02
x	021	65	RCL	077	43	7	133	07	sin	189	32
RCL	022	43	9	078	09	=	134	95	INV	190	22
1	023	01	9	079	09	INV	135	22	if pos	191	80
5	024	05	=	080	95	cos	136	33	sin	192	32
=	025	95	STO	081	42	STO	137	42	3	193	03
STO	026	42	1	082	01	6	138	06	6	194	06
6	027	06	2	083	02	5	139	05	0	195	00
9	028	09	cos	084	33	RCL	140	43	-	196	75
sin	029	32	x	085	65	6	141	06	LBL	197	46
x	030	65	RCL	086	43	7	142	07	sin	198	32
RCL	031	43	9	087	09	-	143	75	RCL	199	43
1	032	01	8	088	08	RCL	144	43	6	200	06
6	033	06	cos	089	33	1	145	01	5	201	05
sin	034	32	x	090	65	8	146	08	=	202	95
=	035	95	RCL	091	43	=	147	95	fix	203	57
STO	036	42	6	092	06	÷	148	55	0	204	00
6	037	95	4	093	04	RCL	149	43	prt	205	98
3	038	03	+	094	85	6	150	06	RCL	206	43
if pos	039	80	RCL	095	43	8	151	08	6	207	06
tan	040	34	9	096	09	=	152	95	6	208	06
3	041	03	8	097	08	INV	153	22	prt	209	98
6	042	06	sin	098	32	tan	154	34	fix	210	57
0	043	00	x	099	65	STO	155	42	4	211	04
-	044	75	RCL	100	43	6	156	06	LBL	212	46
LBL	045	46	6	101	06	6	157	06	cos	213	33
tan	046	34	3	102	03	INV	158	22	RCL	214	43
(	047	53	=	103	95	if pos	159	80	1	215	01
RCL	048	43	STO	104	42	cos	160	33	7	216	07
6	049	06	6	105	06	RCL	161	43	SUM	217	44
9	050	09	7	106	07	1	162	01	1	218	01
cos	051	33	INV	107	22	1	163	01	3	219	03
÷	052	55	cos	108	33	+	164	85	GTO	220	41
RCL	053	43	sin	109	32	RCL	165	43	0	221	00
6	054	06	STO	110	42	1	166	01	1	222	01
3	055	03	6	111	06	3	167	03	8	223	08

Table 1. OSCAR SR-52/PC 100A program.

step 018.

However, if the elevation angle tests as not negative, steps 161 to 211 add t to T_X, convert the result to hours and minutes, and print. Then they apply expression 7, print azimuth and elevation to the nearest degree, refix the decimal point to 4 places, and go to step 214, where the cycle begins again. Thus, a printout is made only when OSCAR is not below the horizon. Labels sin, cos, tan, and log are used internally to save program steps.

OK, so much for the sales pitch and the explanations — how do we go about using the program? Simple! Here is a step-by-step procedure:

FIRST — Key in the program listed in Table 1 (don't forget to either reset or GTO 000 before pressing the LRN key). Now, press LRN to put the calculator back into the calculate mode. Record the program on a magnetic card for future use. If you already have the program on a card, enter it in the usual manner.

SECOND — Key in the west longitude of your QTH (λ_q) in decimal degrees and STO 99; key in the latitude L_q in decimal degrees (if south of the equator, key +/- for the minus sign) and STO 98.

THIRD — Key in the following OSCAR orbit data, and store as shown:

1.916 STO 19 (P)
0.813 STO 18 [R/(R+h)]
101.7 STO 16 (a)
187.9 STO 15 (360/P)

(These values are averaged for OSCARS 6 and 7 and give good results for at least 36 hours of orbit. You can, of course, put more accurate values in if you wish.)

FOURTH — Key in your desired orbital time intervals (Δt) in decimal hours; e.g., if you want 4 minute Δt, key 4 ÷ 60 =, and store the result in register 17 by STO 17. (This will store 0.0666666667 in reg. 17 for this example.)

FIFTH — Set the R-D switch to D (degrees).

This completes setting up the calculator with its permanent data base. Note that, if you have already used the program, then replaced the program with another to work on some other problem but have not turned off the calculator or otherwise disturbed registers 15 through 19, 98 and 99, the second through fourth steps can be omitted.

Now let's take an actual example (which can be used by you as a "check" problem), using my QTH (L_q 32.75, λ_q 117 are stored in registers 98 and 99), and OSCAR 7, beginning on the evening of July 3, 1977, Pacific Daylight Savings Time. Page 16 of the July, 1977, issue of *73 Magazine* lists orbit 12044, A mode, July 4, 0138:05 GMT, 78.1°. This is July 3 at 1838:05, my time. When I enter T_X, I can use either GMT (1.38) or PDST (18.38), as I choose. The resulting times will then be in the same time zone. I will choose PDST and enter to the nearest minute in H.M (Hours.Minutes) as follows:

STEP 1 — (optional) Key 703.77.07 PRT to print my Pacific date and indicate OSCAR 7 (07).

STEP 2 — Key 18.38 (T_X in H.M).

STEP 3 — Press A (the calculator will stop, showing 18.6333, which is T_X in decimal hours, and will print 18.3800 PRT).

STEP 4 — Key 78.1 (λ_X).

STEP 5 — Press RUN.

Now you can relax and do other things, as you wish. The calculator-printer has taken over. It will immediately print 78.1000 PRT, thus giving you T_X and λ_X for reference. It will then print out the time (in H.M), azimuth, and elevation angles in degrees every 4 minutes of orbit time that OSCAR 7 is within the QTH's horizon, throughout the rest of the night of July 3 and throughout July 4. It takes the calculator about 13 seconds for each Δt, thus the first printout will be about 40 seconds after you pressed RUN, because the satellite is not above the horizon until 18.46. At that time, the azimuth is 99°, and the elevation is 8°. It will take the calculator approximately 70 minutes to finish 24 hours of orbit time, and thus about 1½ hours to finish the July 4 evening passes. Fig. 2 is an actual PC 100A tape for this example.

OK, you say, that's fine for a west coast ham, because the orbits listed in *73* are usually the first ones that are within range of the west coast. But how about someone on the east coast? It's still simple: Take that orbit for July 4 GMT, and subtract 115 minutes and 28.75° several times from the listed values in *73* until you get the T_X and λ_X of the first orbit that will be in your range. I have found that the first northbound orbit must be about 65° or less east of my QTH to be within range; this should be suitable within the 48 states and Hawaii.

Or, for the really lazy (or busy?), just start with the preceding day's first orbit, as listed in *73*, and let the calculator crank out about 36 hours of orbital data. This suggestion is probably the easiest for hams in the equatorial and sub-equatorial regions to use, because their usable passes will be either northbound passes, starting from below the equator, or southbound passes.

Well, so far so good, for the fat cats with the printers; now, how about those of you with the bare bones SR-52? Here's how: First, put in the program and data registers, just as indicated earlier, but with 3 simple changes. Change program steps 185, 205 and 209 from prt (98) to HLT (81). The calculator is used in the same way, except that paper and pencil are used instead of the automatic printer.

After T_X and λ_X are entered as above, the calculator will halt and display the first time the satellite is in your range. After writing it down, press RUN, and the calculator will halt with the azimuth displayed. Write it, press RUN, and the calculator will halt with elevation displayed. Write it, press RUN, and a new time will be displayed when the calculator halts, etc., etc. However, remember that each calculation cycle takes about 13 seconds, so that, if the satellite takes 12 minutes to come into range, as in the example above, it will be about 40 seconds before the calculator halts with the first time display, and, after the OSCAR goes beyond your horizon, it will be about 5 minutes before the calculator halts with the next northbound pass in range displayed. It will be much longer than that, after the last northbound pass, until the first southbound pass comes within range. You may find it more convenient to press HLT, if no display has appeared in 20 seconds after a series of displays. Then, add (use the calculator for this; it won't hurt the program) 115 minutes to the previous T_X and 28.75° to the previous λ_X, enter these new values for the T_X and λ_X in the program, and you thus bypass the time to circle the world. A convenient way to do this is to key in the previous T_X (e.g., 18.38), press D.MS, +, RCL 19, =, INV D.MS, and then press A. At the halt, key in the previous λ_X (e.g., 78.1), press +, 28.75, =, and then press RUN.

Well, there it is. Have fun with the program and good hunting on OSCAR. ■

References

[1] W. Danielson and S. Glick, *QST*, Oct., 1969, pg. 54.

[2] HP-65 program, by Dr. Earl F. Skelton WA3THD, Aug., 1975.

Try A T-R For OSCAR 8

-- turnstile over reflector system

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T-R, in this case, is *T*urnstile over *R*eflector antenna, and it could definitely aid your OSCAR performance. Built for three band capability, it will do well for you on the present OSCAR satellites, not to mention the upcoming AMSAT high orbit type machine. If you think using mechanical tracking rotors for the present OSCARs is tough, the next one is going to be impossible for you. True, it moves more slowly, relative to a position on Earth, but I'm sure we will hear the same, "Where the heck is it?" comments we had about OSCARs 6 and 7.

Referring to Fig. 1, I have only shown the two-band 2m/10m version, because that is all I have had a chance to check out. There is no reason at all why two ten-foot masts could not be used in place of the ten- and five-foot versions shown for the vertical mast. An alternative is to build it as shown, and, due to the very small size of the ¾m version, it could even be bracketed to the top at a later date. That is my reason for drawing the unused extra ¼ wavelength of mast poking out of the top on 2m.

Construction is entirely with commercially available antenna parts (especially from Hy-Gain 64Bs). The crossed dipoles on the 10m T-R can be 10m beam driven elements. Two of these are used on mine, less the beta matches, and with the elements stretched out to 10m dimensions. I did this by using some CB antenna aluminum tubing. These tubes were the same o.d. as the tube/reducers on the original 64B and fit nicely into the 64B dipole insulators. The old 64B element o.d. is not quite the same as the i.d. of the new CB tubing, but there are ways around this. You can wrap the smaller element with aluminum foil and then clamp it into the larger element with hose clamps, or go the more complex route I went. I added plugs about 2 inches long, that were bored out and tapped on one end to 3/8-24. This exactly matches the threaded stud on a full-size stainless steel CB whip. I obtained several of these whips, that had been damaged in one way or another, but still had good studs and about 40 inches plus of undamaged whip. If you figure out the average height of a car versus a bumper-mounted CB whip, believe me, there are several whips in this condition around. They are worthless to use on CB, so you can buy them even cheaper than the replacement full-size whips. My CB aluminum tubing came out at 56 inches, so the whips were cut off at 39 inches and screwed into the plugs. The plugs are held in the tubing by ¼-20 hardware through the tubing and plug.

For the reflectors, I used the CB parts that would normally be the ground plane elements. The largest parts just fit the same insulators, and then are grounded to the

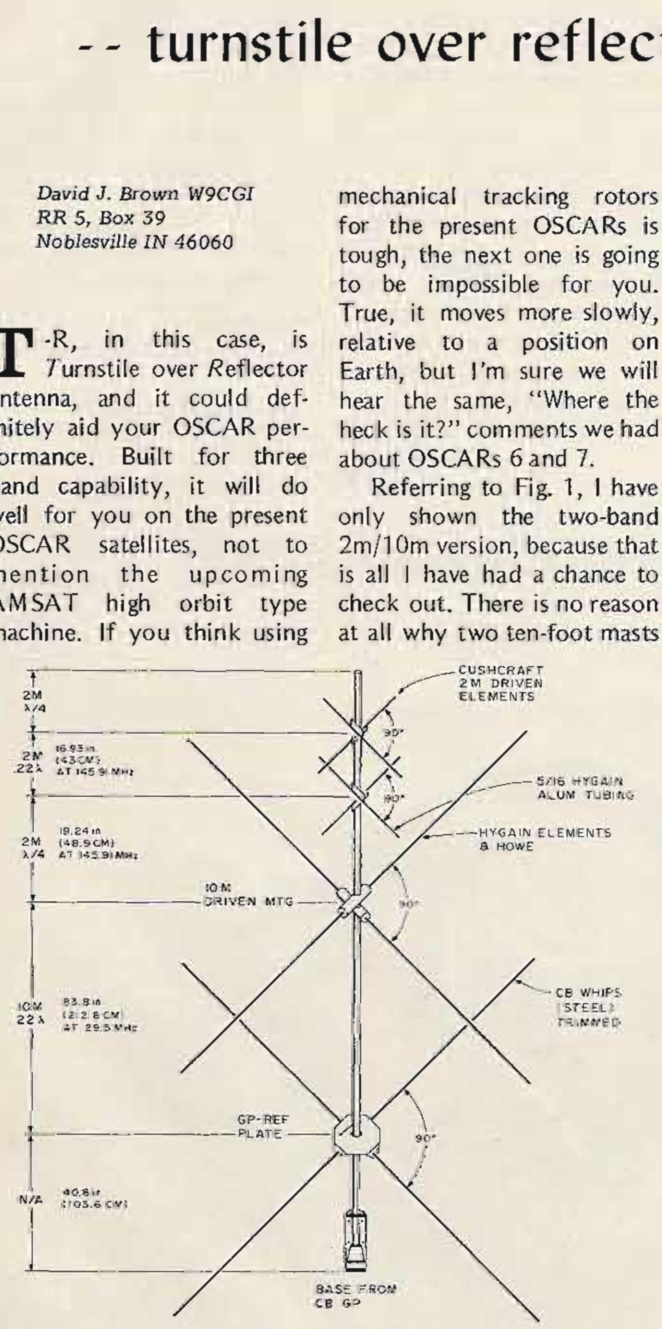

Fig. 1. Vertical mast is 10' x 5' heavy-wall TV mast (bolt through joint). Cut off lower flare to fit into or onto CB base used.

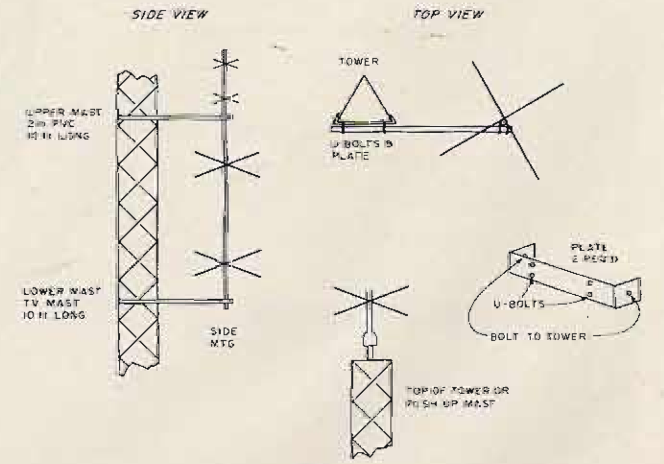

Fig. 2. Mounting.

	General	@ f_o in Fig. 1.
2m driven	$234/f_o$	19.24" 48.9 cm
2m reflected	$234/f_o$ + 5%	20.2" 51.32 cm
10m driven	$234/f_o$	95.2" 241.8 cm
10m reflected	$234/f_o$ + 5%	99.94" 253.86 cm

Table 1. Mast CTR to tip of element.

boom by a 1-inch wide strap, from feed clamp to boom to feed clamp. If you order parts, just use the director clamps instead, and the element will be already grounded.

The 2m T-R is not much different. You can even use a plate and CB whips (or the parts cut off above) to make the reflector elements. You only need pieces about 20 inches long. Simple brackets will mount them to the vertical mast.

The driven elements are made to order, used as is, parts from the A147 type CushCraft antennas. They are just the driven elements from those antennas. When I lost the EME array a while back, I saved the parts off the broken 3 yagis. They are 50 Ohm, coaxial-fed dipoles with gamma matches, so it can't be much simpler. Even their mounting method is obvious from their construction.

All that leaves are the matching harnesses. A letter to Hy-Gain produced the figure of 200 Ohms for a feedpoint impedance using the dipole alone – no beta match. The harness of Fig. 3 shows the material and cutting instructions. Use good lugs on the bolted connections, tape well, and use a good quality, clear spray liberally. Since the clear sets up so rapidly, I have found 4 or 5 light coats work better and crack less.

The 2m harness is even easier, since it uses all coaxial connectors. Measure and solder carefully, and check all the harnesses piece by piece for braid to center shorts, as each piece is completed. Then screw it all together and to the antennas, and tape and spray well. Nothing is more disgusting than to build a good antenna and have it die a month or two later, so please forgive me for belaboring the tape and spray routines.

Fig. 2 covers mounting possibilities. The array size, weight, and low wind load make it a reasonable candidate for chimney mounts. Just remember this is a last resort spot for antennas. It is the most corrosive, thermally changing, lousy spot available, but if it's all you have, it's all you have. I used the side bracket method, with the lower ground planes about 20 feet off the real ground. It is on a tower that also has two stacked halos for a backup on 6m and the Hy-Gain 66B 6m yagi up on top. None of the 6m goodies seems to cause shadows or create any loading effect problems. It all looked the same looking into the feedpoints up and mounted as it did on the ground. The 2m swr was very good at 1.15:1, and it is not worth messing with to improve. The 10m must be getting a little pattern distortion, no doubt from the tower; but it had a 1.1:1 on the ground and a 1.25:1 now. It works fine, and I'm not going to push it to get a little more here and there.

This whole story seems terribly short, but then there just was not much to the construction, either. One weekend of an hour here and an hour there, and it was both done and up. The antenna design is not new, but I thought you might like to share some of my construction methods.

Here's one final note of help: When you get it all together, try the following: As the beast gets larger (as you add the 10m hardware), it pays to have a pipe stuck in

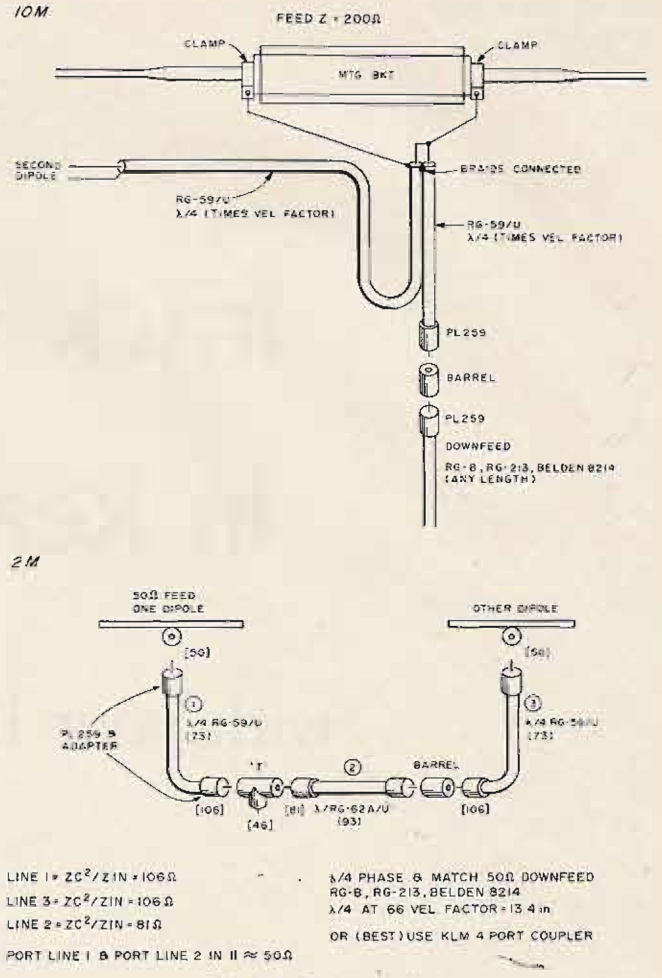

Fig. 3. Feed and phase.

the ground that you can U-bolt it to and work on it upright. I have a 4-foot pipe stuck 3 feet in the ground in a post hole and filled around with concrete. Level the concrete off with the ground in sympathy for your lawn mower. Don't place it where you can break a leg on it, and you have a utility mast and antenna holder. If you saw the expanded end off of a TV mast (as you will do in making the vertical mast in this article), and make the cut-off piece about 8 inches long, you will end up with a dandy test setup. Keep two 10-foot TV masts around (up in garage rafters, etc.), and, if you fit them together to make a 20-foot mast, add the sawed off piece to the unexpanded end of the 20-foot pair, use the whole business upside down (expanded ends up), and choose your 4 feet of water pipe in the ground with an ID larger than the TV mast (but smaller than the expanded part), you wind up with a quicky test setup for checking out small antennas at 21 feet off the ground. Even some of the small and lightweight 6m beams aren't too big to swing up. For larger antennas, two water pipes in the post hole, with the mast pivoted between them (tilt-over tower style), also work well.

Keep me posted on how it all works out for you, preferably when I hear you having fun on OSCAR. I mounted mine in a direction southeast from the tower, due to the tower sides' orientation. The way the legs are on my tower left me the general directions of 0, 120, and 240 degrees, so I chose the 120 degree direction. I favor the early evening passes east of me, since I can be home and make more of them. It also does just fine on passes west of me, too, so have no fear of it being deaf off the tower side. See you on OSCAR. ■

Thomas A. Prewitt W9IJ
2212 S. Webster
Kokomo IN 46901

Track OSCAR In Real Time

-- with your HP-67 calculator

Program Description

H-P 67/97 CALCULATOR

Program Title	OSCAR TRACK
Name	T.A. Prewitt, W9IJ
Address	2212 S. Webster
City	Kokomo
State	IN
Zip Code	46901
Date	5/22/77

Program Description, Equations, Variables, etc. Adapted from equations given in Computerized Satellite Tracking, 73 Magazine, February, 1977, page 72, by WBØJHS.

Store these constants in the indicated registers:

4	Longitude increment (28.7363)*
5	360
6	1/60
8	Inclination to equator (101.77)
9	Period (114.945)
12	-1
13	360
15	Height (910)
16	Latitude of your station
17	Longitude of your station
18	3959
19	69.09

*Values in parentheses are for OSCAR VII

Operating Limits and Warnings Program has been checked for station locations in North latitude and West longitude. Should work for East longitude if longitude is complemented.

DO NOT USE THIS SPACE

User Instructions

OSCAR TRACK - 70522

A	B	C	D	E
TRACK			NEXT ORBIT	ENTER ORBIT #, TIME, LONG.

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1.	Load Program and Data			
2.	Enter Reference Orbit Data	Orbit #		
		GMT (H.MS)		
		Long.	E.	0.
3.	To Look Ahead N Orbits (Immediately Following 2).	N.	R/S	Orbit #
				Long.
				Time
3a.	To Look Ahead One Orbit		D.	Orbit #
				Long.
				Time
4.	To Track AZ-EL in Real Time During A Pass, First Perform 1, 2 and 3 (If Needed). Wait Until Real Time Reaches Time Shown In Display		A.	Note 1
	Note 1 - Display During Track Mode Consists Of Elapsed Time In Minutes, Followed By A Zero and AZ-EL Bearings. AZ Angle Appears Immediately To Left Of Decimal Point And EL Angle Is Immediately To Right Of Decimal Point, Which Serves Only As A Separator. EL Is Zero If Satellite Is Below Horizon.			

In the February (1977) *73*, Henson* presented a beautifully-documented minicomputer program for tracking OSCAR. The program described here calculates and displays the same information (except range), and, in addition, runs in real time during a satellite pass. Written in RPN for a Hewlett-Packard HP-67 pocket calculator, it will run on an HP-97 as well. I'm sure that an equivalent program could be written for the TI SR-52, although I have not done so.

After loading the program and data constants, begin by entering reference orbit data. Then step ahead one or more orbits to the one of interest. The calculator will pause to display the orbit number and the longitude of the equatorial crossing, and will halt with the display containing the predicted time of the equatorial crossing (with all data needed for a real-time track of the satellite on the selected orbit stored in the proper registers).

When real time (clock time) reaches the time shown in the calculator display, press the "TRACK" button to commence a real-time track. Thereafter, the program will run continuously, calculating beam-aiming data once each minute, and pausing every few seconds to display the current results.

Several data display formats have been programmed and evaluated. Although many tracking parameters can be calculated, the ones finally selected for display are the elapsed time, the beam heading, and the elevation angles. To keep the waiting time between successive displays to no more than a few seconds, these three data items are merged into a single line, which is displayed three times as frequently as each would be if they were displayed in sequence.

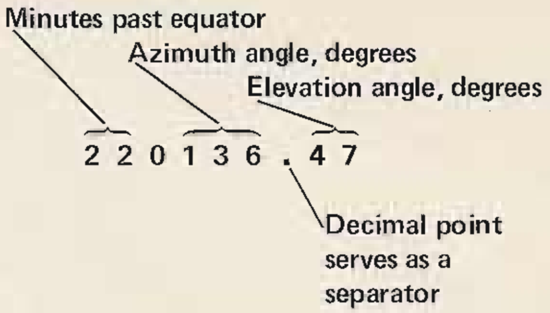

Fig. 1. Typical merged display.

Fig. 1 shows a typical merged display. The elapsed time, in minutes, appears to the left of the first zero. The azimuth heading appears to the left of the decimal point, and the elevation angle is shown to the right of the decimal point. Both angles are in whole degrees, and the decimal point serves only as a separator. The elevation angle will be shown as zero if the satellite is below the horizon.

Approximately thirty seconds of each minute are used in calculating and formatting new data, and the remaining thirty seconds are devoted to six 5-second data displays, which are distributed throughout the one minute period. If your calculator runs the program correctly but completes a loop in less than sixty seconds, add one or more PAUSE commands at the end of a display to pad it out to a full minute.

After the program is running correctly, record it on a program card and save the contents of the registers on a second data card. ■

*Henson WBØJHS, "Computerized Satellite Tracking," *73*, February, 1977, p. 72.

Program Listing

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL E		STORE REF. ORBIT DATA
	GSB 2		
	STO 1		
	↓		
	H	31 74	
	STO 7		
	STO 0		
	↓		
	STO 2		
010	0		
	STO C		
	ST I		
	R/S		HALTS HERE, TO ADV. ORBIT NO. BY N>1, ENTER N IN X-REG & PRESS R/S. *LBL 7 UPDATES ORBIT NO., TIME & LONG., CHECKS FOR T>24 HRS & L>360° & FIXES IF FOUND.
	*LBL 7		
	STO 3		
	STO+2		
	RCL 4		
	×		
	STO+1		
020	RCL 1		
	RCL 5		
	x≷y		
	STO÷1		
	RCL 9		
	RCL 6		
	×		
	RCL 3		
	×		
	STO+7		
030	RCL 7		
	2		
	4		
	x≷y		
	STO−0		
	RCL 2		
	DSP 0		
	PAUSE		
	RCL 1		
	PAUSE		
040	RCL 7		
	H.MS		
	DSP 2		
	RTN		
	*LBL D		ADVANCES ONE ORBIT ONLY.
	1		
	GSB 7		
	RTN		
	*LBL A		REAL-TIME TRACK ROUTINE, —UPDATES CLOCK
	GSB 2		
050	ISZ		
	RCL 6		
	RC I		
	×		
	RCL 7		
	+		
	STO 0		
	DSP 2		
	GSB 8		
	RCL 5		— THEN CALCULATES LAT & LONG. OF SSP.
060	RCL 9		
	÷		
	RC I		
	×		
	SIN		
	RCL 8		
	SIN		
	×		
	SIN-1		
	STO A		— STORES LAT.
070	RCL 5		
	RCL 9		
	÷		
	RC I		
	×		
	COS		
	RCL A		
	COS		
	÷		
	COS-1		
080	RC I		
	4		
	÷		
	+		
	RCL 1		
	+		
	STO B		· STORES LONG.
	GSB 8		
	P/S		— CALCULATES GT-CIRCLE ARC TO SSP
	RCL B		
090	RCL 7		
	−		
	SIN		
	x<0		
	SF2		
	SIN-1		
	COS		
	RCL 6		
	COS		
	×		
100	RCL A		
	COS		
	×		
	RCL 6		
	SIN		
	RCL A		
	SIN		
	×		
	+		
	COS-1		
110	STO 4		... AND STORES IT.
	GSB 8		
	RCL A		— CALCULATES AZ ∠
	SIN		
	RCL 4		
	COS		
	RCL 6		
	SIN		
	×		
	−		
120	RCL 4		
	SIN		
	÷		
	RCL 6		
	COS		
	÷		
	COS-1		
	F? 2		
	GTO 4		
	RCL 3		
130	X/Y		
	−		
	*LBL 4		
	STO D		... AND STORES IT.
	GSB 8		
	RCL 8		—CALCULATES EL ANGLE
	RCL 5		
	+		
	RCL 4		
	SIN		
140	×		
	RCL 8		
	RCL 5		
	+		
	RCL 4		
	COS		
	×		
	RCL 8		
	−		
	÷		
150	TAN-1		
	x<0		
	GTO 9		
	9		
	0		
	X/Y		
	−		
	*LBL 9		
	STO E		... AND STORES IT.
	GSB 8		
160	P/S		— FORMATS MERGED DISPLAY
	RCL E		
	x<0		
	0		
	EEX		
	2		
	÷		
	RCL D		
	INT		
	+		
170	RC I		
	EEX		
	4		
	×		
	+		
	STO C		... AND STORES IT.
	GSB 8		
	GTO A		... THEN LOOPS BACK.
	*LBL 8		DATA DISPLAY SUBROUTINE
	RCL C		
180	-x-		
	RTN		
	*LBL 2		CHECKS P/S REGISTERS AT STARTUP AND REVERSES IF NECESSARY
	RCL 2		
	x<0		
	P/S		
	↓		
	RTN		
190			
200			
210			
220			

REGISTERS

0	1	2	3	4	5	6	7	8	9
REAL TIME	LONG. OF EQX	ORBIT NO.	used	A LONG= 28.7363	360	1/60= 0.01667	TIME OF EQX	INCLIN= 101.77	PERIOD= 114.945

S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
		−1	360	ARC	H= 910	LAT. OF STN	LONG. OF STN.	R= 3959	MI/DEGREE 69.09

A	B	C	D	E	I
LAT. OF SSP	LONG. OF SSP	FORMATTED DISPLAY	AZ ANGLE	EL ANGLE	ELAPSED TIME SINCE EQX

LABELS

A	B	C	D	E
TRACK			NEXT ORBIT	STORE REF. ORBIT
a	b	c	d	e
0	1	2	3	4
5	6	7	8	9

FLAGS

0	
1	
2	
3	

SET STATUS

FLAGS (ON OFF)	TRIG	DISP
0 ☐ ☐	DEG ☒	FIX ☒
1 ☐ ☐	GRAD ☐	SCI ☐
2 ☐ ☐	RAD ☐	ENG ☐
3 ☐ ☐		n 2

Logical Thoughts About OSCAR

-- meaningful to computers!

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Casilla 751
Arequipa, Peru

Several months ago I received a free copy of *Ham Radio Horizons* and read the article about the OSCAR (Orbital Satellite Carrying Amateur Radio) satellites.[1] Up to that time, I had heard of OSCAR but supposed I would need a good deal of auxiliary equipment to access the satellites. However, according to the author, my trusty SB-102 should have been able to hear either of the OSCARs. The only problem was when to listen. Since the maximum exposure (during an overhead pass) is a little more then 20 minutes, and there are, at most, four favorable passes per day, random listening is definitely out.

At the time, I recalled that the ARRL was publishing AMSAT-supplied[2] equator crossings for the OSCARs in daily CW bulletins. A day of poking around in the QRM/N on 20 (why does everyone tune up on 14.080?) netted me a dozen crossings, and, with a dandy desk calculator, I was able to fill in the gaps and make several days of predictions.

Shortly after, I heard OSCAR 7 on one of the passes I had predicted, and I was hooked. I also heard half a dozen or so stations working through the satellite and am now working on a solid state, 2 meter CW rig (you convince *your* wife you absolutely must have a new $700 transceiver, so you can talk to a satellite) and some sort of antenna to go with it.

But, if I can do these predictions on a desk calculator, why can't I do them on a computer?

At work (oddly enough, a satellite tracking facility of the Smithsonian Astrophysical Observatory), we have a NOVA 1200 minicomputer.[3] Since this machine is available for some time each day, the next step was to write a program to predict successive OSCAR passes.

Language

Although we have two more efficient languages available, I chose to use BASIC[4] (DGC Extended BASIC as modified by COI[5]) for three reasons:

1. BASIC is one of the most easily understood languages available. Its clarity far outweighs any lack of speed, especially for the beginner. In this case, speed is no consideration anyway, because the actual computation takes only a few milliseconds, with most of the program time spent in controlling the teletypewriter output device.

2. BASIC is widespread. Most school computers, be they in high schools, colleges, junior colleges or even in grade schools, run in BASIC, in addition to other languages. The chances are good that, if you have ever used a computer, you have programmed in BASIC.

Check with your local school board or with the science and math departments in your school system. If the school does have computer facilities, this might make a nice tie-in for a new educational use for OSCAR.

3. Many advertisements for microprocessor/computer systems list BASIC as a ready-to-run language, either supplied or available as an option.

Programming

For any nontrivial program, a flowchart is almost essential and is an easy way to block out the job. The flowchart will usually suggest ways of breaking up one large job into several smaller ones. Fig. 9 shows some commonly used flowchart symbols and their meanings.

In the main chart for this program (Fig. 1 and Fig. 10, lines 1 through 299), each phase of the program is represented by a separate block. Some blocks stand for a single instruction, but most stand for two, three, or more.

Fig. 1 begins with the block RUN and "flows" in an orderly manner to the block END. Some of the blocks (SELECT A SATELLITE) stand for what are called subroutines. A subroutine is a short program which takes care of some special job, like selecting the elements for a particular satellite. Usually, a subroutine is written because the same small job is to be performed several times, and there is no sense in repeating the same "code" over and over.

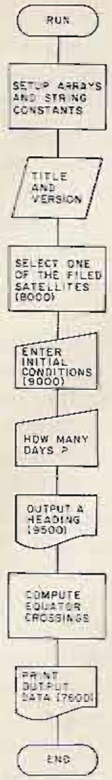


Fig. 1. Main program flow showing data entry points, computations, output points, and major subroutine calls.

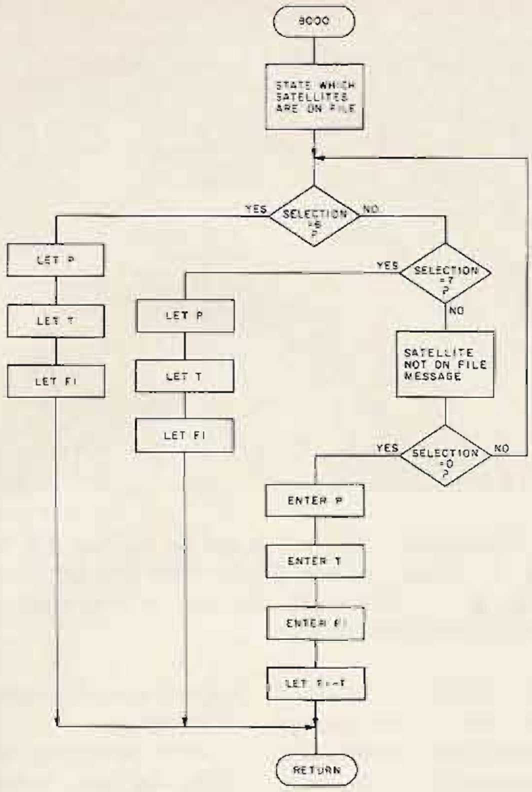


Fig. 2. Subroutine 8000, which is used to select either a filed satellite or a new, unfiled satellite.

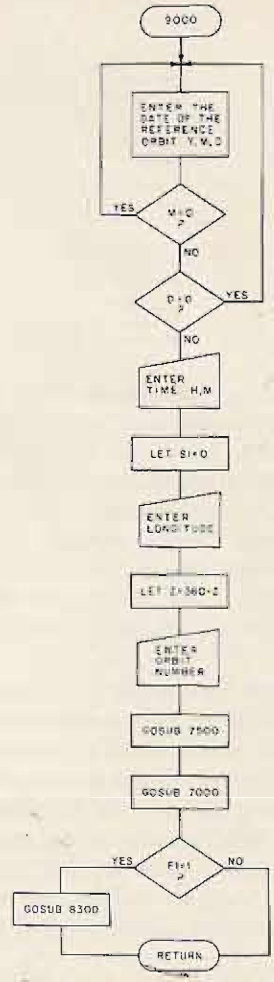


Fig. 3. Subroutine 9000, which is used to enter the reference day and position for the selected satellite.

Quite often a stock subroutine can be used in other programs with little or no modification. For example, I have already used the "calendar" subroutine (7000) in two other programs.

I like to use subroutines to make the big job smaller and easier. If all the subroutines used in this program were combined into a single program and flowchart, we might need a square meter of paper on which to draw it and, certainly, a tour guide to help us through it.

An "ultimate" main program might even begin at RUN, consist of nothing more than GOSUB statements, and finally terminate with an END statement.

To keep things simple:

1. Break up the big job into individual steps.
2. Keep the "main" program and its flowchart in as straight a line as possible.
3. Document your program with explanatory remarks wherever possible. If you decide to make changes in 6 months, you'll be awfully glad you have these notes.

In BASIC, it is not necessary that line numbers follow sequentially. The program always goes to the next highest line number for execution (unless, of course, it encounters a GOTO, GOSUB, or RETURN statement).

I like to think of the available program area (lines 1 to 9999) as a notebook. Early "pages" are used for the main program, with plenty of blank pages left for later changes or corrections; later pages are used for subroutines, filling the "book" from the back toward the front. If you put everything in the front of the "book," and then have to rewrite some section or insert corrections, you will have a major rewrite job on your hands because of the lack of vacant line numbers ("pages").

Equator Crossings

The objective of this program is to produce OSCAR equator crossings (time – UT, longitude – W), based on reference orbits (initial conditions) supplied by AMSAT via W1AW.

In the following discussions, no attempt is made to explain, in detail, the workings of BASIC. It is assumed that, if you have access to a computer and BASIC, you also have access to any necessary "how-to-use" manuals.

Lines 1 and 2 (Fig. 10) are self-explanatory. Lines 10 through 39 are used to set up several constants and an array, all of which will be used later by different sections of the program. Lines 40 and 41 are the "TITLE" block of Fig. 1, followed by line 55, which sends us to the "SELECT-SATELLITE" subroutine, beginning at line 8000.

This subroutine (lines 8000 through 8201 and Fig. 2) tells us which satellites are preprogrammed and asks which we want. Lines 8025 and 8030 direct the flow to the appropriate set of elements, each of which is terminated by a GOTO 8200. Line 8200 announces the chosen satellite, and 8201 contains the RETURN statement, which must end all BASIC subroutines, and which transfers control back to the main program. Lines 8063 and 8083 set the state of a flag, F1, which will be used later to help format the printed output of the program.

If the tests in lines 8025 and 8030 fail, then line 8040, the next instruction in sequence, sends control to line 8090. These are self-explanatory, except for line 8140, which converts the westerly drift, entered by the operator, to easterly drift, the form which will be used by the program in its calculations. We will, of course, convert the output back to westerly degrees before printing.

New satellites may be programmed by inserting an appropriate test in the decision chain, starting at line 8025, and, of course, a block of elements ending with GOTO

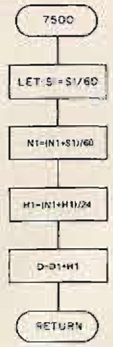


Fig. 4. Subroutine 7500, in reality only one line long, but shown here as 4 separate steps in the interest of clarity. This subroutine converts integer hours, minutes, and seconds into decimal parts of a day, and then adds this number to the current day.

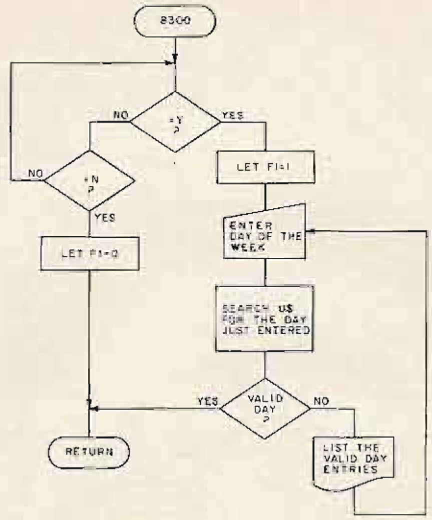


Fig. 5. Subroutine 8300, which sets up the flag, F1, for later use by the output routine. In the event that the unavailable days are to be suppressed, the day of the week for the reference orbit is entered here.

8200. One would also change line 8000. The element block may go anywhere in the subroutine, provided that the elements end with GOTO 8200.

Now, go back in the main program for a second. Line 70 transfers control to the subroutine at line 9000 (Fig. 3).

Lines 9000 to 9040 are self-explanatory. Line 9045 is included because time is only requested to the nearest minute, but, since seconds (S1) are used in the calculations, S1 must have some value. If, later, you want to include seconds as an input variable, the only change needed will be to delete line 9045 and add S1 to the input lines, 9035 and 9040. S1 is already included in all pertinent calculations.

Once again, line 9053 converts west longitude to east longitude, just as was done back at line 8140.

At line 9065, we find another subroutine call. Subroutine 7500 (Fig. 4) is a one-liner which turns seconds, minutes, and hours to decimal parts of a day. "Decimal" days are by far the simplest way of keeping time in a program!

After returning via line 7550, we are immediately sent, by line 9070, to subroutine 7000 (Fig. 6). This is the calendar manager and is perhaps the most complex subroutine in the program. What does it do?

First, it checks to see if the current day is still inside the current month. If it is, then control is passed right back to the calling program. If not (say we had typed FEB 29), the subroutine checks to see if the current year is a leap year. If this is so, the limit day of February is set to 30, if not already so set, and the current day is again tested at line 7020 to see if it has become a legal day by virtue of the limit change. It is the accounting for leap year that makes this subroutine so complex. Without leap years, the only branch would be the first one, at line 7020.

If the current day still fails the test at line 7020, then we must move on to the next month, so lines 7038 through 7060 are executed, and a return is again made via line 7020. This last test is cheap insurance against having created an illegal day.

If line 7045 finds month (M) value greater than 12, it increments year (Y) and returns via the legal day test.

Note that, if the test "L(2)=30?" is not included at line 7085, one logical course of action, after finding that the month is February, would be to set the limit to 30, then reenter at line 7020. This is okay until the day gets to be February 31 or greater, at which point the program has no way of breaking the loop and performs: (LEGAL DAY?) – (MONTH IS FEB?) – (SET LIMIT = 30) – (LEGAL DAY?) – (MONTH IS FEB?) – etc., – etc. . . ., until the cows come home. Flowcharts are a great help in avoiding this sort of bug.

Now let's go back to line 9073 – that is, just following the subroutine call to the calendar manager. Remember, we are entering initial conditions for a prediction run. Only one more parameter needs to be checked – the flag, F1. This is done at line 9073. Subroutine 8300 (Fig. 5) is called, if necessary, and asks if you want all crossings or only those available for use. So far, only OSCAR 6 has a serious restriction, but, since any satellite might have one, the option is included. Return is made to the calling subroutine and then to the main program via line 9075.

Lines 80 through 130 of the main program are self-explanatory. Line 140 sends us to subroutine 9500 (Fig. 7), which will print the satellite number and date for each

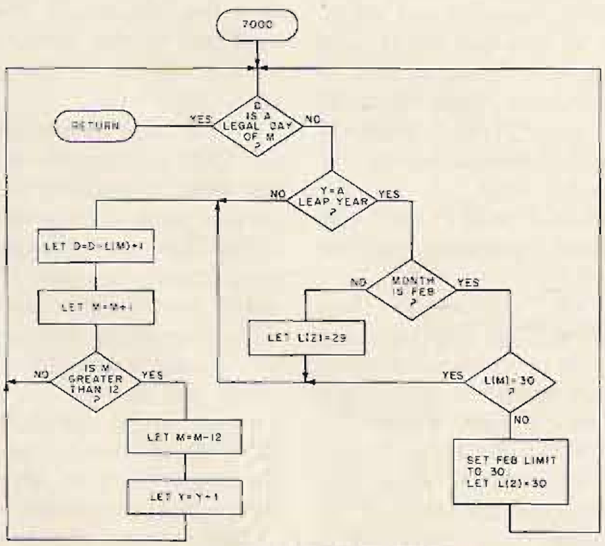


Fig. 6. Subroutine 7000, the calendar subroutine which takes care of advancing the month and year, when required. This subroutine also takes into account the possibility that the current year is a leap year and that, therefore, February must have 29 days instead of the usual 28.

Fig. 7. Subroutine 9500, which prints headings for each day's passes. These headings will be printed even if the output for a particular day is suppressed.

new day predicted.

The actual calculation loop, lines 150 through 195, is executed (13 x I)/S times. See lines 80 through 100 for I and S. Subroutine 7600 (Fig. 8) is the output routine and immediately calls the calendar (7000). Subroutine 7600 then checks to see if this is a new day (line 7612), and, if it is, calls for a heading to be printed.

The decimal day is converted to a day, hour, and minute (lines 7682 through 7691). The orbit number and time are printed (lines 7693 and 7696), and the longitude is converted to west and printed by line 7698.

The odd decision chain, at lines 7625 through 7635, tests the value of F1, which was set up back at lines 8063 and 8083. If F1 is nonzero, only the "available days" are printed. More available days could be added to the chain, if needed.

Note that, since the "new day" test (line 7612) is done before the test of F1 (line 7620), a heading will be printed for every new day, even though the passes for that day are suppressed. The heading doesn't take much paper and lets you see at a glance what the program is up to.

Fig. 11 is a sample run. All human typing is underlined. Computer output is not.

Simplicity or Flexibility

A program such as this requires a lot of work to write, especially when compared with the actual amount of calculation it does. But it takes me several hours to prepare 30 days of predictions, not counting my penchant for arithmetic errors, while the machine can compute and print the same number of predictions in about 20 minutes, with no errors, provided it is programmed properly. Thirty days comes to about 400 crossings.

The amount of work required to prepare this and, perhaps, most programs can be justified only if an equivalent or greater amount of time can be saved later on. It is for this reason that the program was made flexible. A simpler program would not have options like the choice of satellites preprogrammed, entry of trial satellites, and the like. For a little extra work now, I have a program which allows me to file a new satellite in a matter of minutes or to run a trial on a new satellite at the cost of entering its period and westward drift. I can easily suppress output of any day's passes, and the days to be suppressed can be changed by changing only one or two lines.

When OSCARs 8, 9, and 10 come along, this program will be running within minutes of my receipt of the necessary data.

Speaking of data, you may get it from a magazine article, as I did, or you could compute it, if you know any two reference orbits, ORB1 and ORB2. It helps somewhat if the two known orbits are a few days apart.

Period = P = (TIME2 - TIME1)/(ORB2 - ORB1)
Drift (W) = T = (LAT2 - LAT1)/(ORB2 - ORB1),

where TIME and LAT are the initial conditions for two crossings, and ORB1 and ORB2 are the orbit numbers.

One further improvement might be to add a longitude test to the output routine, such that only passes which will be "visible" from your station will be printed. This would drastically cut the total running time.

Parting Thoughts

Keep track of the residuals, or the differences in time and longitude, between

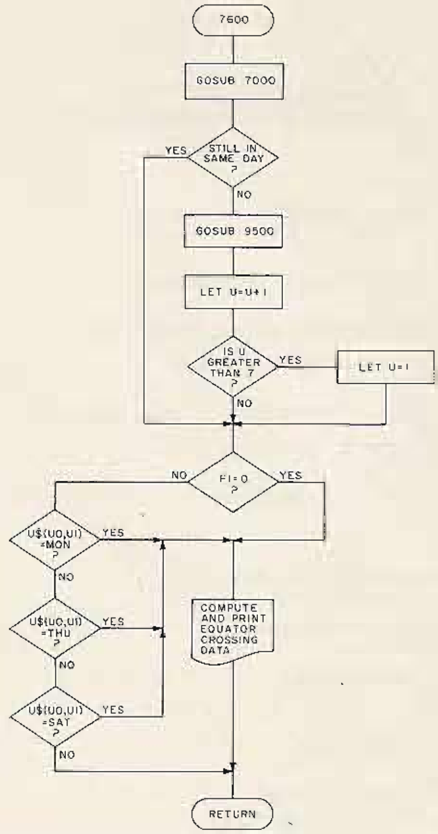
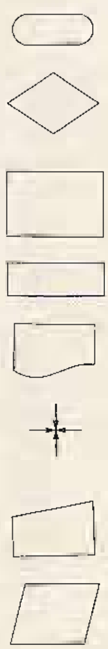


Fig. 8. Subroutine 7600, which causes a heading to be output, if necessary, and then decides which, if any, of the crossings will be printed.



Usually used to signify a start point (RUN) or an END. Also used for entry and exit points of subroutines.

This symbol always signifies a decision point. Usually the branch paths run out from the side of the diamond; however, this is not necessary if the paths are clearly marked — yes, no, true, or false.

This and the following symbol describe any "process." A process may be a GOSUB, GOTO, LET, PRINT, or any other operational instruction.

Output, in the form of a printed document. This symbol may be used for either teletype or line printer output.

These arrows indicate program flow. They are one-way only, like diodes. Once flow has passed through an arrow, it may not go back. In this example, there is an insolvable problem in that all four arrows point into the intersection. There is no exit!

Input, usually from a keyboard terminal.

Comment, either an output from the program or an explanatory block for the programmer. This symbol does not have to represent a section of the program.

Fig. 9. Some of the symbols used in flowcharts and some of their possible meanings.

```
0001 REM MAIN PROGRAM: COMPUTES AND PRINTS
0002 REM EQUATOR CROSSINGS FOR OSCAR SATELLITES.
0010 DIM L[12 ],M$[36],U$[21]
0011 DIM Y$[1],D$[3],A$[8]
0015 DATA 32,29,32,31,32,31,32,32,31,32,31,32
0017 LET U$=" SUNMONTUEWEDTHUFRISAT    "
0018 LET M$=" JANFEBMARAPRMAYJUNJULAUGSEPOCTNOVDEC"
0020 FOR I=1TO 12
0025   READ L[I]
0030 NEXT I
0038 LET A$="8 JUNE"
0039 LET V =2.13
0040 PRINT " EQUATOR CROSSINGS: VERSION";V;
0041 PRINT " OF ";A$;" 1977  [COI-XBASIC]"
0055 GOSUB 8000
0070 GOSUB 9000
0080 PRINT " HOW MANY DAYS OF PREDICTIONS";
0085 INPUT I
0090 LET I=I*13
0095 REM ORBITAL INCREMENT: 1=EACH, 2=EVERY OTHER, ETC
0100 LET S=1
0105 REM CONVERT P FROM MINUTES TO DAYS
0110 LET P=P/60/24
0120 PRINT
0130 PRINT " ORBIT       TIME(UT)        LONGITUDE-WEST"
0140 GOSUB 9500
0150 FOR J=0TO ISTEP S
0155   LET W=W+ S
0160   LET Z= Z+ T*S
0165   LET Z=(Z/360-INT(Z/360))*360
0170   LET D=D+P*S
0185   GOSUB 7600
0195 NEXT J
0299 END
7000 REM $$$ SUBROUTINE: CALENDAR
7020 IF D=>L[M]THEN GOTO 7035
7025 GOTO 7099
7035 IF Y/4-INT(Y/4)=0THEN GOTO 7070
7038 LET D=D-L[M]+1
7040 LET M =M+1
7045 IF M=<12 THEN GOTO 7020
7050 LET Y= Y+1
7060 LET M =M-12
7065 GOTO 7020
7070 IF M=2 THEN GOTO 7085
7075 LET L[2 ]=29
7080 GOTO 7038
7085 IF L[2 ]=30THEN GOTO 7038
7090 LET L[2 ]=30
7095 GOTO 7020
7099 RETURN
7500 LET D=D1+(H1+(N1+S1/60)/60)/24
7550 RETURN
7600 GOSUB 7000
7612 IF INT(D)=D1THEN GOTO 7620
7615 LET D1=INT(D)
7616 GOSUB 9500
7617 LET U=U+1
7618 IF U=<7THEN GOTO 7620
7619 LET U=1
7620 IF F1=0THEN GOTO 7682
7623 LET U0=3* U-2
7624 LET U1=3* U
7625 IF U$[U0,U1]=" MON" THEN GOTO 7682
7630 IF U$[U0,U1 ]=" THU"THEN GOTO 7682
7635 IF U$[U0,U1 ]=" SAT" THEN GOTO 7682
7680 GOTO 7699
7682 LET D1 = INT(D)
7686 LET H1 =(D-D1)*24
7690 LET N1=INT((H1-INT(H1))*60+.5)
7691 LET H1 =INT(H1)
7693 PRINT W,
7696 PRINT USING "####",H1*100+N1;
7697 PRINT "",
7698 PRINT USING "###.#",360-Z+.05
7699 RETURN
8000 PRINT " OSCAR 6 AND 7 ARE ON FILE. ENTER DESIRED SATFLLITF;":
8020 INPUT O
8025 IF O=6THEN GOTO 8050
8030 IF O=7THEN GOTO 8070
8035 REM DEFAULT: REQUESTED SATELLITE NOT ON FILE
8040 GOTO 8090
8045 REM ELEMENTS FOLLOW:
8050 REM ***** OSCAR-6 *****
8055 LET P=114.994+0
8060 LET T=-28.7486+0
8063 LET F1=1
8065 GOTO 8200
8070 REM ***** OSCAR-7 *****
8075 LET P=114.945+0
8080 LET T=-28.7362+0
8083 LET F1=0
8085 GOTO 8200
8090 PRINT " OSCAR";O;" IS NOT ON FILE. TYPE 0 TO RUN A TRIAL":
8095 INPUT O
8100 IF O>0THEN GOTO 8025
8120 PRINT " PERIOD (MINUTES)",
8125 INPUT P
8130 PRINT " DRIFT (DEG WEST)  ",
8135 INPUT T
8140 LET T=T*-1
8145 LET F1=0
8200 PRINT " PREDICTING FOR OSCAR";O
8201 RETURN
8300 PRINT "SUPPRESS UNAVAILABLE ORBITS(Y/N)";
8325 INPUT Y$
8330 IF Y$><" Y" THEN GOTO 8340
8335 LET F1=1
8338 GOTO 8350
8340 IF Y$><" N" THEN GOTO 8325
8345 LET F1=0
8347 GOTO 8399
8350 PRINT "  REFERENCE DAY      ",
8360 INPUT D$
8365 FOR I=1TO 7
8370   LET U=I
8375   IF D$=U$[3* I-2,3*I]THEN GOTO 8399
8380 NEXT I
8384 PRINT "  LEGAL DAYS ARE: ";
8386 FOR I=1TO 7
8388   PRINT U$[3*I-2,3*I];"  ";
8390 NEXT I
8392 GOTO 8350
8399 RETURN
9000 PRINT " REFERENCE ORBIT:"
9015 PRINT "  YY , MM , DD   ",
9020 INPUT Y,M,D1
9025 IF M =0THEN GOTO 9015
9030 IF D1 =0THEN GOTO 9015
9035 PRINT "  HH , MM          ",
9040 INPUT H1,N1
9045 LET S1 =0
9048 PRINT "  LONGITUDE (DEGR-WEST)",
9050 INPUT Z
9053 LET Z=360-Z
9055 PRINT "  ORBIT NUMBER       ",
9060 INPUT W
9065 GOSUB 7500
9070 GOSUB 7000
9073 IF F1=1THEN GOSUB 8300
9075 RETURN
9500 PRINT
9515 PRINT " OSCAR";O;"        "M$[3* M-2,3*M];INT(D);Y+1900
9550 RETURN
```

Fig. 10. A complete listing of the program.

your predictions and the W1AW bulletins. I once predicted OSCAR 7 for 30 days, only to discover later that there was a 10-minute bias to all the times because the reference orbit had been wrongly copied from W1AW. Typical residuals, over a 30-day prediction cycle, have been ±1 minute and ±.1 degree of longitude. These differences creep in mainly because the AMSAT/W1AW bulletins only give time and longitude to these accuracies. We cannot expect the program to be more accurate than the data given it.

This program is only one way of reaching the stated objective. There are usually as many programs per problem as there are programmers

```
 RUN
EQUATOR CROSSINGS: VERSION 2.13 OF 8 JUNE 1977  [COI-XBASIC]
OSCAR 6 AND 7 ARE ON FILE. ENTER DESIRED SATELLITE: ? 7
PREDICTING FOR OSCAR 7
REFERENCE ORBIT:
  YY , MM , DD                 ? 77,5,30
  HH , MM                      ? 0,37
  LONGITUDE (DEGR-WEST)        ? 62.6
  ORBIT NUMBER                 ? 11605
HOW MANY DAYS OF PREDICTIONS ? 2

 ORBIT       TIME(UT)      LONGITUDE-WEST

OSCAR 7         MAY 30  1977
 11606          232           91.4
 11607          427          120.1
 11608          622          148.9
 11609          817          177.6
 11610         1012          206.3
 11611         1207          235.1
 11612         1402          263.8
 11613         1557          292.5
 11614         1751          321.3
 11615         1946          350.0
 11616         2141           18.7
 11617         2336           47.5

OSCAR 7         MAY 31  1977
 11618          131           76.2
 11619          326          105.0
 11620          521          133.7
 11621          716          162.4
 11622          911          191.2
 11623         1106          219.9
 11624         1301          248.6
 11625         1456          277.4
 11626         1651          306.1
 11627         1846          334.8
 11628         2041            3.6
 11629         2236           32.3

OSCAR 7         JUN 1  1977
 11630           30           61.1
 11631          225           89.8
 11632          420          118.5

END AT 0299
```

Fig. 11. A sample run for OSCAR 7. Human input to the program is underlined. Everything else is the product of the program.

attacking the problem. In this case, for example, certain sections of the coding were made to take up several lines, where only one line was really needed. This has resulted (I hope!) in greater clarity at the expense of space. Why not try improving this program?

Not all BASIC versions are identical. Make sure the features I have used are available in your version of the language, before writing a stiff letter to the editor.

Important note: When listing a program, this particular version of BASIC often inserts phantom spaces. These are only important in the following lines:

Line 17 must begin "SUNMON..." with no spaces between the quotation marks and SUN. "...FRISAT " does include 3 spaces following SAT, and then the quotation mark. Line 18 is similar to 17 and must begin "JANFEB ...", without spaces after the leading quotation mark. There are no spaces following DEC.

Lines 7625, 7630, and 7635 are similar in that the test day, for example "MON", must be enclosed in quotation marks without spaces as "MON", "THU", or "SAT".

Lines 8330 and 8340 are the same; the Y and N must be entered as "Y" and "N", without enclosed spaces.

All other blank spaces in Fig. 10 are not critical and may be inserted or deleted according to your whims or the requirements of your flavor of BASIC. ■

References

1. *Ham Radio Horizons*, March, 1977, pp. 18ff.
2. Radio Amateur Satellite Corporation, P.O. Box 27, Washington DC 20044.
3. NOVA is a registered trademark of the Data General Corporation (DGC), Southboro MA 01772.
4. BASIC was developed at Dartmouth College.
5. Computer Operations, Inc. (COI), Beltsville MD 20705.

RTTY Loop

I hope you enjoyed the special RTTY issue! Now that you are completely ready to operate, a few hints and suggestions are in order. Required equipment is a printer/keyboard combination (Model 15), a loop supply, a terminal unit, and an AFSK generator. I assume that you already have a transceiver capable of operating SSB on the low bands. Let's get started!

RECEIVING RTTY

By convention, RTTY operators congregate on certain areas within the CW portion of the band in question. There is activity on both 80 and 20, not much on 40, 15, or 10. Eighty meter activity is usually found around 3615 kHz and up. Twenty meter teletype freaks are found from 14.08 to 14.1 MHz. Sideband conventions are reversed on all HF bands except 80. Therefore, RTTY is received and transmitted on lower sideband on twenty – voice is upper. On 80, SSB and RTTY are both transmitted on the lower sideband.

In order to properly receive RTTY, the signal must be carefully tuned. Allow your transceiver to perk for an hour or so before tuning up the first time. An audio sample must be coupled to the TU ... normally through a matching transformer. Many of the popular TUs such as the HAL ST-6 and Flesher DM-170 require a 500-600 Ohm feed for proper operation. In a pinch, however, the TU can be paralleled across the speaker line. There are two common methods for tuning a RTTY signal. The first, and easiest, method employs a meter. The TU meter indicates a steady value when the signal is properly tuned – if not, it will jump randomly in the presence of RTTY or CW. Carefully tune the receiver until the meter is steady ... it's best to start out on a strong signal! Consult the operating instructions for your particular TU for specific details. The second tuning method uses an oscilloscope with the horizontal sweep disabled. Almost all TUs have "scope output" terminals which allow the mark and space discriminator output to be coupled to the scope. When receiving a RTTY signal, a pattern of crossed ellipses or circles will be present. The technique is to tune the receiver until the elliptical patterns are as large as possible, and as close to right angles to each other as possible. Most modern TUs have both scope outputs and meter tuning; try the meter method until you have the hang of tuning RTTY.

At this point, you should be able to copy amateur QSOs. Saturday afternoon is the best for 20 meters – if you are lucky you'll hear Ricky WAØCKY transmitting one of his classic RTTY pix! You should also hear (see!) stations calling CQ. If you're ready to answer, read on!

TRANSMITTING RTTY

Transmitting is simple. The output of your AFSK generator is connected to the microphone input of the SSB transceiver. When the loop is keyed, either by the keyboard or tape reader, the AFSK oscillator converts the Baudot pulses into frequency shifted mark and space tones. A caution is in order at this point: RTTY, like CW, is a continuous duty transmission. Unlike SSB, RTTY imposes extra strain on the final of your transmitter. It is wise to derate SSB ratings by a factor of four – if your rig is rated at 200 Watts PEP, do not allow the continuous RTTY output to exceed about 50 Watts. Save a tube! You will soon find that most RTTY operators do not use high power . . . like CW, a bit goes a long way. In most cases, 200 Watts and a beam will do the trick. I run 75 Watts, and have needed more on few occasions.

When using a standard SSB transceiver, use 170 Hz shift. This insures that the audio tones are well within the passband of your transceiver's filter. It is possible when using 850 shift to produce a secondary, and illegal, carrier. Most current activity is on 170 shift anyway.

An aside: A good beginner's RTTY transmitter is an old Heath HW-32 20 meter singlebander, popular a few years ago. This rig is designed for phone only service, but can be put on RTTY (or CW) by changing a single crystal. I performed this modification, and threw in a new filter crystal to be safe. The HW-32 will put out 40 Watts continuously, using sweep tubes in the final.

Although this issue marks my last as Executive Editor of *73*, I'll still look forward to seeing you on 14.090 or 3615 in the evening!

John Molnar WA3ETD
Executive Editor

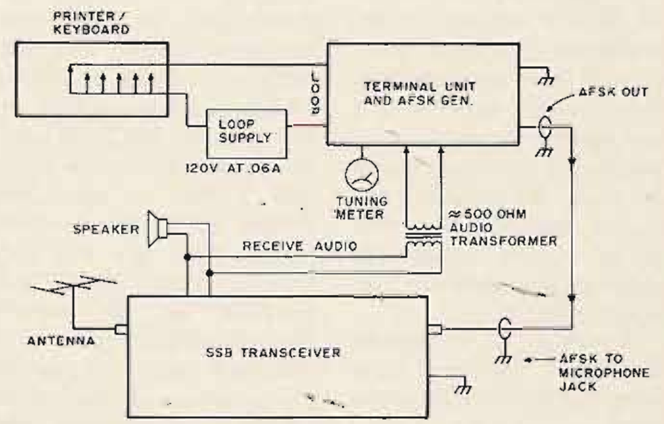


Fig. 1.

Many modern terminal units use a meter for tuning. A steady value indicates a properly tuned RTTY signal. Once the signal is tuned, the printer can be activated. The TU pictured is the HAL ST-5000.

Jack Colson W3TMZ
RFD 3
Mt. Airy MD 21771

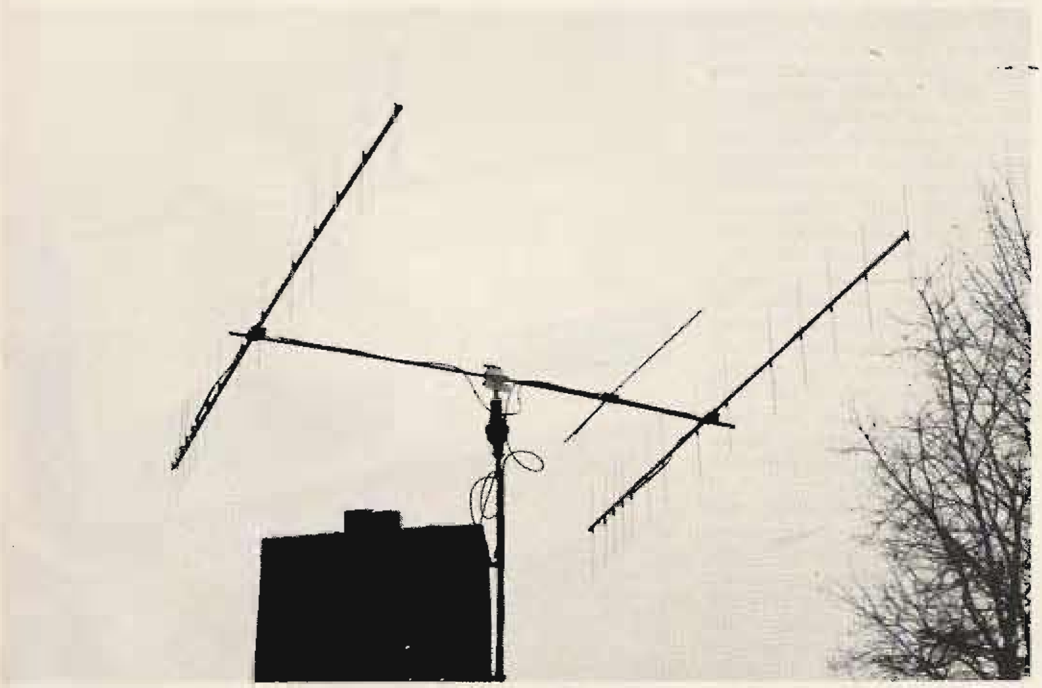
OSCAR DX

-- a new challenge

At one time or another, each of us has experienced difficulty in working DX stations because the HF propagation has been poor. We now have an alternative. With amateur satellites it is now possible to communicate consistently with stations up to 4500 miles away and predict exactly when they can be worked without the propagation problems incurred at HF.

A number of well-known HF DXers are now quite active chasing DX via amateur satellites. In the United States, in less than two and a half years, Ben Stevenson W2BXA has worked 86 countries via satellite. Actually, Ben and Pat McGowen G3IOR are having a battle to see who will be the first to work DXCC via satellite. Pat has at least 86 countries worked to date. Bill Hunter K4TI did a study several years ago and concluded that DXCC was possible via the present OSCAR satellites. Today with OSCAR 6 and 7 it is possible to communicate with amateurs in Europe and Africa every morning and early evening. On subsequent passes, amateurs in South and Central America as well as the Caribbean and Asia (AU9 and Ø) are within range. Between 0300 and 0500 GMT the satellites are passing over California, which brings the KH6s in range. And we can work these DX stations every day, day after day. In fact, when HF propagation disturbances occur occasionally, satellite communications are even enhanced.

As a matter of history, in mid-October, 1972, the first long life amateur satellite was orbited. This satellite, OSCAR 6, has provided many new aspects to DX chasing. In mid-November, 1974, a second long life satellite, OSCAR 7, was orbited. It has provided even more DXing activities.



Two 14 element KLM beams for 2 meters and a 432 MHz KLM beam for satellite DX in use at W3TMZ.

OSCAR 6 contains a 2 to 10 meter transponder with a 100 kHz bandwidth. Specifically, the input frequencies are 145.90 to 146.00 MHz, which translates to 29.450 to 29.550 MHz respectively. For normal communications, a power of approximately 100 Watts effective radiated power (ERP) provides a satisfactory return signal on the 10 meter downlink. For DX chasing, one should be able to access the satellite when it is near the horizon; to be consistent, an ERP of 1 kW is recommended. To keep the AMSAT officials happy and prevent overload of the satellite's receiver, one should adjust his ERP to maintain a reasonable but not strong return signal (comparable to other signals). Effective radiated power is defined as: matched power at the antenna terminal(s) times the antenna gain as a ratio. For example, consider an antenna with 12.5 dB of gain; this relates to a power ratio of 17.78. If the power at the antenna terminals was 100 Watts, the ERP would be 1778 Watts.

OSCAR 7 has two transponders. The first is similar to OSCAR 6 – this is termed Mode A. Its input frequencies are 145.850 to 145.950 MHz, translating to 29.400 to 29.500 MHz output. The second is a 432 to 145 MHz repeater – it is termed Mode B. Its frequencies are a 432.130 - 432.170 input, translating to a 145.970 to 145.930 output. There is an inversion in this transponder – as the operating frequency is increased, the output frequency decreases. This was done intentionally to reduce the effects of Doppler shift. Also, because of the inversion, a USB uplink (input)

AZ/EL VS Equator Crossing Of -.35.0

Time Min.	AZ Deg.	EL Deg.
7	109.	1.
8	102.	6.
11	92.	11.
13	78.	17.
15	61.	20.
17	43.	20.
19	26.	17.
21	13.	12.
23	3.	6.
25	356.	1.

AZ/EL VS Equator Crossing Of -40.0

Time Min.	AZ Deg.	EL Deg.
6	118.	1.
8	111.	7.
10	101.	14.
12	88.	20.
14	70.	25.
16	48.	26.
18	28.	22.
20	14.	16.
22	3.	9.
24	356.	3.

AZ/EL VS Equator Crossing Of -45.0

Time Min.	AZ Deg.	EL Deg.
4	129.	-1.
6	124.	5.
8	117.	12.
10	107.	20.
12	91.	28.
14	68.	34.
16	41.	32.
18	21.	25.
20	7.	17.
22	359.	9.
24	353.	3.

AZ/EL VS Equator Crossing Of -50.0

Time Min.	AZ Deg.	EL Deg.
4	136.	2.
6	131.	9.
8	125.	17.
10	114.	27.
12	95.	38.
14	63.	44.
16	31.	39.
18	11.	28.
20	1.	18.
22	354.	9.
24	350.	2.

Fig. 1. OSCAR 6 and 7 tracking data for Washington DC and vicinity. (-) = west longitude; time = after ascending node equator crossing.

signal becomes an LSB on the downlink (output).

For OSCAR 7, Mode A, a somewhat higher ERP is needed than with OSCAR 6. A good value is 10 dB more or 1 to 10 kW ERP. For Mode B, an ERP of 80-100 Watts will provide an excellent return signal.

Both OSCAR 6 and 7 are termed to be in sun-synchronous orbit — that is, they are available for communications at every point on the earth at the same local time of day. Each satellite is fixed in a near polar orbit approximately 900 miles above Earth. With such an altitude, it is possible to communicate with the satellite when it is 2450 miles away from your location. This yields a maximum communications range of 4900 miles. This can be extended considerably at times due to peculiar propagation phenomena which will be discussed later.

Probably the most exciting facet of DXing via satellite is that you can operate every day and not be concerned with normal HF ionospheric problems. Once the satellite is within your range, you are ready. There are occasional VHF/UHF propagation disturbances which do affect communications, but not to the extent that a solar storm would have upon HF. An example: Last spring when HF communications were almost totally wiped out by a storm, many Europeans were worked via satellite.

Operating

In order to operate via the satellite, one must know when it is available and in what mode it will be for a given day. Orbital data is available from many sources. Probably the most convenient source is the W6PAJ handbook. This book is published yearly and contains all revolutions for OSCAR 6 and 7*. The data is published in the form of date (GMT), revolution number, time (GMT) that the satellite crosses the equator in an ascending node (south to north) and the longitude in degrees west of Greenwich. With this data, one can compute when the satellite will be within his particular window.

The next problem is where to point the antenna. Unfortunately, this is difficult to accurately describe in a few words. Obviously it would be far easier to use a high power transmitter and almost nondirectional antenna, thus eliminating the need for antenna directional data. Sad to say, high power equipment is rare and expensive.

Generally, for ascending node revolutions, the satellite will rise from the south to southeast and go east of your QTH and leave in northwestern azimuth. If the longitudinal crossing is west of your longitude, then instead of passing to the east, it will pass to the west.

This is fine for azimuth, but what about elevation? In most cases the operator will not be interested in elevation, because he is only interested in DX which can be worked principally when the satellite is near the horizon. The only reason for a DXer to use an elevation mount is to achieve practice in satellite usage and communicate with nearby amateurs.

When OSCAR 6 was first launched, the VK amateurs generated AZ/EL data based on longitudinal crossing for many major cities in the world. I personally use this table for my antenna pointing. The second feature of the table is that it defines the satellite coverage for a particular QTH. An example of this information for the Washington area is given in Fig. 1.

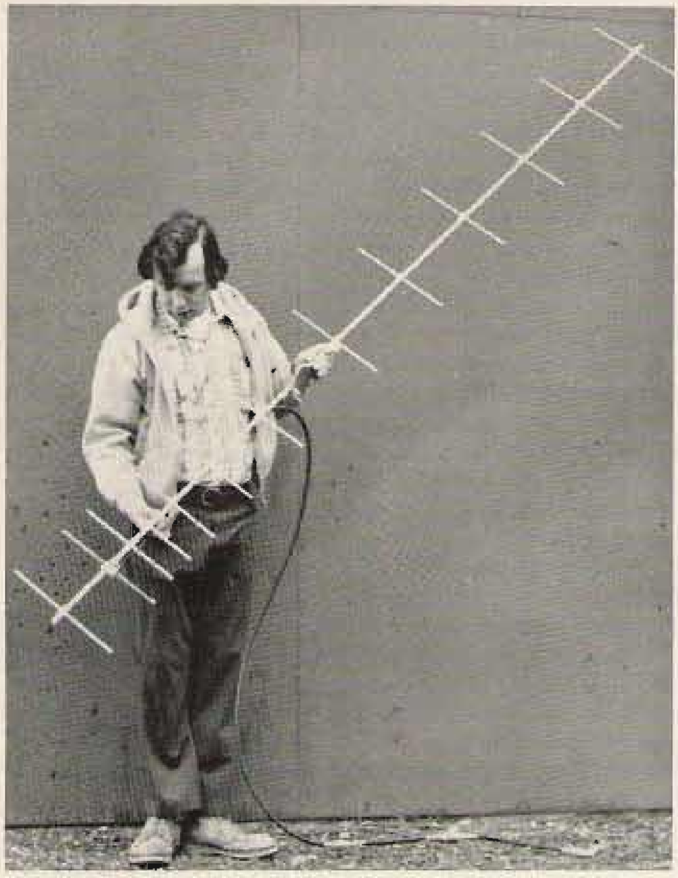
To generate this data, a computer program (written in Fortran IV and adaptable to most machines), is available.

Operating Tips for the Beginner

There are several very important techniques that will be helpful.

Pick an input/output frequency combination to which you can repeatedly reset your equipment, and always start

*Skip Reymann W6PAJ, PO Box 374, San Dimas CA 91773. For 1977 handbook send $5.00 non-AMSAT members; $3.00 AMSAT members and a self-addressed sticky label.



W3TMZ and his home brew 14 element KLM 432.

operating from that frequency. This technique is quite valuable for the following reasons. To find your own downlink signal at the beginning of a pass, you will always know where to expect your signal (± 1 kHz). Once you find your downlink signal, then you can QSY in increments – if you get lost, you can always return to your reference frequency plus Doppler and start over. Believe me, this happens, and this technique works.

On OSCAR 6 and 7, Mode A, it is not unusual to actually be accessing the satellite, but, due to a number of phenomena which are not clearly understood, you may not hear your own return signal. I have worked quite a bit of DX without hearing my own signal.

During my initial contact on OSCAR 7, Mode B, I was unable to hear my own signal because of downlink receiver desensing. Every time I keyed the transmitter I wiped out my receiver and, therefore, could not find my signal. I did not know whether I was getting into the satellite or not, but, by calling CQ repeatedly and tuning the satellite passband, I finally heard W2GN answering my CQ (this is actually poor practice) and now had a reference set of frequencies.

The Art of DXing via Satellite

For working DX alone, it is best to limit your antenna systems to low elevation angles. Concentrate as much energy (within reason) at the satellite so that as soon as it comes into range you have a workable signal. As has been mentioned previously, do not count on always hearing your signal. Sometimes it just isn't there, but others can hear you. To really work super DX via space is similar to 20 meters – you must use or try any tricks that seem reasonable. A technique for working a specified area is to use a high gain antenna(s) positioned at the midpoint of the satellite's ground track. This is a technique that was used to work KH6 from this area. The same technique could be used to attempt to work a UA9.

At some frequencies (28 MHz and above), another interesting phenomena can occur – signal ducting. This is best described by example.

I have heard OSCAR 6 when it was over Eastern Russia heading for the North Pole with excellent signals. This particular pass was quite removed from my normal window.

On several occasions, WA4JID (Ft. Lauderdale, Florida) has had an excellent return signal from OSCAR 6 when the satellite was out beyond KH6 traveling toward ZL. Actually he had acquisition for a period of 7 minutes after his normal loss of signal (LOS) time. There was no one to work, so he called CQ. Finally he dropped out and the next signal he heard was ZL1WB calling CQ on his frequency. WA4JID uses .35 Watts to a 10 element cross-polarized antenna.

ZK1DX regularly hears OSCAR 6 when it is over the East Coast of the U.S.

Based on these observations, it appears highly possible that one could QSO a ZL from Southern latitudes. I believe with a kW, some antenna gain and good CW operating, it would be possible to really stretch the normal communication ranges.

In this regard, I do not believe that OSCAR 7, Mode B, is as easily stretched. The received signals just seem to drop when predicted LOS occurs. I can state that the downlink received signals on Mode B are much better than what one will hear on 28 MHz. An example of this is hearing OA8V with his 10 Watt ERP with a beautiful signal.

Equipment and Antennas

The equipment required to work OSCAR 6 and 7A is some type of 2 meter transmitter and a 10 meter receiver. A good preamplifier for 10 meters will help immensely. Almost anything will work as the transmitter as long as the particular operator is satisfied with its performance. Here are several ideas for equipment that will work:

1. An FM transmitter with provisions for keying installed and control of normal T/R relay (you do not want the relay to follow your keying or you will soon need to replace the relay). Note: Do not use FM for communications via the satellites.
2. A GE/Motorola FM transmit (TX) strip adapted for CW.
3. VHF Engineering TX-150 strip.
4. Homemade/commercial transverter and amplifier.
5. Two meter CW/SSB transceiver and amplifier.

For OSCAR 7, Mode B, the equipment required is somewhat more difficult to obtain. For the downlink, a reasonable 2 meter converter for an HF receiver will do quite well as will almost any of the present multimode 2 meter transceivers.

The uplink transmitter availability is somewhat limited. Several ideas for equipment include:

1. GE/Motorola 450 FM strip converted for CW.
2. Tripler for a 2 meter transmitter.
3. Homemade/commercial transverter and amplifier.
4. Commercial 432 MHz CW/SSB transceiver.
5. GE/Motorola FM strip converted to be a high mixer/amplifier (SSB/CW).

Further information on equipment requirements is given in the reference section at the end of this article.

With respect to antennas, almost anything will work to some degree or another, but remember that the satellite requires a minimum ERP and the antenna for most low power transmitters is quite important. There are several general rules concerning good satellite antenna practice.

Antennas do not need to be particularly high. For

DXing, what is important is that they be high enough to be in the clear.

The antenna feedline loss becomes an ever increasing factor in VHF/UHF satellite operations. As the antenna height is raised, so is the amount of feedline, preferably coax. At VHF/UHF RG-8 is ok, but, for example, at 146 MHz, 100 feet of RG-8 will have a loss of 3 dB (including connectors). This 3 dB loss reduces the ERP to half of what there would have been if the feedline were lossless. At 432 MHz, 100 feet of RG-8 has 5 dB of loss.

For 28 MHz, it is best to use two antennas, a beam pointed at the satellite (which need not be elevated), and a vertical (I use a vertical dipole). As the downlink signal fades, I switch from one to the other and vice versa.

For 146 MHz, I prefer linear polarization. For DX, I use vertical polarization, and for the remainder I use horizontal. Circular polarization works quite well, but I don't like it on the horizon due to losing half my ERP in the opposite polarization. Circular will have less fading, but for DXing the fading is minimal and can be tolerated.

For 432 MHz, the antenna situation becomes a little sticky — the size of the antenna is small but the chance for error in home built antennas is much greater. I recommend using standard proven antennas. Beware: Some antennas on 432 simply do not have the gain that is advertised. Basically a 6 to 16 element yagi will be adequate. But, remember, the larger the antenna, the sharper the beamwidth, thus requiring accurate pointing. Conversely, as the antenna size is reduced, so is its gain, and thereby the ERP.

In summary, a balance or compromise must be achieved in transmitter power, feedline and antenna size versus pointing problems to obtain the performance that is desired.

Various Amateurs' DX Accomplishments

First of all, I am sure that there are sufficient unique DX accomplishments by a number of individuals that we could go on for some time. To mention a few — when a new country comes on via satellite, you can bet that W2BXA will be in there as if it were a "new one" for him for the DXCC Honor Roll. W8DX, W1NU, K1HTV, W1FTX, VE3SAT and a number of the Northern Jersey DX club members have worked over 50 plus countries. Many have worked 5 continents from the US. Asia is the most difficult.

Conclusion

Many amateurs, who have for years chased DX on the HF bands, have recently started working DX on the satellites and found it to be every bit as challenging. Perhaps you too would like to join many of the HF DXers on OSCAR 6 and 7? If so, it is hoped that many of the ideas in this article will help you along to your fifty states via satellite or maybe even fifty countries. ■

W3TMZ with his OSCAR array.

References

1. *ARRL VHF Handbook,* 3rd edition, p. 197, "Turnstile Antenna," p. 133, "Two-meter Transverter."
2. *ARRL Radio Amateur's Handbook,* 1976, p. 108, "Two-meter Transverter," p. 474, "Space Communications."
3. *Ham Radio,* December, 1972, p. 6, "Signal Polarization," June, 1974, p. 36, "Two-meter Preamp;" March, 1975, p. 34, "Az-El Antenna Mount," July, 1975, p. 58, "432 MHz Oscar Antenna," January, 1976, p. 46, "432-16LB Antenna," March, 1976, p. 44, "VHF/UHF Receivers — How to Improve Them," May, 1976, p. 54, "VHF/UHF Techniques," July, 1976, p. 50, "VHF/UHF Techniques."
4. *QST,* December, 1974, Satellite feature issue.
5. *QST,* September, 1975, p. 15, "Method for Phasing Crossed Yagis for Circular Polarization."

LETTERS

from page 48

single person much more than "I".

I have never referred to myself as "we" and I have discussed this with ham friends, who generally agree that "we" is used only by hams who have a Lindberg complex; they seem to try to create the impression that they never use it in this way, but the very next time I hear them on the air, they are referring to themselves as "we."

All this is somewhat confusing to me and the purpose of this letter is to locate someone who can tell me why this is done, how it got started, and, if there is no logical reason for its use, why do hams continue to use it?

Just as a parting shot, why don't hams on voice just laugh instead of saying "hi"?

Keep the good work going, Wayne; you have a forty over nine magazine.

Walter A. Deiter KH6ANM
Kailua HI

SCI-FI

Several months ago I sent you a note which requested hams who read science fiction to write me. You printed it in the Ham Help column. For that I thank you very much. I received a number of replies and have come up with some more information. I would appreciate it if you would print it as a follow-up.

7250-7255 kHz have been designated as calling frequencies for hams who want to discuss science fiction. 7250 will be used in the evenings, and 14310 can be used on weekends daytime. This will not be a net or any type of directed operation; rather, it will be simply a gathering frequency for interested persons. Just get on and holler "CQ SF!"

For any other information, write me at the following address.

Neil Preston WB0DQW
7024 Bales Ave.
Kansas City MO 64132

OSCAR Frequency Relationships

-- now, where is my downlink?

Robert H. Main W1ZAW
Bible Hill Rd.
Hillsboro NH 03244

One of the most difficult things to get a handle on when you first start out on OSCAR is the relationship between uplink and downlink frequencies. Ever hear a signal on 29.440 MHz and wonder what frequency you should be transmitting on? You look for your hand calculator,

UP	DOWN
145.900	29.450
145.901	29.451
145.902	29.452
145.903	29.453
145.904	29.454
145.905	29.455
145.906	29.456
145.907	29.457
145.908	29.458
145.909	29.459
145.910	29.460
145.911	29.461
145.912	29.462
145.913	29.463
145.914	29.464
145.915	29.465
145.916	29.466
145.917	29.467
145.918	29.468
145.919	29.469
145.920	29.470
145.921	29.471
145.922	29.472
145.923	29.473
145.924	29.474
145.925	29.475
145.926	29.476
145.927	29.477
145.928	29.478
145.929	29.479
145.930	29.480
145.931	29.481
145.932	29.482
145.933	29.483
145.934	29.484
145.935	29.485
145.936	29.486
145.937	29.487
145.938	29.488
145.939	29.489
145.940	29.490
145.941	29.491
145.942	29.492
145.943	29.493
145.944	29.494
145.945	29.495
145.946	29.426
145.947	29.497
145.948	29.498
145.949	29.499
145.950	29.500
145.951	29.501
145.952	29.502
145.953	29.503
145.954	29.504
145.955	29.505
145.956	29.506
145.957	29.507
145.958	29.508
145.959	29.509
145.960	29.510
145.961	29.511
145.962	29.512
145.963	29.513
145.964	29.514
145.965	29.515
145.966	29.516
145.967	29.517
145.968	29.518
145.969	29.519
145.970	29.520
145.971	29.521
145.972	29.522
145.973	29.523
145.974	29.524
145.975	29.525
145.976	29.526
145.977	29.527
145.978	29.528
145.979	29.529
145.980	29.530
145.981	29.531
145.982	29.532
145.983	29.533
145.984	29.534
145.985	29.535
145.986	29.536
145.987	29.537
145.988	29.538
145.989	29.539
145.990	29.540
145.991	29.541
145.992	29.542
145.993	29.543
145.994	29.544
145.995	29.545
145.996	29.546
145.997	29.547
145.998	29.548
145.999	29.549

Fig. 1. OSCAR 6.

only to find that it is on your desk at work. So you have to take pencil in hand and try to find some paper to figure things out. By the time all that has been accomplished, either the satellite has flown over, the station you were hearing is talking to someone else, or the station is out of range.

Having had that experience too many times, I decided it was time to have some printouts at my fingertips, or on the wall next to my operating location. So, with the help of a computer, the accompanying tables have been developed. As you can see, OSCAR 7 users (mode B) would really have a calculating problem tripling up from 2m. It's a simple matter to use the desired listening frequency and follow across the chart to find the desired transmitting frequency. We carried this out to five places so that anyone rockbound could order crystals easily. Also, the telemetry fix on board OSCAR 7 has been putting out a good signal and is an excellent way of

Fig. 2. OSCAR 7, mode A.

UP	DOWN
145.850	29.400
145.851	29.401
145.852	29.402
145.853	29.403
145.854	29.404
145.855	29.405
145.856	29.406
145.857	29.407
145.858	29.408
145.859	29.409
145.860	29.410
145.861	29.411
145.862	29.412
145.863	29.413
145.864	29.414
145.865	29.415
145.866	29.416
145.867	29.417
145.868	29.418
145.869	29.419
145.870	29.420
145.871	29.421
145.872	29.422
145.873	29.423
145.874	29.424
145.875	29.425
145.876	29.426
145.877	29.427
145.878	29.428
145.879	29.429
145.880	29.430
145.881	29.431
145.882	29.432
145.883	29.433
145.884	29.434
145.885	29.435
145.886	29.436
145.887	29.437
145.888	29.438
145.889	29.439
145.890	29.440
145.891	29.441
145.892	29.442
145.893	29.443
145.894	29.444
145.895	29.445
145.896	29.446
145.897	29.447
145.898	29.448
145.899	29.449
145.900	29.450
145.901	29.451
145.902	29.452
145.903	29.453
145.904	29.454
145.905	29.455
145.906	29.456
145.907	29.457
145.908	29.458
145.909	29.459
145.910	29.460
145.911	29.461
145.912	29.462
145.913	29.463
145.914	29.464
145.915	29.465
145.916	29.466
145.917	29.467
145.918	29.468
145.919	29.469
145.920	29.470
145.921	29.471
145.922	29.472
145.923	29.473
145.924	29.474
145.925	29.475
145.926	29.476
145.927	29.477
145.928	29.478
145.929	29.479
145.930	29.480
145.931	29.481
145.932	29.482
145.933	29.483
145.934	29.484
145.935	29.485
145.936	29.486
145.937	29.487
145.938	29.488
145.939	29.489
145.940	29.490
145.941	29.491
145.942	29.492
145.943	29.493
145.944	29.494
145.945	29.495
145.946	29.496
145.947	29.497
145.948	29.498
145.949	29.499

UP INPUT FC	DOWN OUTPUT FC
432.125	145.975
432.126	145.974
432.127	145.973
432.128	145.972
432.129	145.971
432.130	145.970
432.131	145.969
432.132	145.968
432.133	145.967
432.134	145.966
432.135	145.965
432.136	145.964
432.137	145.963
432.138	145.962
432.139	145.961
432.140	145.960
432.141	145.959
432.142	145.958
432.143	145.957
432.144	145.956
432.145	145.955
432.146	145.954
432.147	145.953
432.148	145.952
432.149	145.951
432.150	145.950
432.151	145.949
432.152	145.948
432.153	145.947
432.154	145.946
432.155	145.945
432.156	145.944
432.157	145.943
432.158	145.942
432.159	145.941
432.160	145.940
432.161	145.939
432.162	145.938
432.163	145.937
432.164	145.936
432.165	145.935
432.166	145.934
432.167	145.933
432.168	145.932
432.169	145.931
432.170	145.930
432.171	145.929
432.172	145.928
432.173	145.927
432.174	145.926
432.175	145.925

UP INPUT FC	DOWN TRIPLER FC
432.125	144.04167
432.126	144.04200
432.127	144.04233
432.128	144.04267
432.129	144.04300
432.130	144.04333
432.131	144.04367
432.132	144.04400
432.133	144.04433
432.134	144.04467
432.135	144.04500
432.136	144.04533
432.137	144.04567
432.138	144.04600
432.139	144.04633
432.140	144.04667
432.141	144.04700
432.142	144.04733
432.143	144.04767
432.144	144.04800
432.145	144.04833
432.146	144.04867
432.147	144.04900
432.148	144.04933
432.149	144.04967
432.150	144.05000
432.151	144.05033
432.152	144.05067
432.153	144.05100
432.154	144.05133
432.155	144.05167
432.156	144.05200
432.157	144.05233
432.158	144.05267
432.159	144.05300
432.160	144.05333
432.161	144.05367
432.162	144.05400
432.163	144.05433
432.164	144.05467
432.165	144.05500
432.166	144.05533
432.167	144.05567
432.168	144.05600
432.169	144.05633
432.170	144.05667
432.171	144.05700
432.172	144.05733
432.173	144.05767
432.174	144.05800
432.175	144.05833

Fig. 3. OSCAR 7, mode B. Telemetry beacon: 432.100.

IN	OUT	IN	OUT
145.850	29.400	145.901	29.451
145.851	29.401	145.902	29.452
145.852	29.402	145.903	29.453
145.853	29.403	145.904	29.454
145.854	29.404	145.905	29.455
145.855	29.405	145.906	29.456
145.856	29.406	145.907	29.457
145.857	29.407	145.908	29.458
145.858	29.408	145.909	29.459
145.859	29.409	145.910	29.460
145.860	29.410	145.911	29.461
145.861	29.411	145.912	29.462
145.862	29.412	145.913	29.463
145.863	29.413	145.914	29.464
145.864	29.414	145.915	29.465
145.865	29.415	145.916	29.466
145.866	29.416	145.917	29.467
145.867	29.417	145.918	29.468
145.868	29.418	145.919	29.469
145.869	29.419	145.920	29.470
145.870	29.420	145.921	29.471
145.871	29.421	145.922	29.472
145.872	29.422	145.923	29.473
145.873	29.423	145.924	29.474
145.874	29.424	145.925	29.475
145.875	29.425	145.926	29.476
145.876	29.426	145.927	29.477
145.877	29.427	145.928	29.478
145.878	29.428	145.929	29.479
145.879	29.429	145.930	29.480
145.880	29.430	145.931	29.481
145.881	29.431	145.932	29.482
145.882	29.432	145.933	29.483
145.883	29.433	145.934	29.484
145.884	29.434	145.935	29.485
145.885	29.435	145.936	29.486
145.886	29.436	145.937	29.487
145.887	29.437	145.938	29.488
145.888	29.438	145.939	29.489
145.889	29.439	145.940	29.490
145.890	29.440	145.941	29.491
145.891	29.441	145.942	29.492
145.892	29.442	145.943	29.493
145.893	29.443	145.944	29.494
145.894	29.444	145.945	29.495
145.895	29.445	145.946	29.496
145.896	29.446	145.947	29.497
145.897	29.447	145.948	29.498
145.898	29.448	145.949	29.499
145.899	29.449	145.950	29.500
145.900	29.450	145.951	29.501

Fig. 4. OSCAR D, mode A. Telemetry: 29.400.

IN	OUT	IN	OUT
145.900	435.200	145.951	435.149
145.901	435.199	145.952	435.148
145.902	435.198	145.953	435.147
145.903	435.197	145.954	435.146
145.904	435.196	145.955	435.145
145.905	435.195	145.956	435.144
145.906	435.194	145.957	435.143
145.907	435.193	145.958	435.142
145.908	435.192	145.959	435.141
145.909	435.191	145.960	435.140
145.910	435.190	145.961	435.139
145.911	435.189	145.962	435.138
145.912	435.188	145.963	435.137
145.913	435.187	145.964	435.136
145.914	435.186	145.965	435.135
145.915	435.185	145.966	435.134
145.916	435.184	145.967	435.133
145.917	435.183	145.968	435.132
145.918	435.182	145.969	435.131
145.919	435.181	145.970	435.130
145.920	435.180	145.971	435.129
145.921	435.179	145.972	435.128
145.922	435.178	145.973	435.127
145.923	435.177	145.974	435.126
145.924	435.176	145.975	435.125
145.925	435.175	145.976	435.124
145.926	435.174	145.977	435.123
145.927	435.173	145.978	435.122
145.928	435.172	145.979	435.121
145.929	435.171	145.980	435.120
145.930	435.170	145.981	435.119
145.931	435.169	145.982	435.118
145.932	435.168	145.983	435.117
145.933	435.167	145.984	435.116
145.934	435.166	145.985	435.115
145.935	435.165	145.986	435.114
145.936	435.164	145.987	435.113
145.937	435.163	145.988	435.112
145.938	435.162	145.989	435.111
145.939	435.161	145.990	435.110
145.940	435.160	145.991	435.109
145.941	435.159	145.992	435.108
145.942	435.158	145.993	435.107
145.943	435.157	145.994	435.106
145.944	435.156	145.995	435.105
145.945	435.155	145.996	435.104
145.946	435.154	145.997	435.103
145.947	435.153	145.998	435.102
145.948	435.152	145.999	435.101
145.949	435.151	146.000	435.100
145.950	435.150	146.001	435.099

Fig. 5. OSCAR D, mode J. Telemetry: 435.095.

checking your receiver.

By the way, don't forget the Doppler effect which causes the satellite to gradually shift in frequency as the bird moves toward or away from your location. But Doppler effect or not, the relationship between the various uplink and downlink frequencies will remain consistent. ■

J. W. Marriette VE7BGX
#302-33400 Bourquin Place
Abbotsford, British Columbia
Canada V25 5G3

Calculate OSCAR Orbits

-- with your HP-25 calculator

Last year I developed an interest in OSCAR activity after having read a back issue of *73* that was entirely devoted to this subject. When I sat down to work out the orbital times to look for 06 and 07 in my area, I decided very quickly there had to be a better way. The calculation of orbit #5, for example, on any given day can be a time-consuming effort at best, and, if you want the most likely times for communication via this mode on a daily basis throughout the month, these calculations could be a downright nuisance unless you have access to a complete list of tables for this purpose.

Since my HP-25 was sitting idle and I was still trying to justify its purchase price, I decided that it was about time it should start doing more than calculating debits from my savings account.

This program is not very complicated in the sense that it doesn't work out any heavy math problems, but it does do the job of working out the orbits of either 06 or 07 between the times listed each month in *73*. The program will update the orbital number, the equatorial crossing and time of crossing for each successive pass from the first pass listed for each day. If you wish, subtracting the number of hours you are from GMT on the first entry will result in a local time readout for the equatorial crossing.

An example is probably worth a thousand words, so let's take the case of orbit #19264 on January 1, 1977, for OSCAR 6. (See Table 1.) My QTH is eight hours from GMT; therefore, subtracting 8 hours from 0124:02 and adding 24, we arrive at 1724:02 local time. This, of course, is the day before or 5:24 pm on December 31.

HP-25 Program Form

Title: OSCAR ORBITAL DATA — Page 1 of 1
Programmer: J. MARRIETTE

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS				OUTPUT DATA/UNITS
1	Key in Program						
2	Set Constants in Registers						
	(a) Precession	28.75°	STO	2			
	(b) Orbital Period						
	Oscar 6	1.545967	STO	3			
	Oscar 7	1.5456	STO	3			
	(c) # of Degrees in a Circle	360	STO	4			
	(d) Orbit #	19264	STO	5			Data Only For This Example
3	1st Orbit Time	01:24:02	↑				
4	1st Equatorial Crossing	72.5°Long					
5	Initialize		f	PRGM	R/S		Orbit # & Time
			R/S				Local Crossing °Long.
6	Next Orbit		R/S				

HP-25 Program Form

Title: ____ Page ____ of ____
Switch to PRGM mode, press [f] [PRGM], then key in the program.

LINE	CODE	KEY ENTRY	X	Y	Z	T	COMMENTS
00							
01	141104	f FIX 4					
02	2300	STO Ø					
03	22	↓					
04	2301	STO 1					
05	2400	RCL Ø					
06	2402	RCL 2					
07	51	+					
08	2307	STO 7					
09	2401	RCL 1					
10	1500	g H ←					
11	2403	RCL 3					
12	1500	g H ←					
13	51	+					
14	1400	f HMS					
15	2306	STO 6					
16	2405	RCL 5					
17	01	1					
18	51	+					
19	2305	STO 5					
20	1474	f PAUSE					
21	02	2					
22	04	4					
23	2406	RCL 6					
24	1441	f x < y					
25	1329	GTO 29					
26	41	-					
27	32	CHS					
28	2306	STO 6					
29	74	R/S					
30	2404	RCL 4					
31	2407	RCL 7					
32	1441	f x < y					
33	1337	GTO 37					
34	41	-					
35	32	CHS					
36	2307	STO 7					
37	74	R/S					
38	2406	RCL 6					
39	2407	RCL 7					
40	1301	GTO Ø1					
41							
42							
43							
44							
45							
46							
47							
48							
49							

REGISTERS	
R_0	LAST LONG
R_1	LAST TIME
R_2	PRECESSION 28.75
R_3	ORBITAL PERIOD 1.54:59/1.55
R_4	360
R_5	ORBIT #
R_6	TIME
R_7	LONG

Orbit #	Date	Time (GMT)	Eq. Crossing °W
19264	1	1:24:02	79.5

Table 1.

Key in the program information using the HP program forms. When the program is run, the pause will give the pass number, and the first stop will give the time. Pressing the R/S key will then give the equatorial crossing longitude for this orbit. The drawback to this program is that you have to go through each pass to reach the one you want, but, unfortunately, I haven't figured out how to get an extra register and 30 more program steps into the calculator in order to eliminate this problem, so I guess this will have to do until I can get my Micro P operational. (See Table 2.)

Hopefully this article will encourage other members of the ham community with access to one of these calculators to sit down and work out additional programs for this and other areas of our hobby. If this is the case, I will be looking forward to seeing these programs in future issues of *73*. ■

Data

Orbit #	Local Time	Equatorial Crossing (°Long.)
19264	1724:02	79.5
19265	1919:01	108.25
19266	2114:00	137
19267	2308:59	165.75
19268	0103:58	194.5
19269	0258:57	223.25

Table 2.

Corrections

Texas legal beagles and scanner manners have indicted us for stating that the "Big Bust In Amarillo" (Oct., p. 154) took place on July 7th. We throw ourselves on the mercy of the readership, and readily admit that the date was, indeed, July 6th. No more letters, please.

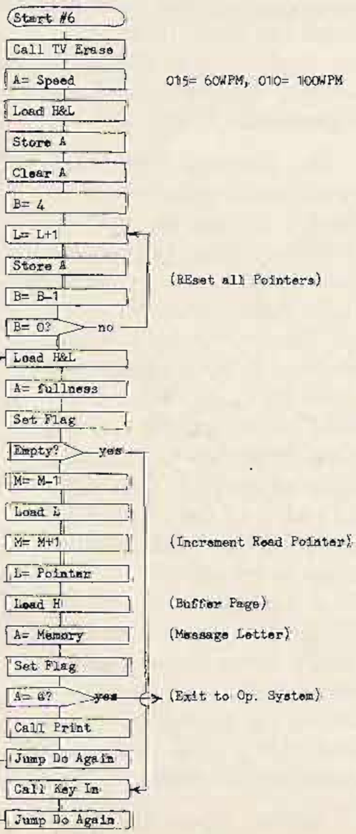
John C. Burnett
Managing Editor

Our apologies to Harry Matthews K2AOU, for inadvertently omitting the documentation for his Main Buffer System ("Digital Group RTTY Micro," Sept., p. 98). Here it is.

John C. Burnett
Managing Editor

Main Buffer System

007 300	315 021 002
007 303	076 015
007 305	041 132 007
007 310	167
007 311	257
007 312	006 004
007 314	054
007 315	167
007 316	005
007 317	302 314 007
007 322	041 133 007
007 325	176
007 326	247
007 327	312 355 007
007 332	065
007 333	056 136
007 335	064
007 336	156
007 337	046 006
007 341	176
007 342	376 200
007 344	312 000 000
007 347	315 000 007
007 352	303 322 007
007 355	315 140 005
007 360	303 322 007



I think I've found an error on page 47 of your August issue. The diagram for the Zeppy Vertical shows the braid of the coax attached to the radiator and the center conductor to the matching stub. These connections should be reversed. As written, the antenna was inferior to a ¼ wave whip. Reversed, it improved on the ¼ wave by several S-units. Keep up the good magazine.

Tim Knauer WD9AMY
Peoria IL

In addition to my new call and address, please note several minor changes to "Synthesize Yourself!" (Oct., p. 182):

1. Page 186, col. 4, lines 16 and 17, should read, "nect the square wave *input* from pin 1 of the MC*4044*,".
2. Page 186, col. 4, line 32, should read, "MC*4044* as shown. The out-".
3. Page 188, col. 4, lines 36 through 38, should read, "generates a square *wave* output. In cases where the vco generates sine waves *or* other wave-".

George R. Allen W2FPP
161 Rosendale Drive
Binghamton NY 13905

Ham Help

I have been interested in ham radio for the past couple of years. I currently hold a Citizens Band license, but I am totally disenchanted with that type of communication. I have been studying on my own and have no trouble with the technical aspect of the license. But the code has been very disheartening. I would like to know if there are any clubs that give Morse code classes in my area. Or if I could meet or contact amateur radio operators who would be willing to help. Any and all help will be deeply appreciated.

Ed Rojas
Box 490
Union City NJ 07087

Help! I purchased a Hallicrafters Tornado SR-500 SSB 500 Watt 80-40-20 rig and need help finding someone who carries the 8236 final amplifiers. Can't find listing in Sylvania, RCA, Amperex, or other tube makers. Where can you get these 8236s and what is their cost (understand Hallicrafters is no longer in business)?

Also, if anyone has information on modifications, improvements, changes, etc., to the SR-500, I would appreciate their writing to me. Can the 8236s be subbed for (for example, with a pair of 6146Bs with only 200 Watts PEP instead of 500 Watts)?

Any assistance from other hams would be appreciated. Thanks.

Marvin Jack Moss W4UXJ
P.O. Box 28601
Atlanta GA 30328

With the ever-increasing use of electronics in hospitals and related health care facilities, there has been a large influx of EE and E Techs to provide repair and calibration for the medical electronic equipment that lies scattered throughout these establishments. It is my guess there must be several hundred amateur radio operators hidden within these ranks. With the help of your column, I would like to compile a listing of all licensed amateur radio operators employed by hospitals/health care facilities/medical electronic equipment manufacturers and service centers.

Interested hams should send their name/callsign/QTH to my attention.

Dave Miller WA4ZKZ
721 Due West Ave.
Apt. G 202
Madison TN 37115

I am the proud owner of a Sumner Model HCV-1B SSTV Camera and a Model HCV-2A SSTV Monitor, neither of which are operating satisfactorily. I urgently require a copy of the circuit diagrams and component listing of these units.

Ken Squires VK2SD
1 Simpson Street
Bondi, N.S.W. 2161
Australia

Help! I am looking for manuals for the following low band radios: Motorola Model L41G-1A — this is an ac base; Motorola Model T71-GKT 1100B — low band 12 V dc mobile. If anyone has manuals or schematics for the radios, a copy would be appreciated. Please drop me a line.

Ron Lula WB9WXO
55428 Meadowview Ave.
South Bend IN 46628

I need the tube test data for the TV-4 tube tester. This is part of the USM-3A. Will buy or copy.

Gary P. Cain W8MFL
2464 Hand Rd.
Niles MI 49120

Would like to hear from anyone who has a National AN/WRR-2.

N. K. Maxwell K5BA
623 Ute Drive
Stillwater OK 74074

David J. Brown W9CGI
RR5, Box 39
Noblesville IN 46060

CB to OSCAR

-- from 10 to the sky!

This article describes how to convert a specific 23 CB radio for use on the OSCAR satellites and gives you my ideas on an OSCAR 10 meter bandplan very much like that of W4NVH in the May, 1977, issue of *73 Magazine*, p. 106. (He covered the 28 MHz portion of 10 meters, but used the same channel and conversion of CB gear principles.) If you read that article, you will see that the method applies very nicely to many of the now very inexpensive 23 channel CB rigs. The more I read W4NVH's article, the more things I could find that directly applied to the Sears 23 channel Model 934.36740500 CB I already had.

The CB channels have a few blanks between the 23 channels (remote control, etc.) that are taken care of by one each of the transmitter offset oscillator crystals and receiver offset oscillator crystals. In my transmitter, the crystal frequencies of 10.595, 10.615, 10.625, and 10.635 MHz are used, and, in the receiver, 10.140, 10.160, 10.170, and 10.180 MHz are used. Following a numbers progression, the oddballs are obviously the 10.595 and 10.140 crystals. In order to maintain continuous coverage, I changed the 10.595 to 10.605 MHz and the 10.140 to 10.150 MHz. Then I had a synthesis scheme capable of 230 kHz coverage in 10 kHz steps.

Considering that the OSCAR 6 and OSCAR 7 combined bandwidth is only 150 kHz, and further considering that an AM or AM/SSB mode (even when CW keying is added) would not be at all welcome above 146.000 MHz, my bandplan starts at 146 MHz and works downward. A couple of unique quirks came out of that fact. They alone might add merit to the bandplan, when using CB radios. The first is that, when you convert a CB radio over to the 10 meter band for transmit and receive, two things happen. The receiver winds up being in the 10 meter downlink, where it belongs, by only changing crystals and repeaking a very few front end stages (on signal, if need be — for those of you with little building experience and test equipment).

On transmit, the transmitter signal output is on 10 meters to go to the upconverter, and, believe me, just about every commercially made transverter uses a 10 meter input. I know, because I have spent two years trying to find a Drake TC-2 to go with my Drake TR-6 to get up to 2 meters. Unfortunately, the Drakes run a 14 MHz i-f out of the TR-6 and into the TC-2, negating using anything but Drake's TC-2. Couple this to very few TC-2s having been made at all (that's when Drake dumped their VHF line altogether, leaving us at the mercy of imports), and you can appreciate my problem.

Another transmitter benefit is that the transverter winds up being 116.45 MHz — exactly the OSCAR offset through the translator in reverse. So, when you tune the receiver, you are tracking the transmitter right along with you, plus or minus Doppler. As for Doppler, the CB manufacturers never could get together to decide on what channel they were transmitting or who was on the channel frequency and who was off. So, manufacturers include a little control on most panels now, marked ± delta — i.e., a Doppler control.

As for the bandplan, if you begin at 146 MHz as the 29.55 MHz downlink (or 146 MHz uplink), the cardinal frequencies of 29.5 MHz and 29.4 MHz (OSCAR 7 band edges) just happen to fall on channel 19 and channel 9 respectively.

Plug in the new synthesizer crystals X-1 to X-6 and change the offset crystals X-10 and X-14 to pull the band together. Then peak up the synthesizer output tank (T8 in mine). C37, across the primary in the Sears, may have to be reduced in capacity slightly, if the synthesizer output transformer lacks enough tuning range. Now, with the new synthesized frequencies from 39.955 to 40.155 MHz coming out of the synthesizer, feed a 10 meter signal (signal generator or off air) into the coax fitting. Align the 10 meter (was 27 MHz) front end receiver coil(s), which are T1 and T2 in mine, by backing out the slugs a bit and tuning for maximum agc, signal, etc. Do *not* touch any other receiver tuning, assuming the rig is new and/or properly aligned for CB frequencies. The i-fs do *not* change. For CW reception, the easiest way is build a little 455 kHz vco, so you can "pot" control it with dc from outside the radio and not botch things up by drilling holes in the panels. Assuming you like channelized transceiving as little as I do, you can build a second vco on the synthesizer frequency, or some submultiple of it and multiply, and run it, too, from an outside pot. After all, it is no longer a CB radio, so vfo/vcos are legal. In my own, I kept the crystals in the X-3, X-4, X-5, and X-6 positions (but at the new frequencies shown), and a vco runs into the X-1 position, with X-2 a blank. This way you can run the vco from 39.955 MHz to 40.155 MHz using a ten-turn pot for vernier action and, by switching from channel 1 through 4 positions, cover the entire 29.32 to 29.55 MHz range on receive and have the proper transmitter frequencies to up-convert to 145.77 to 146 MHz. With the lower edge below OSCAR, you are about in 2 meter AM land. With the same synthesizer schemes used by so many rigs, even an AM/SSB (23 channel version) is cheaper now and would really be a great way to go, if you want the SSB mode through OSCAR and can afford an extra few bucks. By allowing the vco to tune down to 38.185 MHz (or shifting it to cover 230 kHz there, as 39.185 to 39.405 MHz — with a small C switched in?), you can have a dandy 145 to 145.230 MHz out of the transverter and be right with the 2 meter SSB gang. Add a small 2 meter to 10 meter converter (Hamtronics makes a great one), using the same 116.45 MHz oscillator offset, and you have a rig as versatile as the most expensive ones designed for OSCAR and 2 meter gear on the market.

The transmitter conversion is just about as tough as the receiver — in other words, not at all. In mine, once the receiver was done (hence, the synthesizer), it involved peaking up the old 27 MHz transmitter stages to the 10 meter band by backing out the slugs a little and, where needed, reducing the tuning capacitors across the transformers, when the slug had to be backed out too far to be practical (slug showing out of the coil form). In my radio this involves T12-C69, T13, T14-C72, T15-C77, T16-114, T17, and T18. This is as easy as tuning up the average Heathkit for the same reasons, because the test equipment is built in the form of a built-in wattmeter (rf output) and swr combination meter function in transmit. Incidentally, when I said peak the receiver for maximum agc on an incoming steady signal, I had an S-meter in my radio to measure that by.

New Channel	Freq.	Equiv. 2m Freq. + 116.45	Synthesizer	Transmit osc.	Receive osc.	Note
1	29.32	145.77	X1 39.955	X11 10.635	X7 10.180	
2	29.33	145.78	X1 39.955	X12 10.625	X8 10.170	
3	29.34	145.79	X1 39.955	X13 10.615	X9 10.160	
4	29.35	145.80	X1 39.955	X14 10.605	X10 10.150	
5	29.36	145.81	X2 39.995	X11	X7	
6	29.37	145.82	X2 39.995	X12	X8	
7	29.38	145.83	X2 39.995	X13	X9	
8	29.39	145.84	X2 39.995	X14	X10	
*9	29.40	145.85	X3 40.035	X11	X7	Band edge 7
10	29.41	145.86	X3 40.035	X12	X8	
11	29.42	145.87	X3 40.035	X13	X9	
12	29.43	145.88	X3 40.035	X14	X10	
13	29.44	145.89	X4 40.075	X11	X7	
14	29.45	145.90	X4 40.075	X12	X8 Beacon 6	Band edge 6
15	29.46	145.91	X4 40.075	X13	X9	
16	29.47	145.92	X4 40.075	X14	X10	
17	29.48	145.93	X5 40.115	X11	X7	
18	29.49	145.94	X5 40.115	X12	X8	
*19	29.50	145.95	X5 40.115	X13	X9 Beacon 7	Band edge 7
20	29.51	145.96	X5 40.115	X14	X10	
21	29.52	145.97	X6 40.155	X11	X7	
22	29.53	145.98	X6 40.155	X12	X8	
23	29.54	145.99	X6 40.155	X13	X9	
24	29.55	146.00	X6 40.155	X14	X10	Band edge 6

Table 1. CB radios to OSCAR bandplan for a Sears 934.36740500. All figures in MHz. Xmit: Fsynth - Fxmit osc = four MHz; Rcv: Fsynth - Fin - Frcv osc = .455 MHz Lo i-f.

In the extraneous department, the rig I have has a noise limiter that works pretty well as is, so I left that alone. It also has a PA position that can be put to good use. Since mine is an AM only rig, I had only CW in mind. The modulator-audio stages in the transmit mode (they are shared) can be put to use by placing them in PA (which routes the audio to that jack from the receiver as well) and then causing the low audio stages to be an oscillator at some pleasant tone. Or you could use a separate tone oscillator, so that when you key the rig, you have sidetone. On the AM only rigs you might as well, because AM is not very welcome through OSCAR because of its unnecessary BW.

On the subject of keying, since this is an AM rig only, the + voltage for the modulation is broken away from the modulation winding of the common audio transformer by removing an isolation diode (D13) and opening that path. The + voltage from the power supply section is routed out to the external speaker jack, after taking it out of the receiver audio output path and putting a permanent ground on the low side of the speaker.

While on the subject of the speaker, I had a problem with mine. There is a 10 Ohm resistor in series with the 8 Ohm speaker, whose only purpose I can see is to allow them to run one common audio circuit, transformer, and a lower wattage speaker, and to accept the lower audio output on the bottom-of-the-line sets. This was a 1 W 3-inch round unit in my radio, and it was shorted, to boot.

Part of the reason I got the radio for the right price was that it did not work. It had one open copper foil in the +V copper, where the shorted speaker had tried to make a fuse out of it — and it succeeded. That is absolutely all that was wrong, and I ran it as a base by sharing my Heathkit supply for the HW 202 FM for months before I tried working on it. I got mine for less than $10, so check your local sources.

Back to the speaker — when I replaced it, I got a 3-inch round, 2 W replacement speaker and stuffed a small, 2 Ohm ½ W resistor in the 10 Ohm spot. I can now drive you out of the room with audio!

When you plug a key in the external speaker jack now, the key opens and closes the driver and final + voltages, and you have a CW rig — almost. The microphone circuit in my model is rather tricky, as it does all the changeover (X/R) by voltage switching. I substituted another DPDT switch — toggle type — on the same panel as the vco synthesizer and vco/bfo pots, and used it for the transmit position. Leave the microphone and connections off the switch and wire the rest the same, just to be rid of the PTT/hold-the-button-down routine.

When the key is depressed, the LED modulation light comes on, as it is activated by the same power line as the driver and final. It makes a good CW monitor, if you like the visual types and don't want to add the tone oscillator into the audio circuits.

To get the vco lines in and out of the radio, mine had a Heyco type grommet that "bites" the +12 V and ground where it goes into the back panel through a 3/8" hole. Replace it with a normal 3/8" rubber grommet, and you have a hole you can drive a bus through, with plenty of room for 6 to 8 wires.

Convince your CB "good buddy" that he really needs SSB or 40 channels, and offer him a good trade price for his old 23 channel rig. The dealers are offering peanuts on 23 channel rigs, because you can buy a new 23 channel so cheaply now that they can't sell a used one. He will end up happy and so will you! Or, go see your local CB store, and see if he took the same bath most dealers and wholesalers took, when they were stuck with warehouses of 23 channel stock, when 40 channel hit the market. Talk it up at your club (and the bandplan and see if they agree), and then go make an offer on 10 or more identical units — quantity talks. They are great for CD type groups in crowded 2 meter FM areas!

Last, but certainly not least, if you are the least bit adept at repair work and common logic and own just a VOM or VTVM, you can buy a non-working unit from places like Sears Save Shop and local radio dealers who don't really have much in the way of repair facilities.

Well, I've given you a plan of attack, a bandplan so you will have company in the present wasteland of 10 meters, a cheap way to get up on OSCAR, some hints for using my unit, and the source for one of your own if you go looking. Even schematics and manuals are a breeze (unlike the old FM conversion days when *any* Motorola manual or even a close schematic you saw as a ham was yellowed, battered, torn, thumbprinted, and worn from the use of 50-plus hams).

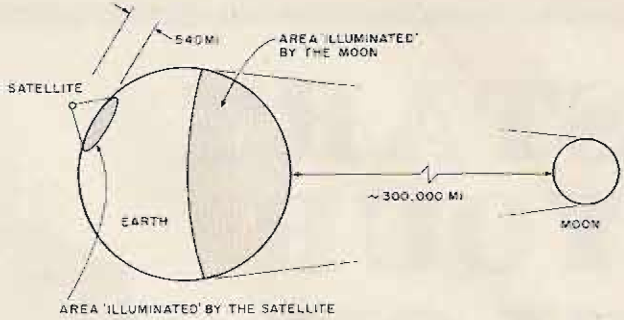
You should know that T18, in my rig, is used to adjust the output to 5 Watts and also that the final device used is a 2SC799 with a 10 W hfe of 50 to 90, 150 MHz rating with a BVcbo = 80 V, BVebo = 5 V, and BV well above the rated use! Consider the low duty cycle of CW versus the AM cycle which it was running a steady 5 Watts at. I run mine off the high regulated 18 V dc and load it up (tune) for about 14 W key down. I haven't lost a device yet, but, to be safe, you may want to quit at the manufacturer's (Nippon Electric) rated 10 Watts.

There are only two words of caution I will add in closing. If you tackle a PLL type synthesizer, it's not so easy. It can be done — on some — at some time and expense and risk of odd products sneaking out.

My only other comment is that you should turn back a few issues and read through W4NVH's article. It is excellent background and easy to follow and use. You can figure out just what kind of rig you have, if you already have it, and how to apply my antics to it.

Don't try to part-convert one to cover 10 meters (say, low end, per W4NVH) for CD activity and try to save a chosen "few" of the CB channels for CB use. You void the manufacturer's approval when you cut into the rig, even if you hold a 1st class radiotelephone license, as I do. You void any warranty on the rig any way you cut it. And you could just void your license if you get caught with this modification. Pick your band, and have fun. ■

Fig. 1. Two stations must "see" the satellite's transponder simultaneously in order to communicate with each other, i.e., they both must be located in the area "illuminated" by the satellite. Note that a transponder located on the moon will allow communication with stations separated farther apart than a satellite orbiting the Earth at lower altitude.



Kazimierz J. Deskur K2ZRO
P.O. Box 11
Endicott NY 13760

Track OSCAR 8!

-- step-by-step method

The launching of the AMSAT OSCAR 6 and 7 satellites gave amateur radio a permanent foothold in space communication. In years to come, satellite communications will become as common as 2m FM or DXing on 20m is today.

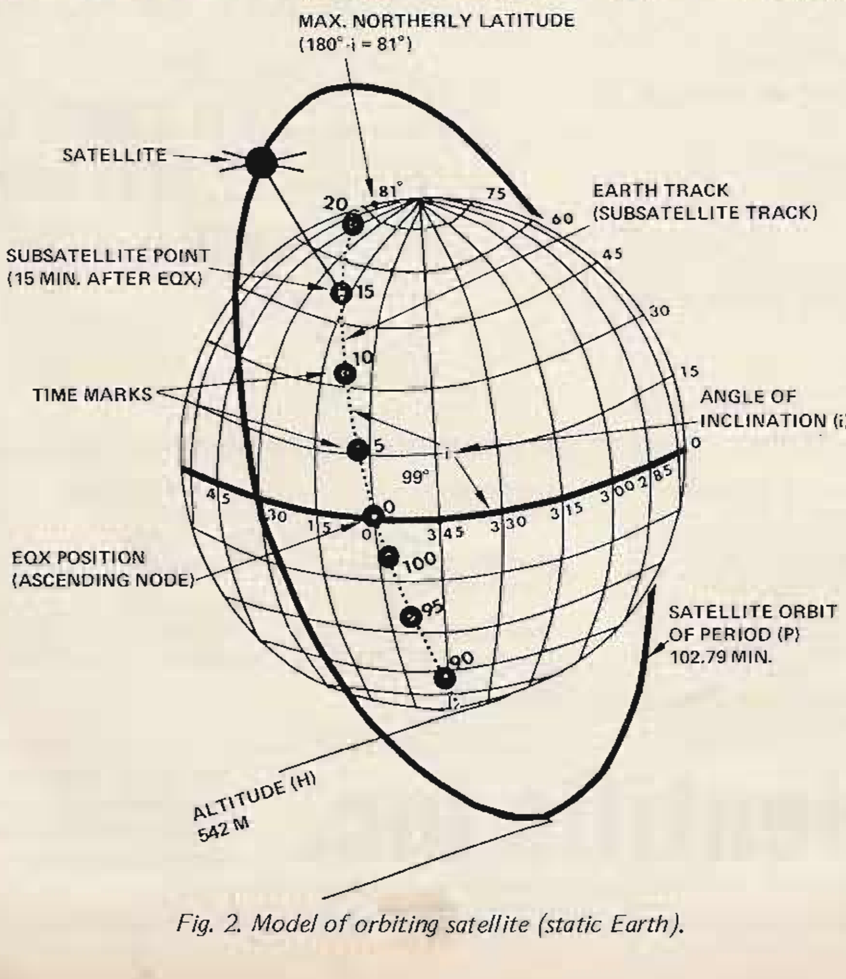


Fig. 2. Model of orbiting satellite (static Earth).

Although there are now thousands of users of OSCARs 6 and 7, they represent only a very small fraction of the total amateur community. Why is it that so many VHFers who own perfectly suitable equipment never worked through OSCARs?

Apparently, the major deterrent is the lack of familiarity with satellite tracking, which many consider to be a formidable and complex problem requiring knowledge of astronomy, astrophysics, higher mathematics, and other disciplines of science. But, in fact, satellite tracking is a relatively simple procedure easily grasped by those who show even a slight interest in this subject.

The purpose of this article is to explain the procedure of satellite tracking from the standpoint of common sense and simple reasoning. I suggest that the reader follow the presented sequence of reasoning step by step and not go to the next paragraph before the previous one is fully understood.

Space communication is the future of amateur radio. We might as well get familiar with it, and the knowledge of satellite tracking is the first step.

The First Earth Satellite – The Moon

Let's suppose that an OSCAR transponder was placed on the moon. Using suitable equipment, we could communicate through it the way we communicate via 2m repeaters. Since VHF waves don't bend around the curvature of the Earth, we may assume that the lunar transponder can be accessed only if the moon is above the horizon in respect to the stations that attempt to communicate through it. Obviously, a two-way QSO between distant stations can only take place if both stations have the moon in direct view.

Without any knowledge of astronomy, we can guess that at a particular instant of time the moon will be visible in different directions, and at different angles above the horizon, in different parts of the world. Also, there will be locations on the Earth where the moon will not be visible at all.

With the combination of the revolution of the Earth and the orbiting of the moon, the prediction of its exact celestial position, at a particular day and hour for a chosen geographical location, represents apparently a very complex problem. Nevertheless, this "difficulty" was solved thousands of years ago by ancient astronomers before trigonometry, calculus, computers, and even writing were invented.

The artificial satellites, such as the OSCARs, behave very much like a moon with the following small differences:

– Artificial satellites are too small to be visible to the naked eye, so their positions can only be predicted.

– They orbit the Earth at the rate of hours per revolution instead of weeks. This implies that their rising and setting at a particular location of the Earth will be more frequent.

– They orbit at low altitudes; therefore, the range from which two stations can "see" a satellite simultaneously will be much shorter (see Fig. 1).

Terminology

In order to better understand satellite tracking, we must form a three-dimensional mental picture of a satellite orbiting the Earth. A globe or any spherical object (even an orange) will greatly facilitate the comprehension of the subject.

In order to simplify the analysis of the orbital flight of the satellite, we are going to assume, for a while, that the Earth is *static*, i.e., it does *not* rotate on its axis. Once the static Earth concept is well understood, the introduction of the Earth's rotation, to complete the picture, will not present much difficulty. Fig. 2 shows a view of a satellite orbiting the static Earth. The orbit is circular.

At this time, familiarization with the principal parameters of orbital flight and related terminology is necessary because it will be used throughout the remainder of the article.

Orbit: The imaginary track of the path the satellite follows around the world. The plane of the orbit is fixed in space and is independent of the rotation of the Earth.

Altitude (H): The distance between the satellite and the surface of the Earth. For satellites in circular orbits, the altitude is virtually constant.

Period (P): The time it takes a satellite to make one full revolution around the Earth. The exact moment the satellite crosses the equator from south to north is used as a reference point. The period, therefore, is the time elapsed between two such equatorial crossings.

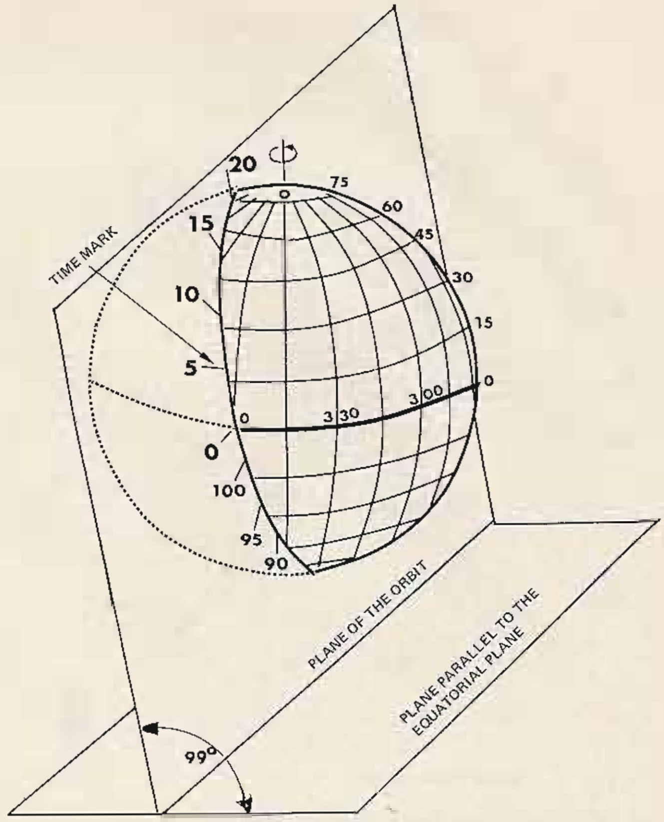


Fig. 3. Simulated Earth track on a plane inclined 99° from the equator (static Earth). Note that the orbital plane is fixed in space and the Earth rotates inside this plane from west to east (counterclockwise as viewed from a point above the North Pole).

Subsatellite Point: A point on the surface of the Earth where the satellite is directly overhead.

Ground Track (also Subsatellite Track): An imaginary path on the surface of the Earth consisting of all subsatellite points (during one period).

Inclination (i): The angle between the equator and the ground track (or the plane) of the satellite. It should be noted that this angle will remain constant through the entire life of the satellite and is not affected by the rotation of the Earth.

The angle of inclination determines the most northerly and most southerly latitude the ground track will ever reach. You may notice that even if the Earth is rotating on its axis, the ground track will never pass beyond a certain latitude.

Max. Lat. (N. or S.) = $180^\circ - i$

For OSCAR AO-D: $i = 99^\circ$

Max. Lat. = $180^\circ - 99^\circ = 81^\circ$ N. or S.

Equatorial Crossing Time (EQX Time): The exact time in UTC (GMT) at which the ground track crosses the equator from south to north. Knowing the exact EQX time of any orbit and the time of the period makes it easy to predict subsequent EQX times. We simply add the period (in minutes) to the exact time at which the previous EQX took place. In fact, the EQX prediction tables published by AMSAT and other amateur journals are derived this way.

In order to complete long-range prediction tables, the

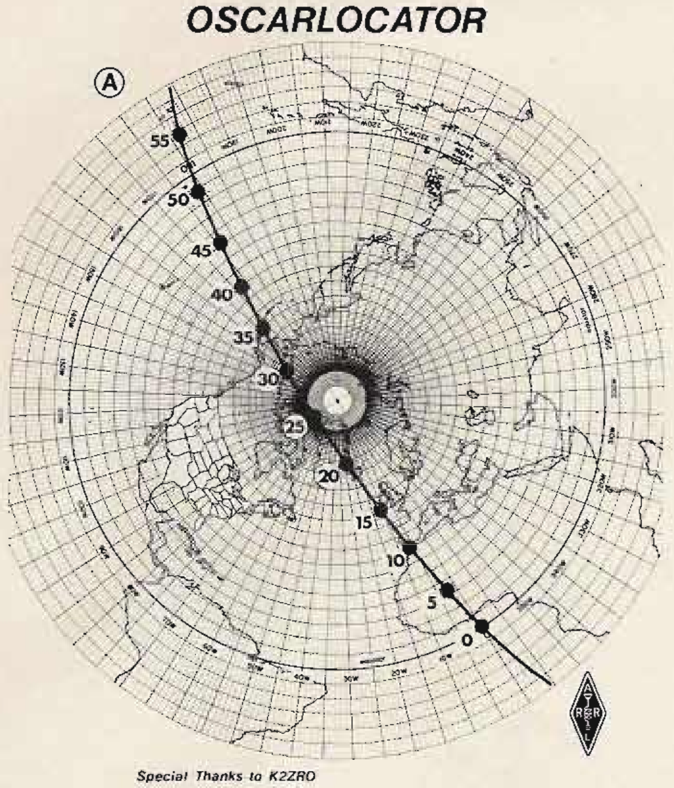


Fig. 4. Static Earth projection of the track of AO-D over the map of the Northern Hemisphere.

period must be known with great accuracy, because even small errors accumulate rapidly. (Example: Period of OSCAR 6 is 114.99441 min.; OSCAR 7 is 114.94513 min.)

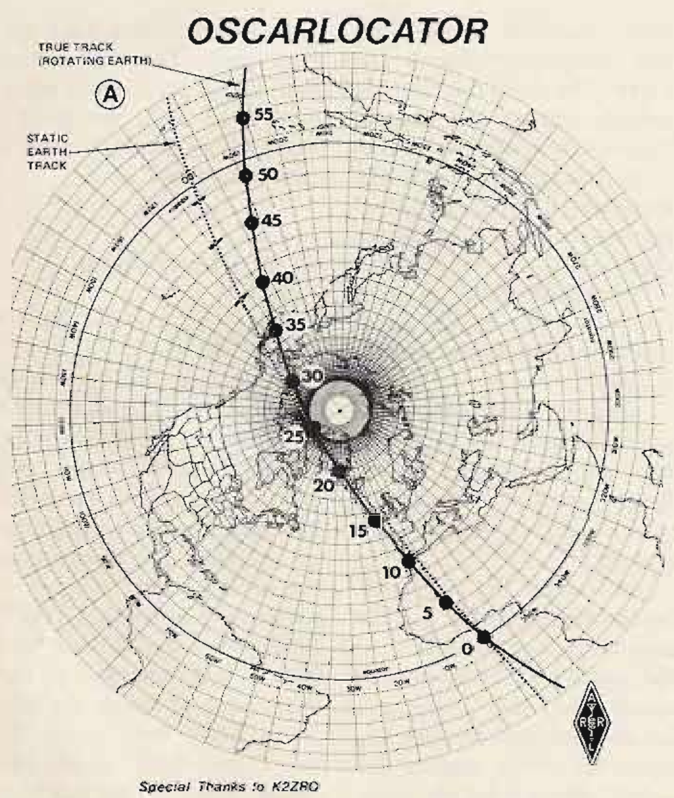


Fig. 5. The effect of the Earth's rotation on the Earth track of AO-D. Note that the track is shifted .25° toward the west for every minute of satellite travel. The static Earth track is shown as a dotted line.

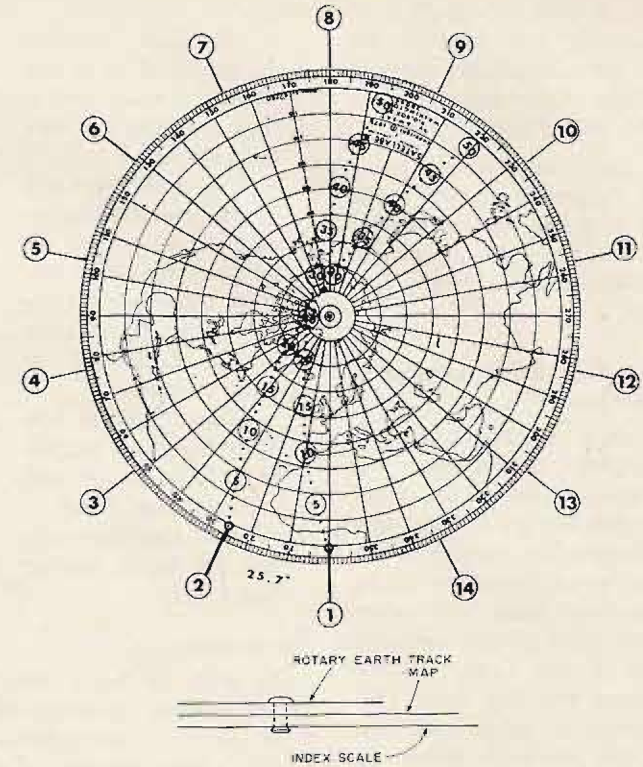


Fig. 6. Index scale. After setting the longitude of the EQX of the reference orbit, all longitudes of EQXs of successive orbits of the day can be predicted.

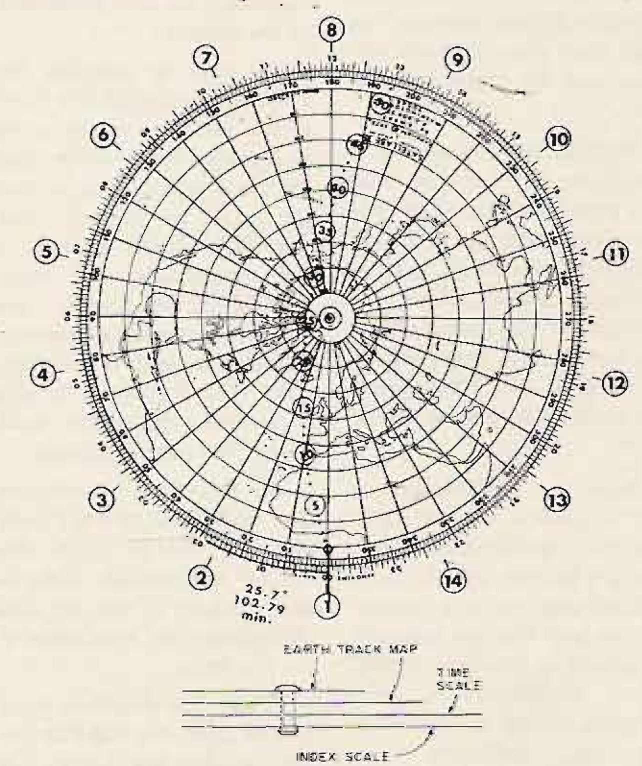


Fig. 7. Time scale. Setting the time of the EQX time of the reference orbit opposite index #1 allows prediction of EQX times of all consecutive orbits of that GMT day. Note that the Earth moving .25°/min. will rotate P x .25° during one period of the satellite, or 25.7° for AO-D. This corresponds to the index mark separation as shown in Fig. 6. Now, if the longitude and the time of the reference EQX are set against index mark #1, we can predict both time and longitude of subsequent EQXs of that GMT day.

Equatorial Crossing Longitude (EQX Lon.): The exact longitude on the equator at which a particular EQX, from south to north, takes place. Also called the "Ascending Node."

It will be shown later that subsequent EQX longitudes are separated by P/4 degrees. These figures are also used for long-range prediction of the EQX data.

Reference Orbit: The first orbit of a UTC (GMT) day, i.e., the first orbit that crosses the equator after 0000 UTC (GMT) from south to north.

Orbit Number: The count of the satellite's full revolutions around the Earth from the instant of the launching.

Reference Orbit Data: The date, orbit number, time, and longitude of EQX of a particular reference orbit. (Example: Mar. 17, 1978, 10526, 0012:24, 56.3°.)

Ascending Orbit or Pass: The part of the orbit when the satellite travels from south to north (over either the Southern or Northern Hemisphere).

Descending Orbit or Pass: The part of the orbit when the satellite travels from north to south. Note: The orbit will change from ascending to descending at the point where the ground track reaches its most northerly position (closest to the North Pole). The orbit will change from descending to ascending at the point where the ground track reaches its most southerly position (closest to the South Pole).

Ascending Node: The EQX position (longitude) during the ascending part of the orbit. It is often used as a reference point for orbital calculations (see Reference Orbit).

Descending Node: EQX position (longitude) during the descending part of the orbit.

Developing the Ground Track on a Static Earth

As previously stated, we are going to assume at first that the Earth is static (non-

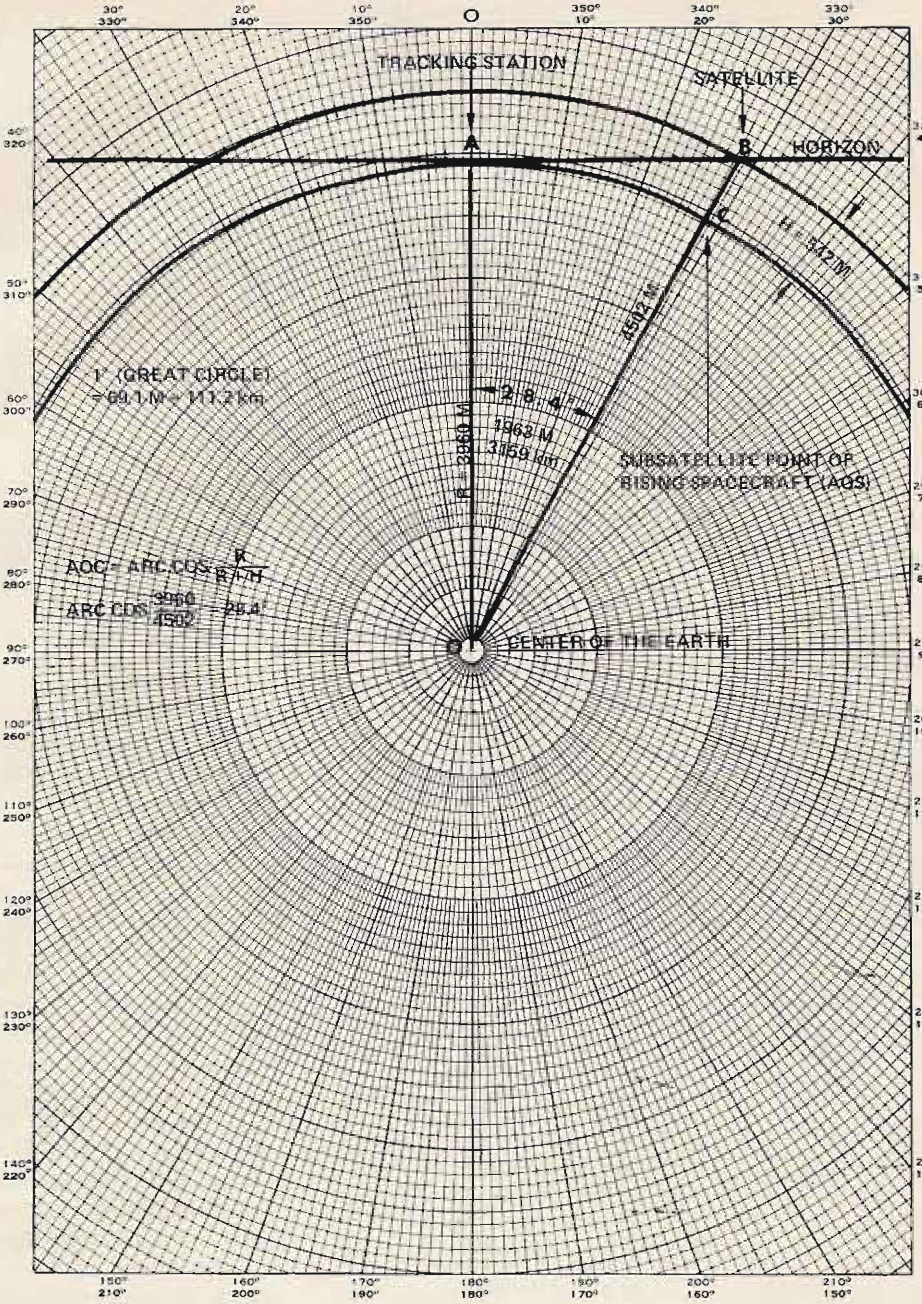


Fig. 8. Calculation of the distance from the tracking station at which the satellite enters the area of accessibility (acquisition of signal — AOS).

rotating). The satellite is the proposed OSCAR AO-D with the following orbital parameters:

Period: P = 102.79 min.
Inclination: i = 99°
Average Altitude: H = 542 miles (872 km)

Examining Fig. 2 again, let's follow the ground track of the satellite.

Assuming the reference point to be of 0° longitude at the equator (ascending node), with the ground track inclined to 99° in respect to the equator, the satellite will follow the following path:

— Starts at 0° longitude at the equator (ascending node).

— Travels northward reaching the most northern latitude of 81° (180°-i).

— Begins descending and then crosses the equator at 180° longitude (descending node).

— Continues moving southward until it reaches the most southern latitude of -81°.

— Starts ascending and crosses the equator again at 0° longitude.

The total elapsed time of one such trip around the world would be equal to the period of the satellite, or ≈ 103 minutes.

If we would slice the globe at a 99° angle, in respect to the equator, and put both halves together again, the seam line would follow exactly the ground path of OSCAR AO-D on a static Earth.

Another way to visualize the Earth track is to cut a circular hole equal to the diameter of the globe in a sheet of stiff material and fit the sheet over the globe at an angle of 99° in respect to the

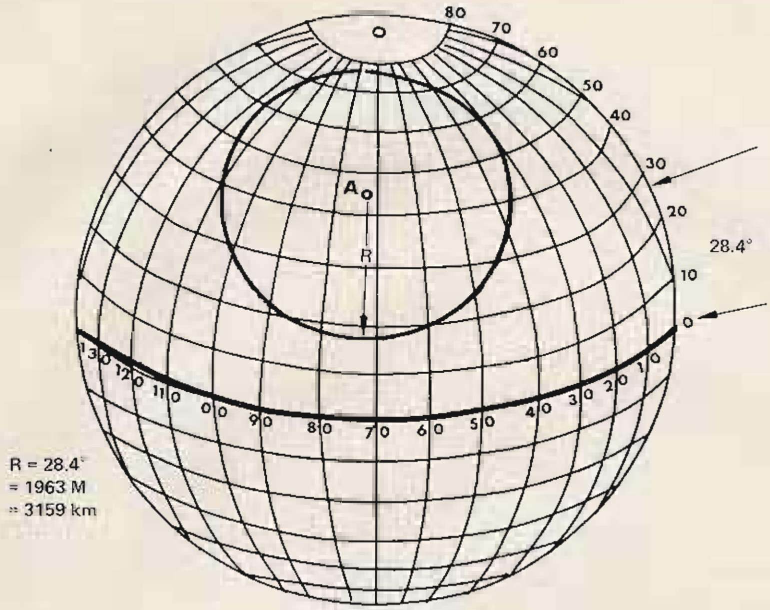


Fig. 9. Area of accessibility. The satellite will be available for communication when its subsatellite point is found inside the circle of accessibility.

equator, as shown in Fig. 3.

A satellite traveling in a circular orbit moves with a constant velocity. Consequently, all equal distances will be covered in equal increments of time.

The period of the AO-D is 103 minutes. Therefore, if we divide the entire length of the ground track into 103 equal segments, each segment would represent a distance traveled during a time interval of one minute.

In spite of its good accuracy, tracking of the satellite on a globe is rather cumbersome. A flat map is much more convenient for this purpose. Probably the best and most easily obtainable polar projection map suitable for satellite tracking is the OSCARLOCATOR, distributed and sold for just $1 by the ARRL. This handy device can be adapted for tracking almost any satellite.

Let's now project the static Earth satellite track onto the map. Once the track is drawn on the globe, including the time marks, its coordinates, latitude and longitude at one minute intervals, can now be drawn at corresponding coordinates on the map as shown in Fig. 4.

If the track is traced on a separate piece of transparent material and pivoted on the North Pole, it can now be rotated to allow the start of its origin (Ø min. mark) at the longitude of any chosen equatorial crossing.

Setting an auxiliary clock to read ØØ minutes at the exact time of the equatorial crossing, we can now follow the progress of the satellite minute by minute. The time on the auxiliary clock will correspond to the time marks on the track that, in turn, will indicate the position of the satellite at that very time.

Obviously, tracking of the satellite on the static Earth is of little use. Therefore, we will now introduce the effect of the rotation of the Earth.

As mentioned previously, the plane of the orbit of the satellite is fixed in space, but the Earth rotates on its axis. As the Earth rotates, the ground track will no longer retrace itself during each orbit, but will be displaced .25° towards the west for every minute of satellite travel. The rationale is as follows:

– The Earth rotates on its axis from east to west (counterclockwise as viewed from a point above the North Pole).

– The Earth makes one full revolution of 360° in 24 hours or 1440 minutes.

– This corresponds to angular travel of 15° per hour (360 ÷ 24) or 1° in 4 minutes.

– In one minute, the Earth will rotate .25°.

Now, how will this affect the Earth track developed for the static Earth (Fig. 4)?

In Fig. 5, the static Earth track is drawn with a dotted line; the true Earth track (for the rotating Earth) is the solid line. You will notice that the true track is shifted .25° for every minute of satellite travel.

For example: 10 minutes after EQX, the true track will be shifted 2.5° west of the static Earth track; 20 minutes after EQX – 5°; 30 minutes after EQX – 7.5°; 51.4 minutes (half of the period) after EQX – 12.85°; 102.79 minutes after EQX (full period) – 25.70°.

From the last figure, we may draw the correct conclusion that after one full period, the EQX longitude (ascending node) will be located P/4° west from the preceding one (in this example, 102.79/4 = 25.70°).

The effect of the Earth's rotation may be demonstrated another way. Using Fig. 4 with the Earth track (static Earth) drawn on a transparent material and

Time (min.) After EQX	Lat.	Long.
-8	-27.6	353.3
-6	-20.7	355.3
-4	-13.8	356.7
-2	-6.3	358.4
0	0.0	0.0
2	6.3	1.6
4	13.8	3.3
6	20.7	4.9
8	27.6	6.7
10	34.5	8.5
12	41.3	11.3
14	48.1	13.8
16	54.9	17.0
18	61.6	21.3
20	68.1	28.0
22	74.1	39.6
24	79.1	61.7
26	81.0	102.1
28	78.1	138.6
30	72.7	157.0
32	66.5	169.0
34	59.9	172.6
36	53.2	176.7
38	46.4	179.7
40	39.6	182.5
42	32.7	184.4
44	25.9	186.8
46	19.0	188.5
48	12.1	190.2
50	5.2	191.8
52	-1.7	193.4
54	-8.6	195.1
56	-15.5	196.7
58	-22.4	198.4
60	-29.3	200.1

Table 1.

pivoted on the North Pole, we immobilize the track and rotate the map counterclockwise at a steady rate. The time checks on the track indicate the position of the satellite at so many minutes after EQX. If while rotating the map we mark the location of substatellite points, we will notice that the resulting track will look similar to the one shown in Fig. 5.

For example: To establish the satellite location 10 minutes after EQX, we rotate the map 2.5°; for 20 minutes after EQX, rotate the map 5°; for 30 minutes after EQX, rotate the map 7.5°; etc.

Fortunately, you don't have to go to all this trouble to develop the Earth track for AO-D. For your convenience, Table 1 lists the coordinates for the normalized Earth track for OSCAR AO-D. These equations were used in the preparation of the table:

$$\text{Latitude} = \arcsin\left[(\sin i)\sin(360\,T/P)\right] \quad (1)$$

$$\text{Longitude} = \arccos\left[\cos(360\,T/P)/\cos\emptyset\right] + \frac{T}{4} \quad (2)$$

where: i = orbit's inclination to equator, P = satellite period, T = time after EQX (ascending node), and Ø = latitude (result of equation 1).

Note: Equation 2 minus the last term (T/4) will calculate longitudes for the Earth track on the static Earth. Equation 1 is valid for both the static and rotating Earth.

Employing the above formulas, the Earth track of any satellite in a circular orbit can be easily calculated using a simple scientific calculator, as long as its period and inclination are known.

To use the device, we take published EQX data (time and longitude) of a chosen orbit. Align the zero minute mark of the pivoting transparent ground track on the equatorial longitude of the EQX. Start the clock at ØØ minutes at the time of EQX and follow the satellite's progress minute by minute by relating the time marks on the track to the time indicated on the clock.

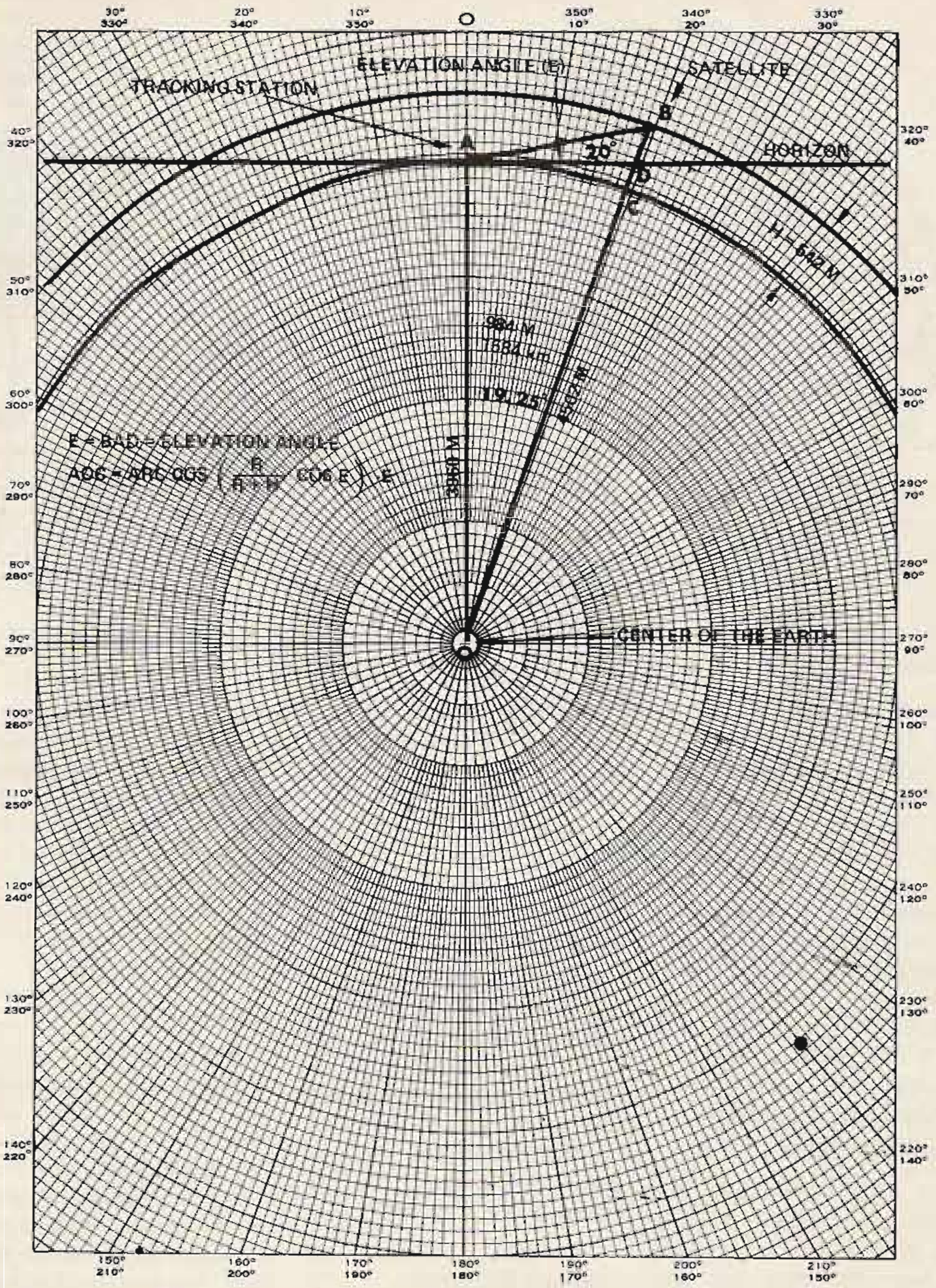


Fig. 10. Calculation of the distance from the tracking station at which the satellite is located 20° above the horizon.

Successive EQX Index Scale

We learned that the longitudes of successive equatorial crossings are separated by P/4° (25.70° for AO-D in which the period is 102.79 min.), and that in order to predict the EQX of the next orbit, we must add that value to the EQX longitude of the previous pass.

This process can be easily "automated" by adding a circular scale to be located under the map and pivoted on the North Pole. The scale consists of index marks separated by P/4° and numbered from 1 to 14. We will consider index mark number 1 as a reference and use it as a starting point for calculations of EQX longitudes of all satellite orbits of one full UTC (GMT) day (see Fig. 6).

Obtaining the data of the reference orbit of a chosen day, we align both the origin of the ground track and the longitude of the reference orbit against index mark #1 on the index scale.

Now, without disturbing the position of the map and the index scale, we can pivot the ground track and set its origin on the successive index marks and read the value of the longitude of the equator on the map. These will be the EQX longitudes of successive passes of the satellite.

In this way, we are able to predict EQX longitudes and follow the satellite's ground track over the Northern Hemisphere throughout the entire day.

EQX Time Scale

We also learned that the

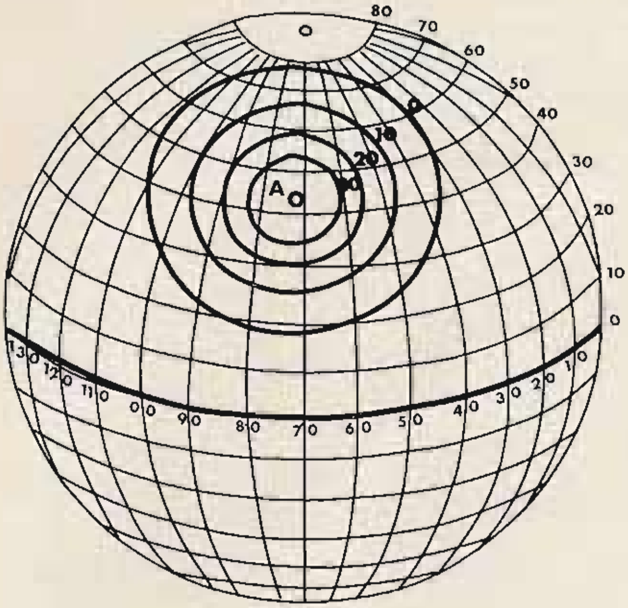


Fig. 11. Circles of equal elevation in respect to tracking station located at A.

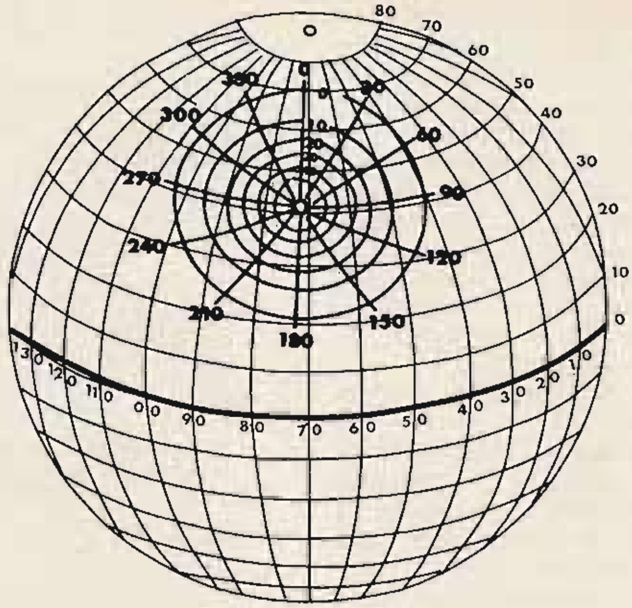


Fig. 12. Complete range overlay showing both azimuth and elevation.

time of the successive EQX can be predicted by adding the value of the period of the satellite to the actual time of the previous EQX. For OSCARs 6 and 7, with periods almost exactly 115 minutes, it was a relatively simple procedure: Two hours were added and then 5 minutes were subtracted. For OSCAR AO-D, with a period of ≈103 minutes, such calculations are a little more cumbersome and prone to frequent mistakes.

In order to simplify this problem, a rotary *time scale* has been added. It is placed between the map and the previously described index scale (see Fig. 7). The circumference of the scale (360°) is divided into 24 sections of 15°, each corresponding to 1 hour of Earth rotation. The hour segments can further be subdivided into 10 minute intervals 2.5° long. If more accuracy is needed, more subdivisions can be made; one minute will correspond to .25° on the scale.

Now, the setting of all scales for the reference orbit is as follows:

– Align the track, the map, and the index mark #1 as described previously.

– Align the exact time of the EQX of the reference orbit also against the index mark #1.

– Now the EQX times of successive orbits can be read directly on the time scale just opposite the corresponding index marks.

Once set for any chosen reference orbit of a particular satellite, both the map and the time scale can be cemented together (but not too permanently) and will not require resetting for a period of several months. The rationale is as follows:

– EQX longitudes are separated P/4° apart.

– During one period of the satellite, the Earth rotates P x .25° (.25° per minute) or also P/4°. Therefore, index marks spaced P/4° apart will correctly indicate the correct time intervals between successive equatorial crossings.

– Cementing the map and the time scale will imply that each longitude of EQX will have a specific time associated with it. This can easily be verified by consulting any long-range orbital predictions. You will find that like equatorial crossing longitudes always occur at the same UTC (GMT) time.

In practice, this relation is not that constant. Due to various factors, such as the solar year not being exactly 365 days, gravitational pull of the moon, etc., a slight drift between both scales will be noticed over a period of time. Therefore, it will be necessary to realign the scale slightly a couple times a year if high accuracy is required.

Summary

An orbital calculator described above consisting of four scales (the Earth track, the map, the time scale, and the index scale) provides a complete satellite tracking system, as long as the data of the reference orbits are available. The system allows prediction of EQX times and the longitudes of all successive orbits of that day. In addition, this system permits tracking the exact position of the satellite during the entire 24 hour period when the spacecraft is passing over the Northern Hemisphere.

Azimuth/Elevation Overlay

Just to be able to track a satellite in respect to the Earth is not sufficient for an OSCAR user. Since the communication via satellite is only possible when the satellite is within the "view" (above the horizon) of the tracking station, the user must be able to predict the rising and setting of the spacecraft at his geographical location. Moreover, if directional antennas are used, the azimuth (bearing) and the elevation (angle above the horizon) of the satellite in reference to the communicating station must be known at all times so the antenna can be aimed directly toward the orbiting transponder.

Communication Range

Fig. 8 depicts, diagramatically, the Earth and the orbit of the satellite. Both are drawn to scale. The Earth radius is 3960 miles (6371 km), and the average altitude (H) of AO-D is 542 miles (872 km). Consequently, the radius of the orbit will be 4502 miles (7243 km).

Point A in Fig. 8 represents the QTH of the user and the horizontal line represents the horizon as viewed from point A. As long as the path of the satellite lies below the horizon, the bulk of the Earth will prevent radio waves from reaching the transponder and no communications will be possible.

At the very moment the satellite crosses the local horizon, it will become "visible" to the user and two-way communication through the spacecraft's transponder will be possible. It stands to reason that at the instant the satellite sets below the horizon, the communication via its transponder will be abruptly terminated.

With the aid of Fig. 8, we can easily calculate the maximum communication range of OSCAR AO-D. Point B on Fig. 8 represents the location of the satellite just crossing the local horizon of a station located at A. A straight line drawn between B and the center of the Earth will intersect the surface of the Earth at point C, which becomes the subsatellite point of the spacecraft just rising above the horizon.

It becomes evident that the distance AC on the surface of the Earth is the maximum distance from which the satellite will be visible from point A. In other words, as long as the subsatellite point of the spacecraft is no further away than distance AC, the satellite will be within communication range of a station at point A.

The distance AD, on the surface of the Earth measured in Great Circle degrees, is the angle AOC. Careful measurements of this angle, or mathematical calculations, will show that for OSCAR AO-D, this distance is 28.4° Great Circle degrees (1 Great Circle degree equals 69.1 statute miles, or 111.2 km).

Therefore, we may conclude that as long as the subsatellite point of AO-D is found within a circle with the radius of 1963 miles (3159 km) from the user's QTH, the satellite will be available for communication.

This circle of accessibility is easily plotted on the globe. Using a compass, measure the distance of 28.4° (using longitude markings on the equator) and inscribe a circle centered on the user's QTH (Fig. 9).

Two stations communicating with each other must have the satellite in view simultaneously. Therefore, their areas of accessibility must overlap. Also, the satellite must be passing through that overlapping area in order to be visible from both QTHs at the same time. With this in mind, we may conclude that the maximum theoretical separation between two distant stations capable of communicating via AO-D will be 2 x 28.4° = 56.8 Great Circle degrees or 3926 miles (6318 km).

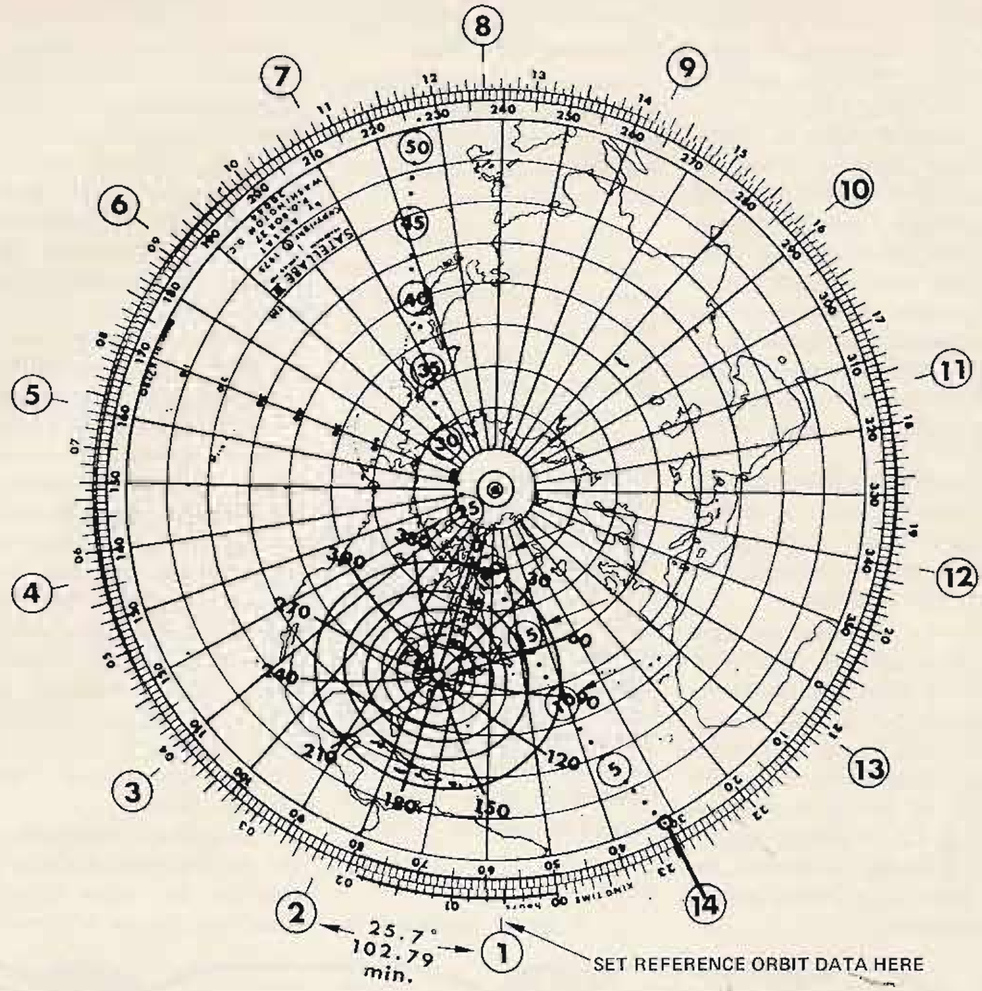


Fig. 13. Complete tracking system. Example: Reference orbit — 0032 GMT, longitude 57.2°. Set these values against index #1. We want to track AO-D during 14th orbit. Under index #14, we read EQX data: time 2247 GMT, longitude 31.8°. Tracking: satellite AOS (acquisition of signal) 10 minutes after EQX, 90° azimuth. 15 minutes after EQX — azimuth 45°, elevation ≈ 8°. LOS (loss of signal) 20 minutes after EQX, 10° azimuth.

Equal Elevation Range

Using a procedure similar to the one described above, we may plot distances from which the satellite will be seen at a constant elevation angle above the horizon in respect to point A. Fig. 10 shows how it is done.

Angle BAD is the angle of the satellite above the horizon, say 20°. Point C is the subsatellite point at this elevation. Consequently, the angle AOC is its distance from A in Great Circle degrees.

Using a graphical method, or mathematical calculations, distance AD can now be calculated. As in the previous example, a circle corresponding to that distance can be drawn on the globe. Repeating this procedure for different values of elevation angles,

Elev. Angle	c	Distance Miles	Km
0	28.4	1962	3158
1	27.4	1893	3096
2	26.5	1831	2947
3	25.5	1762	2836
5	23.8	1644	2647
10	20.0	1382	2224
15	16.8	1161	1868
20	14.3	988	1590
30	10.4	719	1156
40	7.6	525	845
50	5.6	387	623
60	3.9	269	434
70	2.5	173	278
80	1.2	83	133
90	0	0	0

Table 2. Distance between subsatellite point and tracking station at different elevation angles. Note that even a small topological obstacle that elevates the horizon angle by 3° will shorten the distance of accessibility by 200 miles.

a family of concentric circles can be plotted, each representing a different angle of elevation (Fig. 11).

Elevation angles as a function of distance from the user's QTH for OSCAR AO-D are given in Table 2. You may observe, by examining Table 2, that even a small loss of low angle radiation due to topological configuration of one's QTH may result in substantial loss of the maximum communication range.

Azimuth Lines (Bearing)

Once the circle of accessibility is drawn on the globe, the azimuth, or bearing, lines can easily be added.

If, for example, we want to draw azimuth lines every 15°, we divide the circumference of the circle of accessibility into 24 equal parts and draw straight lines toward the center of the circle as shown in Fig. 12. If azimuth lines at 10° intervals are needed, the circle must be divided into 36 equal parts.

Projecting Azimuth/Elevation Overlay on a Flat Map

Once the azimuth/elevation overlay is drawn on the globe, it can be transferred on the circular orbital calculator described previously.

This is accomplished by transferring coordinates (longitudes and latitudes) of various points of the overlay from the globe to the corresponding coordinates of the flat map. The result will be an elliptical overlay with curved azimuth lines as shown on Fig. 13.

Due to projection distortion, the shape of the overlay will be different for different latitudes of the user's QTH — circular for North Pole and quite elliptical for points close to the equator. It should be noted, however, that the overlays will be identical in shape for QTHs located at identical latitudes.

Notes

1. A globe produced by the National Geographic Society comes equipped with a transparent "cap." If the azimuth/elevation overlay is drawn on the cap, it can easily be centered on any chosen location of the globe allowing instant determination of coordinates for azimuth and elevation points from that location.

2. Those who possess a so-called "azimuthal equidistance projection map" centered on (or very close to) his own geographical location can use it easily for plotting the azimuth and elevation overlay and don't have to resort to the more cumbersome globe. (The ARRL DX map is of this type and is centered on Wichita, Kansas. Other maps centered on principal cities are available from the U.S. Dept. of Commerce, Coast and Geodetic Survey.)

Calculations involved in the development of the az/el overlays are quite complicated and involve knowledge of spherical trigonometry. This subject is beyond the scope of this article.

A circle drawn on the northern projection map (such as used in the ARRL's OSCARLOCATOR) is a reasonable solution, if utmost accuracy is not required. The circle, however, will indicate somewhat shorter than actual range to the west and east of the tracking station.

Application

To use the az/el overlay, we simply follow the satellite's progress and determine its subsatellite points during the pass.

If the location of the satellite is found within the borders of the overlay, the spacecraft is accessible for communication.

Then, the correct antenna bearings are determined by relating the satellite's position in respect to the azimuth/elevation markings on the overlay as shown on Fig. 13. ■

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2000-147 Meridian Rd.
Tallahassee FL 32303

Build A 2m Power Amp

- - great for OSCAR uplink

Class C amplifiers have been popular for some time for 2 meter use. However, to go to the trouble of adding an outboard amplifier, it must produce enough gain to make it worthwhile. A minimum of 6 to 8 dB is required to make the additional amplifier worthwhile and 10 dB gain is desirable.

Many amplifiers I have observed, both commercial and homebuilt, have used two generation old transistors, 2N5590 and 2N5591, for power levels of 10 to 25 Watts. There is a much better device available in the 25 to 30 Watt range, the Motorola MRF238. For comparison of the data sheets of the 2N5591 and MRF238, see Table 1.

At 150 MHz, the gain of the MRF238 is approximately 0.5 dB higher than at 160 MHz (shown in Table 1). The MRF238 is rated at 30 Watts and the 2N5591 is rated at 25 Watts. In practice, the MRF238 has proven much more rugged than the 2N5591 series (more tolerant of high VSWR). The MRF238 also has higher efficiency.

The amplifier shown schematically and pictorially in Figs. 1 and 2 respectively is not unlike many others; however, it makes use of the high performance MRF238.

The performance data in Table 2 was recorded for this

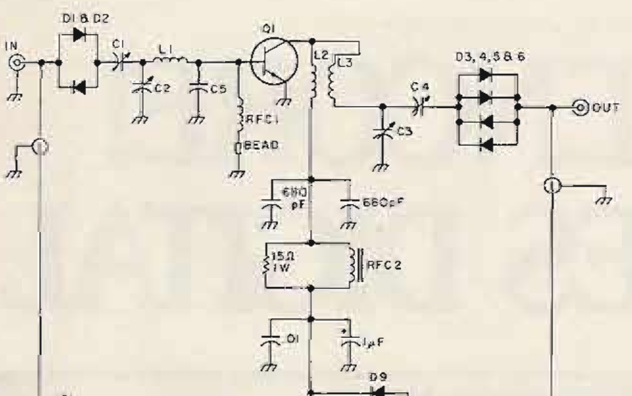

Fig. 1. Amplifier schematic. C1-C4 — Arco 463, 464, or 424; RFC1 — 10t #20 on 270 Ohm 1/2 Watt resistor; C5 -- 3-90 pF silver mica in parallel or 2-150 pF uncased micas also in parallel; RFC2 — 6 to 8 turns #18 around toroid core; L1 — 1/2 turn #14 approx. 1½ inches long; L2 — 4t #14, 1/4" I.D. spaced wire diameter; L3 — Curved wire #14, 1-1/4" long; Q1 — MRF238 Motorola rf power trans.; D1-D8 — 1N4148; T1-T2 — 1/4 wavelength of RG-174 or similar 50 Ohm coax cable; D9 — 2 Amp silicon rectifier.

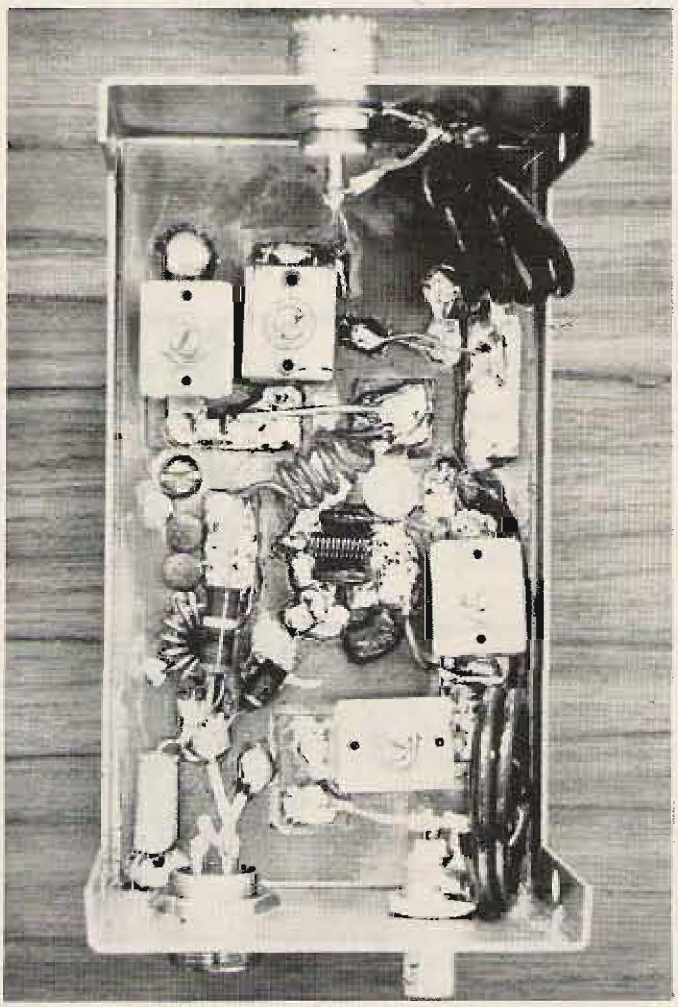

Fig. 2. Photo showing construction of the amplifier. The input is via the BNC connector at the top.

Device	Voltage	Freq.	Power In	Power Out	Gain
2N5591	13.6	150 MHz	2 Watts	10.8 Watts	7.3 dB
			4 Watts	20.5 Watts	7.1 dB
MRF238	13.6	160 MHz	1.5 Watts	19.5 Watts	11.1 dB
			2 Watts	24 Watts	10.8 dB
			3 Watts	30.5 Watts	10.1 dB

Table 1. Comparison of 2N5591 and Motorola MRF238.

Voltage	Power in	Power Out	Gain
13.7	2 Watts	26 Watts	11.1 dB
13.7	1.3 Watts	18 Watts	11.4 dB

Table 2. Performance data.

amplifier.

A small loss is involved with the diode switching.

The amplifier was assembled by using single-sided copper epoxy board and cementing small "islands" of board onto the main board. The main board is 2-7/8" x 5" and the minibox is 3" x 5-1/4" x 2-1/8". A heat sink is mounted to the top of the minibox. The only critical items are L1, L3, and C5. Make sure T1 and T2 are an electrical 1/4 wavelength, approximately 13-1/2" with polyethylene coax (RG-174). All capacitors should have leads as short as possible. The amplifier is usable with inputs of less than 1 to 2.5 Watts.

The price of the 30 Watt MRF238 is $8.55 in unit quantities, which is less than the 25 Watt 2N5591 or 2N6082, another point in its favor.

If all items are bought new, the cost is about $23; however, with a reasonable junk box, it can be constructed for about $12 (the MRF238, a minibox, and miscellaneous items not in the junk box). ■

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Build A General Purpose Preamp

-- uses common components !

For those of us who are engineers, it is relatively easy to crank out a custom circuit to fit every little need. However, most experimenters and hams are not in that category, and, for them, the next best thing is an accumulation of a few good circuits about which they know a lot. This article describes a simple audio amplifier which has high gain, low noise, and excellent stability toward temperature extremes.

While it is very simple and is used in many commercial devices, it can be used in almost all those places where you need a preamp, such as mike boosters, first af amplifier after a detector stage in a receiver, etc.

Referring to Fig. 1, the circuit can be seen as a direct coupled pair of 2N3904 transistors. This transistor is cheap, high gain, fairly low noise, and very easily obtained. The Q2 transistor is hooked up like any ordinary amplifier stage, but the base resistor that normally goes from its base to ground has been replaced with another transistor, Q1. This Q1 transistor varies the bias on Q2, so the circuit is immune to heat effects. The way it's hooked up, if Q2 draws more current, the voltage on R2 rises, turns on Q1 harder via the 100k resistor connected to its base, and cancels out the increased current in Q2. The result is almost no change in current due to temperature variations. The capacitor C2 prevents the ac signal from being fed back and reducing the overall gain. By placing the capacitor as shown, a very small value, which is also small in physical size and cheaper, will permit the amplifier to keep its full gain to low frequencies as well as would be the case for a very large C placed across R2. The values in Fig. 1 will amplify down to about 10 cycles using a physically small capacitor. To make the amplifier roll off at a higher frequency on the low side, reduce C2 to about 1 uF or less, or, alternately, you could reduce the 100k resistor to about 10k. This would make the frequency roll off around 100 cycles and turn the circuit into a speech amplifier rather than a hi-fi type.

The circuit shown in Fig. 1 performs best when driven by a moderate impedance source from 500 Ohms to 3k Ohms impedance. With this kind of source, the gain will be about 250, and the output noise with no signal in will be about 2 millivolts. This is equivalent to an input noise of only 8 microvolts, so the noise is quite low for all but extraordinary uses.

If you wish to drive the circuit with a low impedance source, such as a speaker of 4 to 16 Ohms or a telephone earphone (which makes an excellent high output mike), use the circuit in Fig. 2. Here, the base is tied to ground via a capacitor, and the signal is fed to the emitter of Q1 through a capacitor. This circuit will perform very similarly to Fig. 1, but will have slightly higher gain reaching perhaps 500 and about the same low noise performance.

Ten microfarad capacitors are used throughout because they are small and cheap, and are more than enough to do the job here.

This simple circuit can be made up in a ball smaller than an acorn and put into mikes to give you more gain than you need to drive even the worst transmitter. It also works well when driven by a speaker put out in the yard to let you listen for prowlers at night, when you don't care to get out of a warm bed, but the dog barks like he's on to something. Fed into any hi-fi input, such a preamp will let you hear better than if you were out in the yard. There are many other uses, and most of them will please you because the low noise of this preamp lets you really hear clean audio. ■

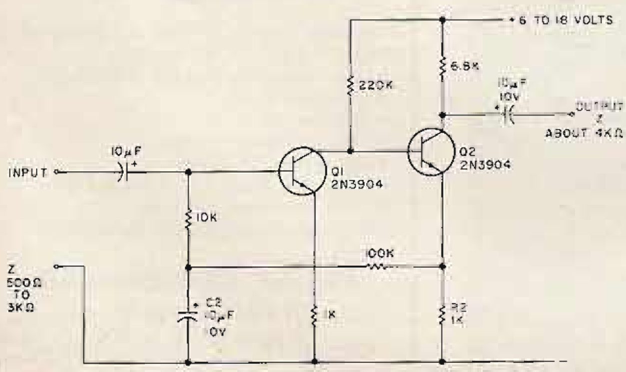

Fig. 1.

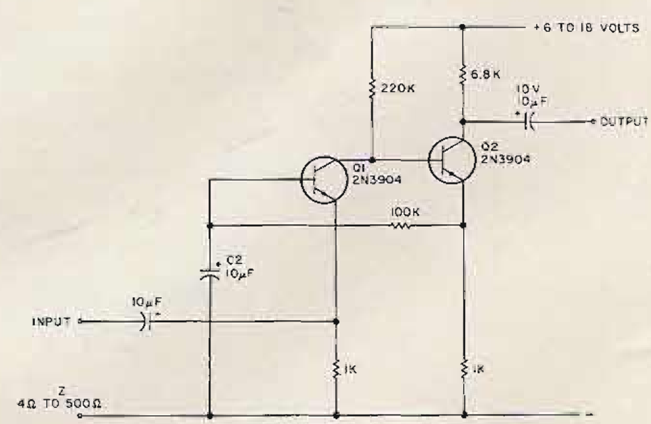

Fig. 2.

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Receive CW With A KIM

-- micro-controlled, of course!

In the January, 1977, issue of *73 Magazine*, WB2DFA presented a fantastic article concerning the use of the KIM-1 microprocessor for the transmission of Morse code. We have used the program repeatedly on the air since that time, and it has been met with never-ending amazement. The KIM was finally given a ham-oriented use. The next step had to be reception of Morse, a formidable project hinged on an entire handful of variables: Morse code was *not* predictable – speeds changed, intra- and inter-character lengths were not constant, word spaces seemed unpredictable, and even sending "style" played a big part. Could it be done? Finally, after much writing, rewriting, hour-long QSOs to solve bugs, and a good deal of hair-pulling, the program worked.

The reader should be cautioned at this point that "perfect" reception is nearly impossible without "perfect" sending. This will rarely be encountered, given noise and the multitude of sounds issuing forth from the CW bands. Suggestions will be offered for copying both hand key and off the air.

The program fits comfortably in the onboard KIM 1K memory. No additional equipment is needed for hand key decoding. Connection to a receiver requires only a simple adapter, which can easily be constructed for under $5.00 with readily available parts. The program allows the option of displaying the decoded Morse on the integral KIM 7-segment LED display or having the output sent to an ASCII TTY or a video terminal. Due to the slow speed of a mechanical printer, only very slow Morse can be decoded. Of course, a high baud rate video terminal will allow the program to run at full speed without getting bogged down in the out-character subroutine. A video terminal usually offers automatic carriage return/line feed at the end of each line. Obviously, these functions are not part of the Morse code and require terminal generation. Using the KIM display allows the decoded material to be displayed in a "Times Square" format, with letters shifting left automatically with the reception of each new letter. The program even offers automatic placement of word space "blanks" between completed words, for easier reading.

Finally, the program here has run equally well on the KIM-1 and also on a 6502-based home brew. It has been tested for several months and, we think, does the best job possible with such an unpredictable code as Morse. Using the program on a KIM is straightforward. Using the program on another 6502-based system would require only changes to call-ups of KIM subroutines and ROM locations. A timer would also be required; the KIM has two built in.

A description of how the program accomplishes its goal is a bit involved. Basically, when pushing "Go," you will see the six digits on the KIM board display random garbage which was in locations 000A-000F when the computer was powered up. About half a second later, the display will shift left one digit, and a blank digit will appear on the right, ready for the first decoded Morse character. After reception has continued for a while, these locations will hold the last six decoded characters. But the microprocessor never sits idle. It is constantly inspecting pin A-8 (PA7) for data input from the hand key or optional receiving adapter. The program loop also checks the onboard timer to see if a 4-millisecond period has elapsed. Each time the timer expires, the loop breaks long enough to increment location 0001. Assuming no code has been received, after about half a second, location 0001 has been incremented up to hex 7F. At this time, the loop breaks again and jumps to the SHIFT LEFT DISPLAY subroutine. Its next move is to the zero page conversion table. The count in location 0007 is used as an offset to select the proper data in the table.

If, as we are assuming, no Morse has actually been received yet, location 0007 will still be at its initialized value, and an error sign will be called up. This data is placed in location 000F, which serves the right-most digit on the KIM board. Then location 0001 is compared to 0005, which was initialized to a value of hex 01. Since 0001

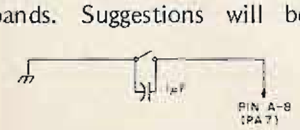


Fig. 1. Connecting a code key to the KIM.

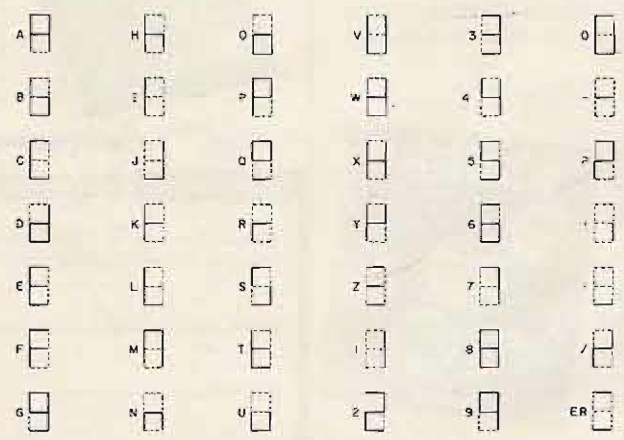


Fig. 2. Decoded Morse code as it will appear on the KIM display.

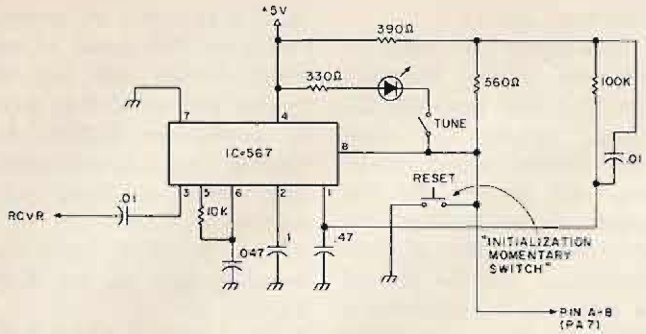


Fig. 3. Tone adapter to use the KIM with a receiver.

will contain a greater count, a second trip through the SHIFT LEFT DISPLAY and the conversion table will be accomplished. This time, the code for turning all display segments "off" will be loaded into 000F. Then the microprocessor reinitializes 0007 and returns to the loop. Also set was 0002, which serves as a flag for the loop to now bypass its checks on the interval timer. Until actual code is received, this final loop will be repeated endlessly. The visible effect on the activity just described is that about one-half second after starting the program, the random data displayed will shift left twice, with the two right-most digits containing an error symbol followed by a blank.

After this has occurred, you will next initialize the code speed. This is done simply by grounding the input pin (A-8), either by holding down the hand key or, if you're using the receiving adapter, by holding down the initialization momentary switch. As soon as the microprocessor discovers that the status of the input pin has changed, the interval timer is put to work again. Holding the key/initialization switch down about one second will allow 0001 to again be incremented up to 7F. Again the loop breaks, but this time a different path is taken because it was learned that the key was indeed "down." Location 0003 is now set equal to location 0001 and will serve as a flag to steer the program through the initialization routine.

Now, as code is entered via the input pin, the program increments location 0001 every 4 milliseconds, to measure the length of time the key is kept down or up. The first key-down is multiplied by two (i.e., shifted left once) and stored in location 0005. Then, it is shifted right two times, which effectively divides the original count by two. This final count gets stored at 0006.

Why get these counts? The microprocessor will use succeeding key-down counts for comparison to those just stored. The processor must decide which was a dot and which was a dash. The first count, by definition, was either less than half the latest count or greater than twice the latest count. If the first count was a dot, initialization is ended. If it was a dash, counts in 0005 and 0006 are updated with the latest count, since proving that the original count was a dash requires that the latest count was of dot length. Initialization, then, requires both dots and dashes so that a comparison can be accomplished. All future counts will be compared to the one now loaded at 0005. Any count less than that in 0005 will be considered a dot; those counts greater will be considered dashes. At this point, all the computer knows is the difference between dots and dashes; we still don't have characters!

So, where does the computer begin to determine that there is intelligence in what it is receiving? The magic begins to occur in location 0007. Every time a dot is received, 0007 is shifted left. Also, for each dot detected, a jump to a speed adjustment subroutine can be taken, if desired (described later). Dashes shift 0007 left once and add "1".

"Key-up" counts must also be considered and serve to complicate the decoding of Morse even more. As long as the counts test to be less than that count in 0005, the program assumes a single Morse character is still in the process of being sent. But as soon as any key-up count exceeds the value in 0005, the single character is considered completed. After a check to see that bit 7 in 0007 is not equal

Character	Zero page Address	7-segment code	Terminal code
A	15	F7	C1
B	28	FC	C2
C	2A	B9	C3
D	1C	DE	C4
E	12	F9	C5
F	22	F1	C6
G	1E	EF	C7
H	20	F4	C8
I	14	B0	C9
J	27	8E	CA
K	1D	F0	CB
L	24	B8	CC
M	17	B7	CD
N	16	D4	CE
O	1F	DC	CF
P	26	F3	D0
Q	2D	EB	D1
R	1A	D0	D2
S	18	AD	D3
T	13	F8	D4
U	19	9C	D5
V	21	BE	D6
W	1B	FE	D7
X	29	F6	D8
Y	2B	F2	D9
Z	2C	C9	DA
1	3F	86	B1
2	37	DB	B2
3	33	CF	B3
4	31	E6	B4
5	30	ED	B5
6	40	FD	B6
7	48	87	B7
8	4C	FF	B8
9	4E	EF	B9
0	4F	BF	B0
-	41	C0	AD
?	5C	D3	BF
,	83	84	AC
.	65	88	AE
/	42	D2	AF
ERROR	11	89	C0
WORD SPACE	10	00	A0

Table 1. How to use the table: Decide whether you want to have output of the decoded Morse on the KIM's 7-segment display or whether you will be using an external terminal (be it TTY or video). If you want:-

7-segment Display — Load the appropriate data in the "7-segment code" column at the specified zero page locations. For example, you will be loading data for an "A" by loading "F7" at location ØØ15. Disregard the "Terminal code" column.

Terminal Display/Printout — Load the appropriate data in the "Terminal code" column at the specified zero page locations. For example, you will be loading data for an "A" by loading "C1" at location ØØ15. Disregard the "7-segment code" column. Note: For terminal use, the KIM-1 requires jumpering of pin 21 to pin V on the Application Connector. Installation of an SPST switch between those points allows switching from the KIM's integral display to a terminal for I/O.

to a one, the program uses this value as an offset to the zero page conversion table. If bit 7 were a one, the program recognizes that the letter received could not have been Morse (no Morse character is 7 elements long!) and displays the error symbol. Note that, in practical use on the air, errors are followed by a string of dots. The computer will advise you of this occurrence!

We have mentioned the data in 0007 as being all-important, as it represents the actual Morse character. Note several points:

1. 0007 will be initialized to hex 01. (This will serve our "error" condition stated above, if this bit gets shifted left to the 7th bit.)

2. Dots will be entered in this location simply by a shift left (effectively entering a zero).

3. Dashes will be entered as ones.

Morse character "A" will end up in 0007 as "0000 0101" in binary form. The "di-dah" appears in the first two places to the right, with the initial "one" being shifted to the third position from the right. This code for an "A" has a decimal value of "5", and the program at location 025F uses this value, offset by 10, to find the code for an "A" at 0015. At this location, a hex F7 has been entered, if you planned on using the KIM display as your output; if you had decided on using a terminal and wanted ASCII output, a hex C1 would have been loaded instead (see Table 1).

Subroutines are used to shift the display memory, scan that data onto the displays, adjust the code speed during actual operation, and provide for the output of the decoded data to a terminal. Any of these subroutines may be deleted by replacing the appropriate JSR instruction with NOPs. The first two subroutines are required, if the integral KIM display is to be used; the third is optional, to allow automatic code speed adjustment. If you do not use this subroutine, the initial code speed will be considered by the computer to be the only code speed, and it will not adjust to speed changes. Obviously, if you are receiving Morse from a station using a keyboard or another computer, this speed adjustment routine will not be needed and would only serve to complicate matters by slowing the program down. The JSRs to these subroutines are located at:

0243 – SCANDS – puts the decoded data on the KIM display.

0257 – SHIFT LEFT DISPLAY – allows the data to move "Times Square" format across the KIM display.

02AD – ADJUST SPEED – allows the computer to update the code speed it is receiving.

0263 – OUTCHARACTER – allows the computer to output the decoded character to an ASCII terminal.

For instance, let's say we don't want data to be dis-

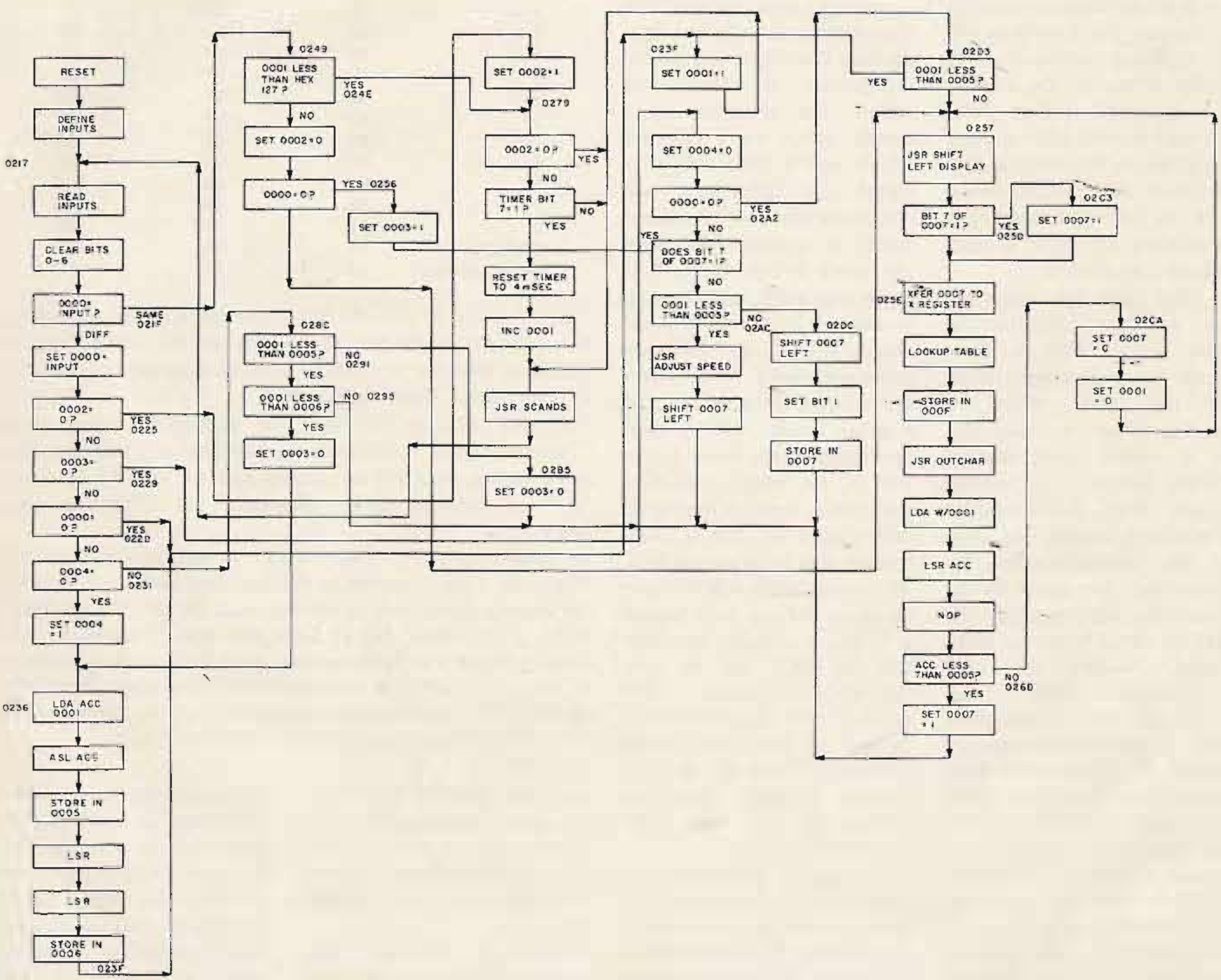


Table 2. This detailed flowchart is intended to give a better idea of operation of the program. Hex addresses are provided at key points.

played on the KIM display, but, instead, we want to use a video terminal. You would delete both the SCANDS and SHIFT LEFT DISPLAY subroutines by removing the JSRs and entering NOPs. Example:

Before
0243 20 0E 03
-
-
-
0257 20 30 03
After
0243 EA EA EA
-
-
-
0257 EA EA EA

Here we have effectively removed the SCANDS and SHIFT LEFT DISPLAY subroutines. Since we have not removed the ADJUST SPEED subroutine or the OUTCHARACTER routine, the resulting program will still adjust to new code speeds and output the decoded data to a terminal. The KIM display will not light. It is pos-

```
Address        Data           Op Code

0200           D8             CLD
0201           58             CLI
0202           A9  00         LDA imm
0204           8D  01  17     STA abs
0207           85  01         STA zp
0209           85  04         STA zp
020B           A9  01         LDA imm
020D           85  07         STA zp
020F           85  05         STA zp
0211           85  02         STA zp
0213           A9  80         LDA imm
0215           85  00         STA zp
0217           AD  00  17     LDA abs
021A           29  80         AND imm
021C           C5  00         CMP zp
021E           F0  29         BEQ
0220           85  00         STA zp
0222           A5  02         LDA zp
0224           F0  4F         BEQ
0226           A5  03         LDA zp
0228           F0  73         BEQ
022A           A5  00         LDA zp
022C           F0  11         BEQ
022E           A5  04         LDA zp
0230           D0  5A         BNE
0232           A9  01         LDA imm
0234           85  04         STA zp
0236           A5  01         LDA zp
0238           0A             ASL acc
0239           85  05         STA zp
023B           4A             LSR acc
023C           4A             LSR acc
023D           85  06         STA zp
023F           A9  01         LDA imm
0241           85  01         STA zp
0243           20  0E  03     JSR
0246           4C  17  02     JMP
0249           A5  01         LDA zp
024B           C9  7F         CMP imm
024D           90  2A         BCC
024F           A9  00         LDA imm
0251           85  02         STA zp
0253           A5  00         LDA zp
0255           F0  65         BEQ
0257           20  30  03     JSR
025A           A5  07         LDA zp
025C           30  65         BMI
025E           AA             TAX
025F           B5  10         LDA zp,X
0261           85  0F         STA zp
0263           20  45  03     JSR
0266           A5  01         LDA zp
0268           4A             LSR acc
0269           EA             NOP            (see article)
026A           C5  05         CMP zp
026C           B0  5C         BCS
026E           A9  01         LDA imm
0270           85  07         STA zp
0272           4C  3F  02     JMP
0275           A9  01         LDA imm
0277           85  02         STA zp
0279           A5  02         LDA zp
027B           F0  C6         BEQ
027D           AD  07  17     LDA abs
0280           10  C1         BPL
0282           A9  04         LDA imm
0284           8D  07  17     STA abs
0287           E6  01         INC zp
0289           4C  43  02     JMP
028C           A5  01         LDA zp
028E           C5  05         CMP zp
0290           B0  23         BCS
0292           C5  06         CMP zp
0294           B0  A9         BCS
0296           A9  00         LDA imm
0298           85  03         STA zp
029A           4C  36  02     JMP
029D           85  04         STA zp
029F           A5  00         LDA zp
02A1           F0  30         BEQ
02A3           A5  07         LDA zp
02A5           30  98         BMI
02A7           A5  01         LDA zp
02A9           C5  05         CMP zp
02AB           B0  2F         BCS
02AD           20  E7  02     JSR
02B0           06  07         ASL zp
02B2           4C  3F  02     JMP
02B5           A9  00         LDA imm
02B7           85  03         STA zp
02B9           4C  3F  02     JMP
02BC           A9  01         LDA imm
02BE           85  03         STA zp
02C0           4C  3F  02     JMP
02C3           A9  01         LDA imm
02C5           85  07         STA zp
02C7           4C  5E  02     JMP
02CA           A9  00         LDA imm
02CC           85  07         STA zp
02CE           85  01         STA zp
02D0           4C  57  02     JMP
02D3           A5  01         LDA zp
02D5           C5  05         CMP zp
02D7           90  0A         BCC
02D9           4C  57  02     JMP
02DC           A5  07         LDA zp
02DE           0A             ASL acc
02DF           09  01         ORA imm
02E1           85  07         STA zp
02E3           4C  3F  02     JMP
02E6           EA             NOP
02E7           A5  01         LDA zp
02E9           0A             ASL acc
02EA           85  09         STA zp
02EC           C5  05         CMP zp
02EE           90  0C         BCC
02F0           E5  05         SBC zp
02F2           4A             LSR acc
02F3           4A             LSR acc
02F4           4A             LSR acc
02F5           18             CLC
02F6           65  05         ADC zp
02F8           85  05         STA zp
02FA           60             RTS
02FB           EA             NOP
02FC           38             SEC
02FD           A5  05         LDA zp
02FF           E5  09         SBC zp
0301           4A             LSR acc
0302           4A             LSR acc
0303           4A             LSR acc
0304           85  08         STA zp
0306           38             SEC
0307           A5  05         LDA zp
0309           E5  08         SBC zp
030B           85  05         STA zp
030D           60             RTS
030E           A9  7F         LDA imm
0310           8D  41  17     STA abs
0313           A0  09         LDY imm
0315           A2  0A         LDX imm
0317           B5  00         LDA zp,X
0319           8D  40  17     STA abs
031C           8C  42  17     STY abs
031F           84  23         STY zp
0321           A0  00         LDY imm
0323           8C  42  17     STY abs
0326           A4  23         LDY imm
0328           C8             INY
0329           C8             INY
032A           E8             INX
032B           E0  10         CMX imm
032D           D0  E8         BNE
032F           60             RTS
0330           A5  0B         LDA zp
0332           85  0A         STA zp
0334           A5  0C         LDA zp
0336           85  0B         STA zp
0338           A5  0D         LDA zp
033A           85  0C         STA zp
033C           A5  0E         LDA zp
033E           85  0D         STA zp
0340           A5  0F         LDA zp
0342           85  0E         STA zp
0344           60             RTS
0345           A5  0F         LDA zp
0347           20  A0  1E     JSR
034A           60             RTS

END
```

Fig. 4. Program listing. KIM-1 Morse code receive program.

sible to run the entire program unchanged, but running the SCANDS without using it would waste valuable time; running the OUTCHARACTER routine, when you're only interested in the KIM display, could be a disaster. As a good, general rule, remove unwanted subroutines with NOPs. Don't waste the computer's time; it has been given enough to do!

A few words about the heretofore unexplained SPEED ADJUST subroutine – this subroutine, if it has not been replaced by NOPs, will be called up each time a dot is received. The subroutine divides the count stored in 0005 by two and compares the result with the current dot value stored in 0001. Any difference is divided by eight and added to, or subtracted from, the count in 0005. This new value, then, has gradually been adjusted to a new code speed. Obviously, the computer will not accurately handle great single jumps in code speed but does well with substantial changes if they are gradual. Without this subroutine, the initial count in 0005 becomes the dot comparison and cannot change. There is, as usual, one catch to trying to "cover all corners": Occasional bursts of static and noise can easily fool the subroutine into raising the expected code speed. In this case, a string of "Ts" will be displayed. Reinitialization is easy, though. Hold the initialization momentary switch down for about a second. The computer will "start over" in its search for code speed.

Ready to try it? Load the program, the character lookup table (Table 1), and begin by NOPing the OUTCHARACTER subroutine. Connect a hand key to the computer, as in Fig. 1. Although not a major problem, the 0.1 uF capacitor across the key serves to get rid of some switch bounce. Some keys we have used worked fine without it; others seemed to require it. Take a look at Fig. 2, so you have a little idea of what will appear on the KIM display once the program is up and running after several characters.

Since there is no way to display all letters (let alone punctuation!) on a 7-segment LED, we have chosen symbols that seem easiest to identify. Note that an "S" must be distinguished from a "5", an "O" from a "Ø", and even a "T" from a "7". Once you have gotten used to the oddballs, you'll recognize them right away. On a terminal, of course, you'll get standard characters (with the exception of ERROR, which will print as an "@").

If you've gotten this far, set up address 0200, and press "G". Hold the tape key down about a second, then simply begin sending. The first few characters will produce garbage until the computer determines your average dot and dash. Then, you'll see proper Morse being displayed. You'll soon discover how well you're sending. Articulate! The computer and other OM will appreciate it! Try sending the entire alphabet one letter at a time. Pause between each and you'll see a word space placed on the display between your letters. This is an ideal way to get used to the odd characters and to see which letters you don't send very well.

After becoming thoroughly familiar with the program's operation, you will probably want to try it connected to a receiver. The schematic in Fig. 3 offers one suggestion which works amazingly well for its low cost and simplicity. Connect pin 3 of the 567 through the .01 capacitor to your headphone jack. Don't forget to run a ground from the jack to ground on this adapter board. The 567 will be looking for a frequency of about 2100 Hz. This is simply to allow the same adapter to work for RTTY (we're working on it). You won't be able to use a CW filter, since this frequency will be outside its bandpass. When you tune in a CW signal, flip the "tune" switch on. The LED will light when the 567 hears the proper tone. Adjust your receiver from the highest frequency the LED will still light with, to the lowest. Set your receiver in the middle. The circuit is designed to have pin 8 ground when it decodes the proper tone. The 567 will thereby simulate key-up and key-down for the computer. Again, a common ground must be shared between the adapter and the computer. Begin by trying to copy a clean-sending station, one that is on a fairly open frequency, and one that is sending moderate speed (13 wpm is fine). Again, set up address 0200 and hit "G", and then, after a second or so, press the initialization momentary switch down on the adapter board. Let go after a second, and the computer will begin to decode. It is advisable to have the "tune" switch off after you have tuned up.

Should you be troubled by too many word spaces being displayed on slow CW, add a second LSR to the program at 0269. A NOP has been placed there as a space filler. The second LSR instruction lengthens the time that must pass before the computer enters a word space.

In retrospect, a program this simple (anything that fits in less than 1K can't be too involved) cannot be expected to produce perfectly decoded Morse. Your initial patience will be required until you "get the feel" of how the computer is accomplishing this task. The program is not infallible, as it's being required to decode a language overflowing with variables. It does, however, a very respectable job given these conditions. This is at least another step in bringing ham radio and computers together; the future will be what we make it. ■

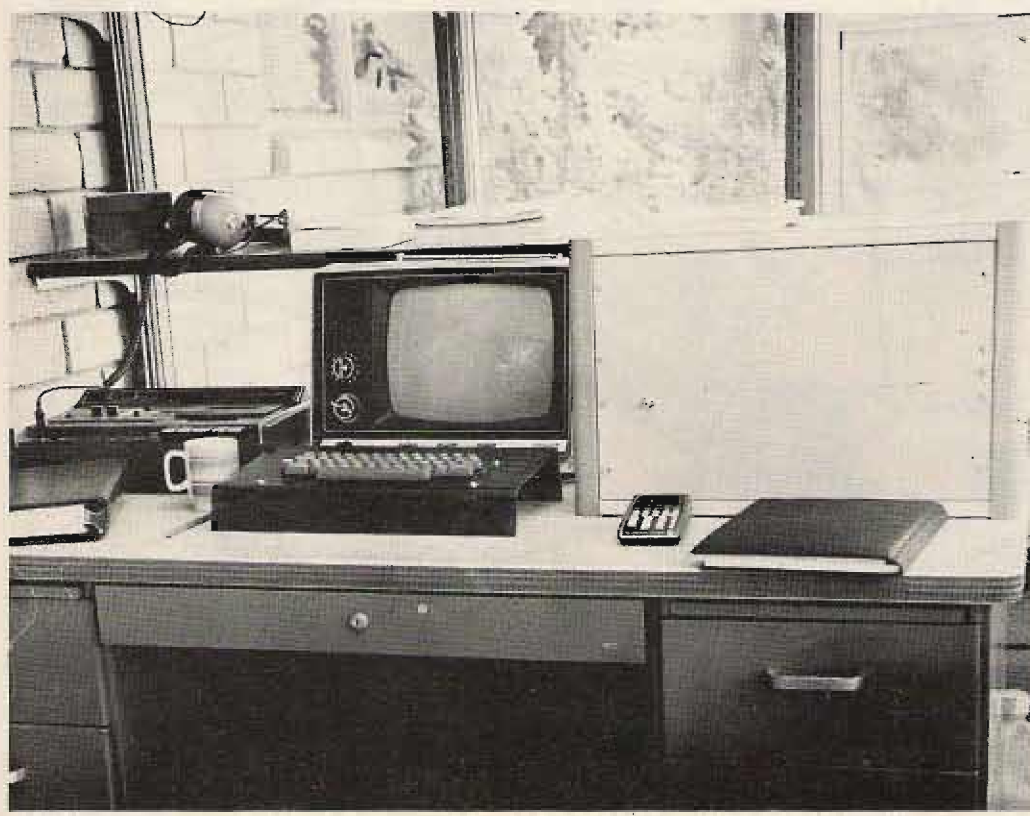
	1-24	25-49	50-99
8 pin	.47	.42	.37
10 pin	.45	.41	.37
14 pin	.39	.38	.37
16 pin	.43	.42	.40
18 pin	.75	.68	.62
22 pin	1.00	.97	.95
24 pin	1.00	.94	.75
28 pin	1.09	.98	.84
36 pin	1.59	1.45	1.30
40 pin	1.49	1.39	1.29

CM4006AE	2.00
CM4007AE	8 / 1.00
CM4008AE	3 / 1.00
CM4011AE	8 / 1.00
CM4012AE	5 / 1.00
CM4013AE	4 / 1.00
CM4014AE	3 / 2.00
CM4015AE	3 / 2.00
CM4017AE	2 / 1.00
CM4018AE	1.00
CM4019AE	4 / 1.00
CM4020AE	3 / 2.00
CM4022AE	1.00
CM4023AE	8 / 1.00
CM4024AE	3 / 1.00
CM4025AE	5 / 1.00
CM4030AE	7 / 1.00
CM4035AE	3 / 2.00
CM4037AE	2.00
CM4041AE	2 / 1.00
CM4047AE	1.00
CM4049AE	4 / 1.00
CM4050AE	4 / 1.00
CM4116AE	4 / 1.00

Al Gerbens K7SBK
1038 E. 6th Place
Mesa AZ 85203

Build This SSTV Pattern Generator

-- now, if only the FCC...



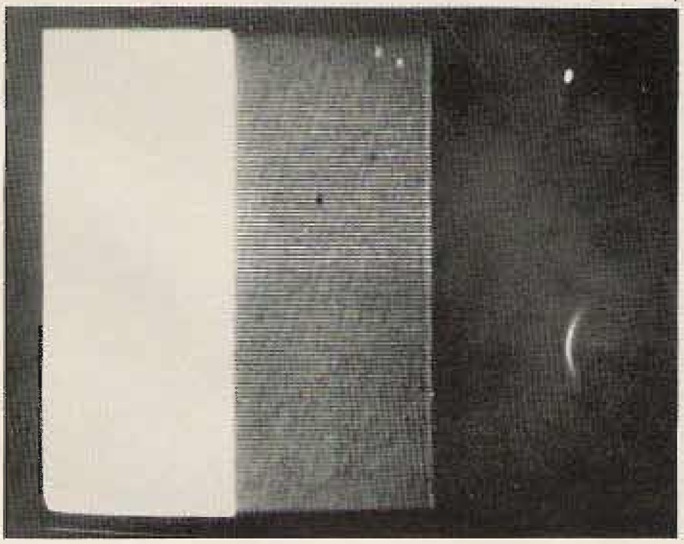
The microcomputer. The large box on the right contains the Digital Group Z-80 system and power supply.

I went directly to programming in BASIC after completing the construction of a Digital Group Z-80 system from a kit. I postponed machine language programming until recently, in order to experience the games and other slow speed applications available in BASIC. I've been interested in slow scan television for the past couple of years, and the generation of a slow scan video signal appeared to be a logical place to get my feet wet in machine language programming. The following program is what resulted. I think you'll find it interesting.

Slow Scan Video Signals

It takes about 7.5 seconds to generate a single frame in the slow scan format currently used by radio amateurs. Each frame begins immediately following a vertical synchronization pulse. This pulse consists of a burst of 1200 Hz oscillations and lasts 30 milliseconds. This is equivalent to 36 cycles, with each cycle lasting 833 microseconds. Each frame consists of 128 lines, and each line starts with a horizontal synchronization pulse which lasts 5 milliseconds. The frequency is 1200 Hz, and the burst, therefore, consists of 6 cycles, lasting 833 microseconds each. Following each horizontal synchronization pulse, there are approximately 60 milliseconds available for the information required to generate one of 128 lines in each frame. The line information consists of oscillations from 1500 Hz to 2300 Hz, with 1500 Hz representing black and 2300 Hz representing white. The line data for an intermediate grey tone only would, therefore, consist of 60 milliseconds of 1900 Hz oscillations, or 114 cycles, each 526 microseconds in length. The fre-

Option list showing the addition of the seventh option.



A 3-bar grey scale.

quency range required to generate a slow scan signal is, therefore, 1100 Hz, between 1200 Hz and 2300 Hz. The generation of these frequencies should be well within the capability of a CPU clocked at 2.5 MHz.

Square Wave Generator

The first requirement is for a machine language subroutine which can generate audio frequency oscillations. Three possibilities were considered:

1. The program would simply generate an 8-bit word, which it would output to one of the available output ports. This word would be used by external hardware in the form of a digital to analog converter and a voltage controlled oscillator, to produce a sine wave of the appropriate frequency. The pro and con are simple software and complex hardware.
2. The program would generate sine waves using only a digital to analog converter at the output port. This would not be a true sine wave, but would consist of discrete steps of voltage changes at the output of the D/A. Each step would require the outputting of a different digital word under software control. Using this approach, the software is relatively complex, and an external D/A is still required.
3. The program would generate audio frequency square waves at the lsb of any output port by simply outputting 01 and 00 alternately. The advantages are simple software, with little or no external hardware required. The disadvantage is that a square wave is generated instead of a sine wave. If sine waves are required, however, low pass filter hardware could easily filter the high frequency component of the output, yielding a sine wave.

The latter was chosen because most SSTV monitors will accept square waves quite successfully. The subroutine, which generates the square wave output, begins at program address 06 78(16) and works as follows.

Prior to calling the subroutine, two numbers are entered into registers H and L. The number which is loaded into register H is a timing constant. It will determine the length of each half cycle and, therefore, the frequency of the generated square wave. The second number, which is entered into register L, is the number of pulses to be generated. The combination of frequency and number of oscillations defines burst duration and function (synchronization pulse or line information data). The square wave generator in the program first outputs 01(16) to output port one. It then loads the timing number, which we previously entered into register H, into the accumulator. The timing number is then sequentially decremented with a check for zero after each reduction by one. On zero, the program jumps to memory location 06 84(16), where a 00(16) is outputted to port one. The lsb of port one, therefore, drops from about (+) 5 volts to 0 volts. The same timing number from register H is then reloaded into the accumulator, and the decrementing procedure begins again. When the contents of the accumulator equal zero, one complete cycle has been generated. The number of cycles number in register L is then decremented by one, and a check is made to see if it is equal to zero. If it's not equal to zero, then another cycle is generated by jumping back to the top of the subroutine. If the number of cycles number is equal to zero, then a jump is made to the return from subroutine statement in memory location 06 99(16).

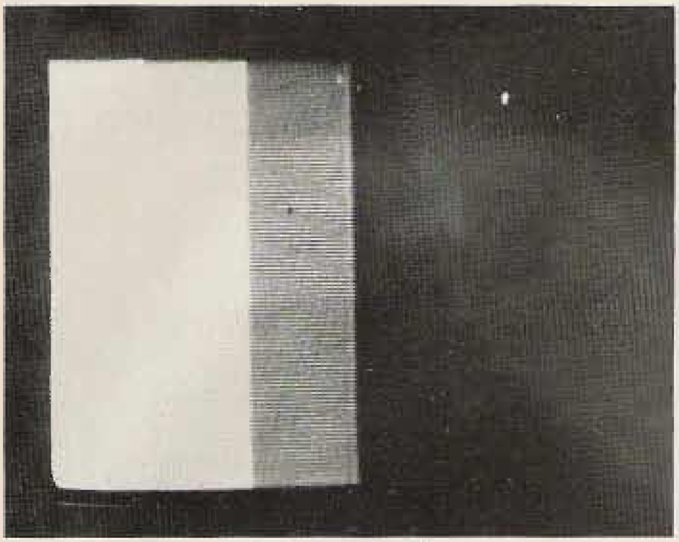
The Timing Constant

Using the square wave generator just described, the numbers which were loaded into register H to determine frequency turned out to be 2B(16) for the 1200 Hz synchronization pulses and 22(16) to 16(16) for the 1500 to 2300 Hz grey shade information. Since 22(16) minus 16(16) equals thirteen, there are 13 different shades of grey which can be generated using this system. One of the patterns generated by this program is a thirteen-bar grey scale.

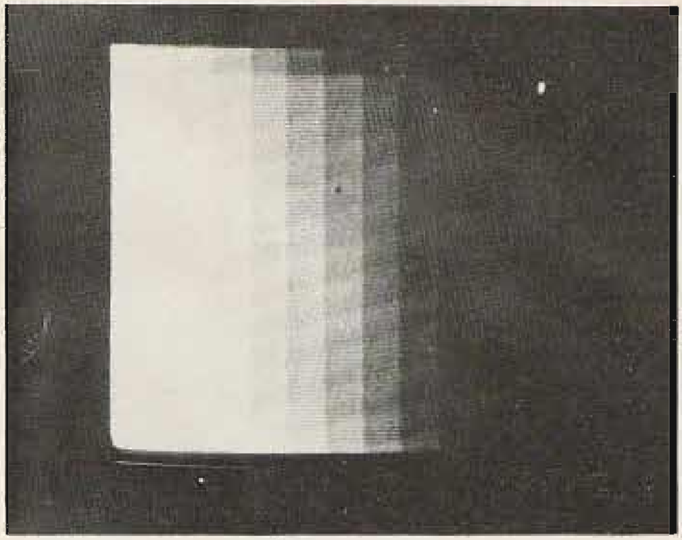
Program Execution

Generally, the generation of the slow scan signal takes place in the following sequence:

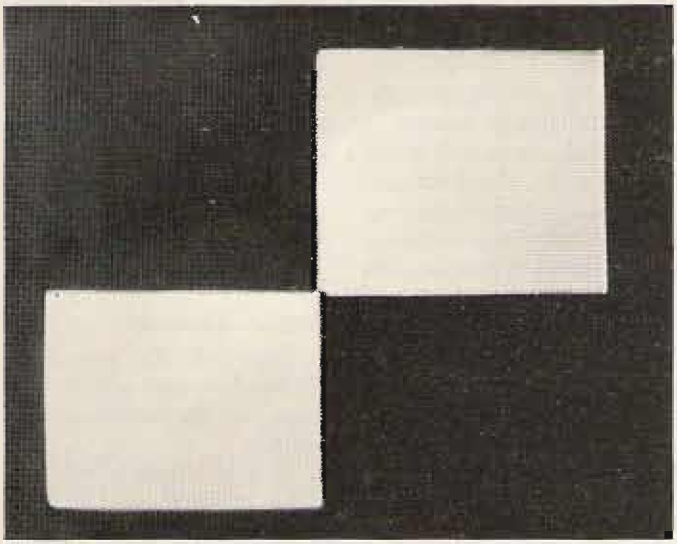
1. First a vertical synchronization pulse is generated by loading 2B(16) into H and 26(16) into L and then calling the square wave oscillator subroutine.
2. Next, the line data subroutine at 06 C6(16) is called. This routine first determines which line data sequence is to be used, then vectors to one of 9 routines. Each routine systematically loads H and L and calls the square wave generator subroutine as many as 13 times to generate the information for a single line.
3. A horizontal synchronization pulse is generated by loading 2B(16) into H and 06(16) into L and calling the square wave oscillator subroutine.
4. The line data subroutine at 06 C6(16) is again called to output line data for line number 2.
5. The sequence of horizontal synchronization pulse



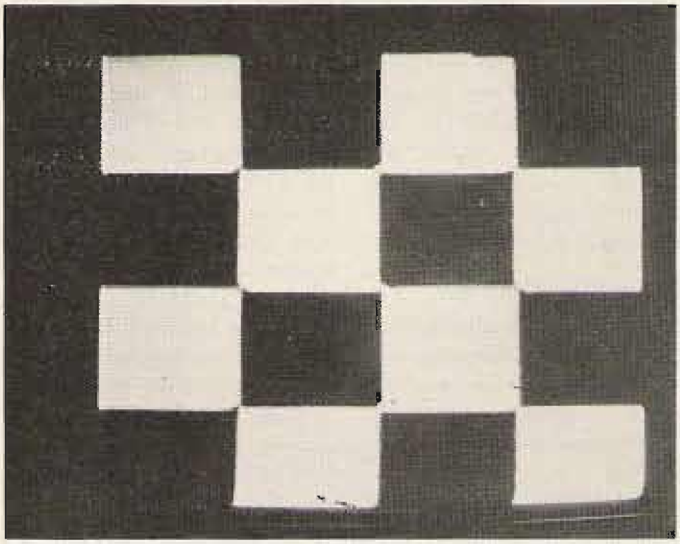
A 5-bar grey scale.



A 13-bar grey scale.



A 2 x 2 alternating checkerboard.



A 4 x 4 checkerboard.

followed by line data is repeated until 128 lines have been generated.

6. The vertical synchronization pulse is repeated after restoring register E to 128 or 80(16), and the next frame begins.

Specifically, I have used the operating system supplied with the computer to implement the program. The operating system consists of cassette read, write and dump and program routines, in both hexadecimal and octal number systems. This is a good place to relate a feature of the Digital Group Operating System which is particularly valuable in debugging machine language programs. By simply inserting an F7(16) into any memory address in the program, you can stop the program and examine the status of all registers in the CPU, and any memory location can be examined or altered. When the system encounters the F7, it stops and displays register status, including all flag status, and it waits for further instructions. I used that feature repeatedly in developing this program, and it's a tremendous debugging tool.

An addition was easily made to the options list, which provided a seventh option of SSTV, as you can see in the photograph. Entering seven results in the message "HOW MANY BARS" being written on the screen. The routine which does this uses a couple of subroutines located in the operating system. As you go through the program listing, any address less than 06 00(16) is in the operating system. If you adapt this program to another system, these subroutines will obviously have to be supplied or the call and function deleted. The remarks in the listing provide function information. The slow scan test pattern generator portions of the program, however, do not utilize the operating system, and, by getting the correct number in address 06 C5 (16), you can select one of nine line data routines. The selections available are:

B1. 4 x 4 checkerboard pattern.
B2. A split screen, with black on the left side, white on the right side.
B3. A 3-bar grey scale.
B4. A 4-bar grey scale.
B5. A 5-bar grey scale.
B6. A 6-bar grey scale.
B7. A 7-bar grey scale.
B8. A 2 x 2 checkerboard, which alternates black and white areas with each frame.
B9. A 13-bar grey scale.

All instructions used in the program are common to both Z-80 and 8080 chips. Instruction execution time may be a minor problem, if the program is implemented on an 8080 system. The number of grey tones which can be generated may be reduced. I have it running on a Z-80 system with a clock frequency of 2.5 MHz.

Results

The output from the lsb port one was connected to the tape input of a Robot 300 slow to fast scan converter. The patterns were then displayed on a 9-inch black and white fast scan receiver. The scan converter accepted the square waves nicely, and, therefore, no filtering was implemented. The system is capable of resolving the 13 grey tones, when displaying the 13-bar pattern, and the corners of the checkerboard patterns line up quite well. The vertical lines are reasonably straight, and, overall, the generator appears to be doing the job it was intended to do.

Conclusion

Presented is a machine language program which is easily adapted to any Z-80 based microcomputer system. The program generates 9 different slow scan test patterns as square wave oscillations appearing at the lsb of one of the microcomputer's output ports.

Generating these patterns using only hardware would be a monumental task, while producing new patterns with a microcomputer is simply a matter of altering a few software instructions. ■

Reference

1. *Slow Scan Television Handbook*, Don C. Miller W9NTP and Ralph Taggart WB8DQT, 73 Inc., 1972.

Program listing.

```
06 00  C3
06 01  57
06 02  06
06 57  CD    Call subroutine
06 58  9A
06 59  06
06 5A  06    Load B with 0
06 5B  00
06 5C  1E    Load E with 128(10)
06 5D  80
06 5E  26    Load H with time constant for 1200 hz
06 5F  2B
06 60  2E    Load L with 38(10) = number of cycles for
06 61  26    vertical sync pulse
06 62  CD    Call square wave generator subroutine to
06 63  78    generate vertical sync pulse
06 64  06
06 65  CD    Call subroutine to generate line data
06 66  C6
06 67  06
06 68  26    Load H with 1200 hz freq. constant
06 69  2B
06 6A  2E    Load L with 06 to get 6 cycles of
06 6B  06    1200 hz for horizontal sync pulse
06 6C  CD    Generate horizontal sync. pulse
06 6D  78
06 6E  06
06 6F  7B    Load contents of E into Accumulator
06 70  3D    Decrement accumulator
06 71  CA    Jump on zero to reset number of lines
06 72  5C    per frame and restart new frame
06 73  06
06 74  5F    Load accumulator into E
06 75  C3    Jump to line information subroutine
06 76  65
06 77  06
06 78  3E    Square wave generator subroutine
06 79  01    Load A with one
06 7A  D3    Output to port one
06 7B  01
06 7C  7C    Load A with H
06 7D  3D    Decrement A
06 7E  CA    Jump on zero to generate second
06 7F  84    half of each cycle
06 80  06
06 81  C3    Jump back to decrement again
06 82  7D
06 83  06
06 84  3E    Load A with zero
06 85  00
06 86  D3    Output A to port 1
06 87  01
06 88  7C    Load A with H
06 89  3D    Decrement A
06 8A  CA    Jump on zero
06 8B  90    to 06 90
06 8C  06
06 8D  C3    Jump unconditionally to decrement A
06 8E  89
06 8F  06
06 90  7D    Load A with L
06 91  3D    Decrement A
06 92  CA    Jump on zero to return from call
06 93  99
06 94  06
06 95  6F    Load A with L
06 96  C3    Jump to beginning of subroutine to
06 97  78    add another cycle
06 98  06
06 99  C9    Return from call
06 9A  06    Load B with 06
06 9B  06
06 9C  0E    Load C with B7
06 9D  B7
06 9E  0A    Load A with contents of memory location BC
06 9F  00    Call Print Character subroutine which is
06 A0  CD    part of the operating system
06 A1  FA
06 A2  0C
06 A3  0C    Increment C
06 A4  79    Load A with C
06 A5  FE    Compare
06 A6  C5
06 A7  CA    Jump on zero to  stop  printing
06 A8  AD    message
06 A9  06
06 AA  C3    Jump to continue printing message
06 AB  9E
06 AC  06
```

06 AD	CD	Call keyboard monitor routine in
06 AE	A8	operating system
06 AF	01	
06 B0	32	Load input into address 06 C5
06 B1	C5	
06 B2	06	
06 B3	CD	Call print character subroutine in
06 B4	FA	operating system
06 B5	00	
06 B6	C9	Return from call
06 B7	C8	H
06 B8	CF	O
06 B9	D7	W
06 BA	01	Print one blank
06 BB	CD	M
06 BC	C1	A
06 BD	CE	N
06 BE	D9	Y
06 BF	01	Print one blank
06 C0	C2	B
06 C1	C1	A
06 C2	D2	R
06 C3	D3	S
06 C4	01	Print one blank
06 C5		Data; Contains inputted selection
06 C6	3A	
06 C7	C5	Load A with number of bars (contents of
06 C8	06	06 C5)
06 C9	FE	Compare with 02
06 CA	B2	
06 CB	CA	Jump on zero to two bar subroutine
06 CC	F9	
06 CD	06	
06 CE	FE	Compare with 03
06 CF	B3	
06 D0	CA	Jump on zero to three bar subroutine
06 D1	08	
06 D2	07	
06 D3	FE	Compare with 04
06 D4	B4	
06 D5	CA	Jump on zero to 4 bar subroutine
06 D6	1F	
06 D7	07	
06 D8	FE	Compare with five
06 D9	B5	
06 DA	CA	Jump on zero to five bar subroutine
06 DB	3C	
06 DC	07	
06 DD	FE	Compare with 06
06 DE	B6	
06 DF	CA	Jump on zero to six bar subroutine
06 E0	60	
06 E1	07	
06 E2	FE	Compare with 07
06 E3	B7	
06 E4	CA	Jump on zero to 7 bar subroutine

06 E5	8B	
06 E6	07	
06 E7	FE	Compare with 09
06 E8	B9	
06 E9	CA	Jump on zero to 13 bar subroutine
06 EA	BD	
06 EB	07	
06 EC	FE	Compare with 01
06 ED	B1	
06 EE	CA	Jump on zero to 4x4 checkerboard
06 EF	19	
06 F0	08	
06 F1	FE	Compare with 08
06 F2	B8	
06 F3	CA	Jump on zero to alternating 2x2 checkerboard
06 F4	63	
06 F5	08	
06 F6	C3	Jump to beginning to regenerate request
06 F7	57	for input
06 F8	06	
06 F9	26	Beginning of two bar line routine
06 FA	22	
06 FB	2E	
06 FC	2D	
06 FD	CD	
06 FE	78	
06 FF	06	
07 00	26	
07 01	16	
07 02	2E	
07 03	45	
07 04	CD	
07 05	78	
07 06	06	
07 07	C9	Return from 2 bar subroutine
07 08	26	Begin 3 bar line routine
07 09	22	
07 0A	2E	
07 0B	1E	
07 0C	CD	
07 0D	78	
07 0E	06	
07 0F	26	
07 10	1C	
07 11	00	NOP
07 12	2E	
07 13	26	
07 14	CD	
07 15	78	
07 16	06	
07 17	26	
07 18	16	
07 19	2E	
07 1A	2E	
07 1B	CD	
07 1C	78	

07 1D	06	
07 1E	C9	Return from 3 bar subroutine
07 1F	26	Begin 4 bar line routine
07 20	22	
07 21	2E	
07 22	17	
07 23	CD	
07 24	78	
07 25	06	
07 26	26	
07 27	1E	
07 28	2E	
07 29	1A	
07 2A	CD	
07 2B	78	
07 2C	06	
07 2D	26	
07 2E	1A	
07 2F	2E	
07 30	1F	
07 31	CD	
07 32	78	
07 33	06	
07 34	26	
07 35	16	
07 36	2E	
07 37	23	
07 38	CD	
07 39	78	
07 3A	06	
07 3B	C9	Return
07 3C	26	Begin 5 bar subroutine
07 3D	22	
07 3E	2E	
07 3F	12	
07 40	CD	
07 41	78	
07 42	06	
07 43	26	
07 44	1F	
07 45	2E	
07 46	14	
07 47	CD	
07 48	78	
07 49	06	
07 4A	26	
07 4B	1C	
07 4C	2E	
07 4D	17	
07 4E	CD	
07 4F	78	
07 50	06	
07 51	26	
07 52	19	
07 53	2E	
07 54	19	
07 55	CD	
07 56	78	
07 57	06	
07 58	26	
07 59	16	
07 5A	2E	
07 5B	1C	
07 5C	CD	
07 5D	78	
07 5E	06	
07 5F	C9	Return from 5 bar subroutine
07 60	26	Begin 6 bar line subroutine
07 61	22	
07 62	2E	
07 63	16	
07 64	CD	
07 65	78	
07 66	06	
07 67	26	
07 68	1F	
07 69	2E	
07 6A	11	
07 6B	CD	
07 6C	78	
07 6D	06	
07 6E	26	
07 6F	1D	
07 70	2E	
07 71	12	
07 72	CD	
07 73	78	
07 74	06	
07 75	26	
07 76	1B	
07 77	2E	
07 78	14	
07 79	CD	
07 7A	78	
07 7B	06	
07 7C	26	
07 7D	19	
07 7E	2E	
07 7F	15	
07 80	CD	
07 81	78	
07 82	06	
07 83	26	
07 84	16	
07 85	2E	
07 86	17	
07 87	CD	
07 88	78	
07 89	06	
07 8A	C9	Return fro m 6 bar line subroutine
07 8B	26	Begin 7 bar line subroutine
07 8C	22	

```
07 8D 2E
07 8E 0F
07 8F CD
07 90 78
07 91 06
07 92 26
07 93 20
07 94 2E
07 95 0C
07 96 CD
07 97 78
07 98 06
07 99 26
07 9A 1E
07 9B 2E
07 9C 0F
07 9D CD
07 9E 78
07 9F 06
07 A0 26
07 A1 1C
07 A2 2E
07 A3 10
07 A4 CD
07 A5 78
07 A6 06
07 A7 26
07 A8 1A
07 A9 2E
07 AA 11
07 AB CD
07 AC 78
07 AD 06
07 AE 26
07 AF 18
07 B0 2E
07 B1 13
07 B2 CD
07 B3 78
07 B4 06
07 B5 26
07 B6 16
07 B7 2E
07 B8 14
07 B9 CD
07 BA 78
07 BB 06
07 BC C9    Return from 7 bar line subroutine
07 BD 26    Begin 13 bar line subroutine
07 BE 22
07 BF 2E
07 C0 07
07 C1 CD
07 C2 78
07 C3 06
07 C4 26
07 C5 21
07 C6 2E
07 C7 07
07 C8 CD
07 C9 78
07 CA 06
07 CB 26
07 CC 20
07 CD 2E
07 CE 08
07 CF CD
07 D0 78
07 D1 06
07 D2 26
07 D3 1F
07 D4 2E
07 D5 08
07 D6 CD
07 D7 78
07 D8 06
07 D9 26
07 DA 1E
07 DB 2E
07 DC 08
07 DD CD
07 DE 78
07 DF 06
07 E0 26
07 E1 1D
07 E2 2E
07 E3 08
07 E4 CD
07 E5 78
07 E6 06
07 E7 26
07 E8 1C
07 E9 2E
07 EA 09
07 EB CD
07 EC 78
07 ED 06
07 EE 26
07 EF 1B
07 F0 2E
07 F1 09
07 F2 CD
07 F3 78
07 F4 06
07 F5 26
07 F6 1A
07 F7 2E
07 F8 09
07 F9 CD
07 FA 78
07 FB 06
07 FC 26
```

07 FD	19	
07 FE	2E	
07 FF	0A	
08 00	CD	
08 01	78	
08 02	06	
08 03	26	
08 04	18	
08 05	2E	
08 06	0A	
08 07	CD	
08 08	78	
08 09	06	
08 0A	26	
08 0B	17	
08 0C	2E	
08 0D	0A	
08 0E	CD	
08 0F	78	
08 10	06	
08 11	26	
08 12	16	
08 13	2E	
08 14	0B	
08 15	CD	
08 16	78	
08 17	06	
08 18	C9	Return from 13 bar line subroutine
08 19	04	Increment B
08 1A	3E	Load 32(10) into A
08 1B	20	
08 1C	90	Subtract B from A
08 1D	FA	Jump on sign negative
08 1E	3D	
08 1F	08	
08 20	26	
08 21	22	
08 22	2E	
08 23	17	
08 24	CD	
08 25	78	
08 26	06	
08 27	26	
08 28	16	
08 29	2E	
08 2A	23	
08 2B	CD	
08 2C	78	
08 2D	06	
08 2E	26	
08 2F	22	
08 30	2E	
08 31	17	
08 32	CD	
08 33	78	
08 34	06	
08 35	26	
08 36	16	
08 37	2E	
08 38	23	
08 39	CD	
08 3A	78	
08 3B	06	
08 3C	C9	
08 3D	26	
08 3E	16	
08 3F	2E	
08 40	22	
08 41	CD	
08 42	78	
08 43	06	
08 44	26	
08 45	22	
08 46	2E	
08 47	17	
08 48	CD	
08 49	78	
08 4A	06	
08 4B	26	
08 4C	16	
08 4D	2E	
08 4E	23	
08 4F	CD	
08 50	78	
08 51	06	
08 52	26	
08 53	22	
08 54	2E	
08 55	17	
08 56	CD	
08 57	78	
08 58	06	
08 59	3E	Load 64(10) into A
08 5A	40	
08 5B	B8	Compare with B
08 5C	CA	Jump on zero to 08 60 to set B to zero
08 5D	60	
08 5E	08	
08 5F	C9	Return
08 60	06	Load zero into B
08 61	00	
08 62	C9	Return
08 63	04	Increment B; Begin 2x2 alternating board
08 64	3E	Load 64(10) into A
08 65	40	
08 66	90	Subtract B from A
08 67	FA	Jump on sign negative to 08 79
08 68	79	
08 69	08	
08 6A	26	
08 6B	16	
08 6C	2E	

```
08 6D  45
08 6E  CD
08 6F  78
08 70  06
08 71  26
08 72  22
08 73  2E
08 74  2E
08 75  CD
08 76  78
08 77  06
08 78  C9
08 79  26
08 7A  22
08 7B  2E
08 7C  2E
08 7D  CD
08 7E  78
08 7F  06
08 80  26
08 81  16
08 82  2E
08 83  45
08 84  CD
08 85  78
08 86  06
08 87  C9        Return from 2x2 alternating board
                 subroutine
```

Jack G. Starr WB4GXE
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Super Baud Bumper

-- for your SWTP 6800

I was frustrated by the time that was required to load and punch 110 baud programs on my SWTPC 6800 computer using an ASR 33 as an I/O. So I took a long look at the alternatives offered by SWTPC in the computer documentation. Southwest had apparently settled for a maximum speed of 300 baud, using Kansas City Standard audio cassettes. This would allow loading a basic length program in five minutes, instead of the fifteen minutes required at 110 baud. This would be a significant improvement, but, since you're faced with procurement of additional equipment anyway, why not shoot for something faster?

A careful review of the SWTPC 6800 system revealed that baud rates up to 1200 baud were presently being generated in the system and, in fact, were bused and clearly identified on the mother board and the CPU board. The next step was to settle on an I/O for the higher baud rate, because the ASR 33 couldn't hack it. SWTPC's TV typewriter, with the optional baud rate generator, appeared to be the least expensive route to obtaining an I/O with a 1200 baud capability. Then the only bottleneck in the system appeared to be the serial control interface board (MP-C) in the computer, which doesn't pick up the higher baud rates from the mother board. Alas, why did SWTPC pass up the opportunity to provide the user with full baud rate control (110 to 1200 baud) throughout the system? With the TV terminal, I now had 110, 150, 300, 600, and 1200 baud capability, with the exception of the bottleneck at the serial control interface board.

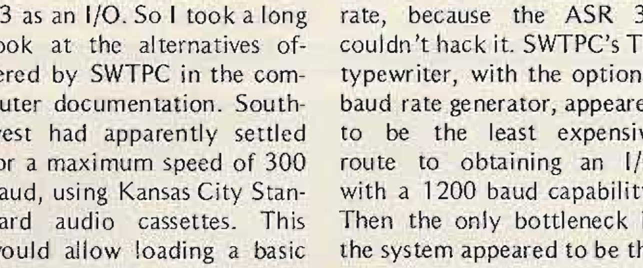

Fig. 1. Panel layout. H = home up cursor to start of page; EL = erase screen to end of line; EF = erase screen from cursor location on; U = move cursor up; D = move cursor down; L = move cursor left; and R = move cursor right.

Investigation of the system design and subsequent discussions with some of the helpful folks at SWTPC indicated that probably nothing would be lost in trying, except the effort. Hoping that all advice was sound and that I wouldn't smoke the system, I began the project. The following paragraphs outline the steps I took and the results I achieved. They are in sufficient detail to guide anyone through the conversion.

Step one was to develop a convenient switching system to permit:

1. Changing of the baud rates, at the computer serial control interface board and at the TV terminal, simultaneously.
2. Interconnecting the tape recorder, the Teletype™, the TV terminal, and the computer; and
3. Control of which pieces of equipment were on line at any given time for maximum flexibility in operations.

To accomplish the modifications at minimum disruption to the up and going system, I decided to provide switches on the control panel already in use at the TV terminal. The control panel already provided cursor control switching for the terminal. A neat little two-pole, five-position rotary switch was procured, which permits separate simultaneous switching of baud rates at the TV terminal and at the serial control interface board on the computer. Fig. 1 shows the panel layout for anyone who would like to cold copy what has proven to be very efficient. The seven momentary contact push-button switches on the left are for the cursor controls.

Space is provided for an additional switch or indicator at the lower left of the panel, if a need should develop later. The two-pole, five-position rotary baud rate selector switch is located in the upper center, with a terminal ready indicator LED located below it. On the right side, six single-pole, single-throw toggle switches provide selective control of the Teletype, the TV terminal, and the tape recorder. Each peripheral is controlled with two single-pole, single-throw switches. This arrangement provides split bus control and permits input and/or output selection of the peripheral units desired. A single-pole, double-throw is shown in the right-hand corner, which controls the baud rate selection at point C on the serial control interface board. Changing point C from low to high controls the number of stop bits at the computer. A subsequent improvement has deleted this control by replacing the two-pole, five-position baud rate selector switch with a three-pole, five-position switch. Wiring of the cursor control push-button switches is described in the TV typewriter documentation and won't be addressed here. Fig. 2(a) shows the wiring diagram for the two-pole, five-position baud rate selector switch and separate single-pole, double-throw switch. Fig. 2(b) shows the three-pole baud rate selector switch, which also automatically switches the baud rate selection at point C on the

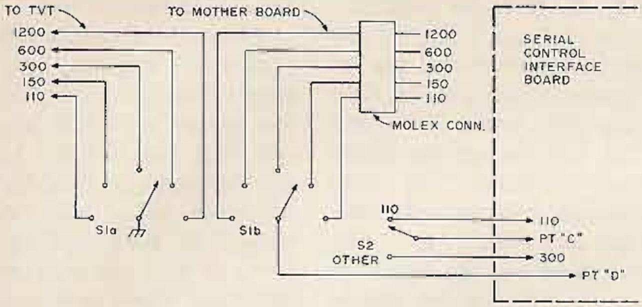

Fig. 2(a).

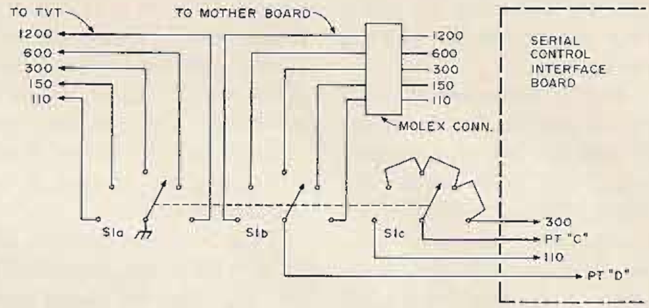

Fig. 2(b). Note that switch S2 is not used in this scheme.

serial control interface board.

The peripheral unit selection switches are straightforward on-off control of the input and output of the RS232 data to and from the units. A wiring diagram for the switching is shown in Fig. 3. Additional peripheral devices can be controlled by additional pairs of switches on the control panel.

The actual connections that were made to the computer and the terminal will be described for those who may be hesitant to experiment. A step by step test out will also be described. The only drawback is the additional wiring that runs from the computer and the terminal to the switches. A neat installation can be had with average care.

Step 1. Locate a convenient place for the control panel. A word of caution: Limit the length of the wires from the baud rate selector switch to the computer to an absolute minimum. You are dealing with digital devices, and long leads leaving printed circuit boards invite problems. I experienced none, but the possibility always exists.

Step 2. Lay out the switching control that best suits your needs. The panel layout in Fig. 1 can be used, if it suits you, or you can come up with your own. There is nothing critical in the layout, only convenience. Mount the switches in the control panel.

Step 3. Solder one set of leads on the baud rate selector switch, S1a. It's suggested that you color code the leads for troubleshooting convenience. Five leads go from switch S1a directly to JS-1 on the serial interface or UART board of the TV typewriter. Connections are shown in Table 1. A sixth lead from the wiper of the switch goes to ground, because grounding activates the baud rate selected by the switch. See Fig. 2(a) or 2(b), depending on which switching arrangement you used.

Step 4. Solder the second set of leads on the second pole of the baud rate selector switch, S1b, using the same color code as used in Step 3. Solder a female molex connector, that matches the pins on the mother board, to the computer end of these leads. This connector can be plugged onto any vacant set of pins from the baud rate buses on the mother board. The molex connector is available from Southwest Technical Products Company, if you can't find it locally. The sixth lead from the wiper of the second pole of the baud rate selector switch, S1b, goes to point "D" on the serial control interface board of the SWTPC 6800. There are no connections to "110" and "300" adjacent to point "D" on the serial control interface board. Be sure to remove any jumpers you may have installed at these points. These two sets of leads should be bundled or six-conductor cable should be used, to provide a neat installation. See Fig. 2(a) or 2(b).

Step 5. From switch S2 in Fig. 2(a), connect three wires to the switch. These wires all go from switch S2 on the control panel to the serial control interface board of the computer, so consider bundling them with wires in step 4 for neatness. The center pin of the switch is connected to point "C". The 100 baud speed side of the switch goes to "110" adjacent to point "C", and the "other" side of the switch provides all other baud rates and is connected to "300" adjacent to point "C" of the serial control interface board.

Step 6. Connect the computer side of switches S3, S5 and S7 together. This forms the "output from computer" bus. Connect the computer side of switches S4, S6 and S8 together. This forms the "input to computer" bus. You have now established common input and output buses for the computer. Connect switch S3 to the input side and switch S4 to the output side of the TV terminal (TVT). Connect switches S5 to the input side and S6 to the output side of the tape recorder (TAP). Connect switches S7 to the input side and S8 to the output side of the Teletype (TTY). The grounds for all peripheral devices and the computer are connected together, as shown by line G in Fig. 3.

Step 7. If you want the terminal ready LED, connect the anode of the LED to the terminal ready connection, which is pin 2 of JS-1 on the TV terminal. The cathode of the LED should be grounded through a 250Ω, ¼ Watt resistor. The terminal ready line is limited to sensing and to a 5 mA current, so don't forget the resistor.

Now, if you have carefully checked your connections, you are ready to check out your conversion job. At this point, you probably have abandoned the step by step procedure and have changed things around to suit yourself and that's fine. I did, too, remember! But, for the more timid, I will go ahead with a checkout procedure. These tests assume that you have the optional baud rate generator in your TV terminal and that you have a digital tape recorder (or, have borrowed one). The tests don't have to be performed in any particular order. Depending on the peripherals you have connected, the checkout must be arranged to suit your conditions.

In all cases, the input to computer side of the RS232 connections from the peripherals should show a negative voltage when the peripheral is switched on. Check each one individually at the input to computer bus to assure proper connection. If you don't get a negative volt-

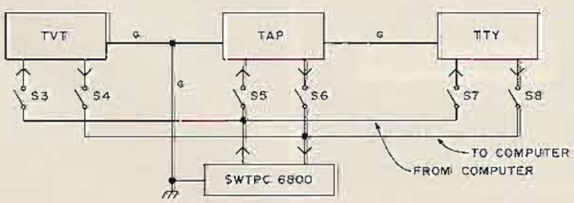

Fig. 3.

Baud rate	JS-1
110	pin no. 9
150	pin no. 10
300	pin no. 11
600	pin no. 12
1200	pin no. 3

Table 1.

age, try reversing the leads from the peripheral you are testing.

Test 1. Open switches S3, S4, S5 and S6. Close switches S7 and S8. Set baud selector switch to 110 baud. Set switch S2 to "110". This arrangement connects only the Teletype to the computer. Test your Mikbug™ memory address functions — they should work normally. If they don't, you have probably reversed the leads from the Teletype to S7 and S8, so try reversing them. If you are satisfied at this point, load a machine language program such as tic-tac-toe or blackjack into the computer via the paper tape reader on the Teletype. Open switches S5, S6, S7 and S8. Close switches S3 and S4. Set switch S2 to "OTHER." Set baud selector to 1200 baud. Type in "S9" and "G" on the TV terminal, and the program should be initiated at 1200 baud. Check the remaining baud rates, 600 to 150, on the TV terminal. Change S2 to "110", and check the 110 baud rate out. If this step has checked out, go to test 2. About the only problem you would encounter is reversal of leads from switches S5 and S6 to the tape recorder.

Test 2. Open switches S5, S7 and S8. Close switches S3, S4 and S6. Set baud rate selector switch to 1200 baud. Set switch S2 to "OTHER." This arrangement connects the "from computer" side of the tape recorder and the TV terminal to the computer, and it sets up for a print-punch operation, which will transfer the program resident in the computer to the tape recorder. After you have the program dumped to tape, turn the computer off to clear the program from memory. Power the computer back up. Using the TV terminal at 1200 baud, type "L" to initiate the program load function. Open switches S3, S4, S5, S7 and S8. Close switch S6. Load the program from tape into the computer. Open switches S5, S6, S7 and S8. Close switches S3 and S4. Initiate the program at 1200 baud by typing "S9" and "G". Go through the above listed procedures for baud rates of 150 through 600. Then set S1 and S2 to "110", and check out the 110 baud rate for dumping and loading of programs.

Test 3. If steps 1 and 2 were successful, let's proceed. So far we have checked out the Teletype, the TV terminal, and the tape recorder, individually. Now it's time to try split bus operation. Set the baud rate selector switch and switch S2 to 110 baud.

Open switches S4, S5 and S6. Close switches S3, S7 and S8. We now should be able to input data from the Teletype keyboard and output data on the Teletype and TV terminal, simultaneously. Try it and see. This will only work at 110 baud, because that's the limiting speed of the Teletype. Experiment with the other functions.

There are obviously other tests you could run, but, if tests 1 through 3 were okay, you should now have a system that has reduced load and print-punch time by a factor of 12, if you were using 110 baud, and by a factor of 4, if you were using 300 baud. Quite an improvement, wouldn't you say? We set out to provide faster loading of the SWTPC 6800, and we succeeded!

Once again, if you are reasonably careful you probably will have no problems. Too long leads from the baud rate switch to the computer could cause problems, but check for wiring errors, switch setup errors, and/or reversed wiring before you blame lead length. I hope this gives others as much fun as it's given us. I would like to see what control panel and switching arrangements you come up with, so how about dropping me a line and sending me a picture? ■

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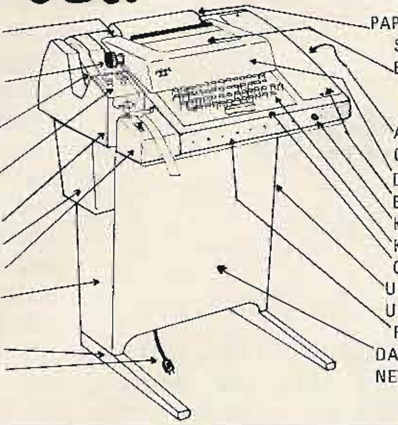

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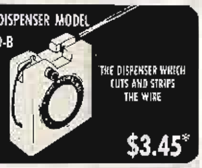

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Avid chess players will recognize P-K4 as the opening Bobby Fischer uses in the majority of his chess games. What's your favorite, and have you tried it on ham radio? There is plenty of radio chess going on in the ham bands. If you like chess, why not join in? You don't have to be an expert, you just have to like the game. Combining two interests makes them even more enjoyable.

OK, you say, I like chess. Where can I find a game on the radio? First of all, here are some frequencies where chess players can be found: Midcars, 7258 kHz; Eastcars, 7255 kHz; and Westcars, 7255 kHz are service groups which operate most of the daylight hours. Check in and ask if any chess players are on the frequency. When you make contact arrange to QSY and start your game. If you don't make contact ask the service control to list your request or just monitor for a while until someone else checks in and asks for a chess game.

Rus W9CQD playing radio chess.

Another frequency to monitor, starting about noon, is 7235 kHz. There is a pretty regular group on every day, and they will welcome some fresh talent. Evenings, after 7 pm, try around 3990 kHz and 3928 kHz for two other informal, friendly gatherings.

Now for some tips on beating the dipoles for opponents on your own. Firstly, bring up the subject during your usual QSOs. It's surprising how many hams you will find who know how to play and might be interested in a game. If they don't have time immediately, try to arrange a schedule. Check in any traffic net, and make a request for chess players. Always move off frequency quickly. Decide beforehand where you want to move so you will not hold up the net. Contact any local amateur radio club. Leave your phone number with the officers, and ask them to inquire of their membership whether anyone would like to set up a schedule. Put out a call on 2 meter FM repeaters. Again, always arrange to QSY quickly when you make contact with a player. Ask your opponents if they know of anyone else interested in playing radio chess. Keep at it, and soon you'll have a good list to choose from.

Now for some hints about actual play. It may be a little hard to maintain concentration because of noise or QRM. Remember, this is for fun, so enjoy it and don't fret about losing a game or two. You'll find a great variety of skill in the various challengers, so if you are up against an excellent player, don't prolong a game when you are down one or more pieces. Resign and start over rather than try to make him mate you. He's more apt to be willing to play you again.

Always score the game, that is, write down the moves. This helps if you have a mix-up and want to straighten out the board. Say your moves twice and always acknowledge the other fellow's moves. In radio chess you have the opportunity to move the pieces around to see how a particular position looks, and it is easy to forget to move a piece back to the right square. Try to avoid this if you can. You certainly would not be allowed to do it if you were playing across the board. It becomes a bad habit as well as leading to messing up the board.

Don't be afraid to play because you don't know chess notation. It can be learned in a few minutes. Ask an experienced player to explain it or check any elementary chess book at your local library. Try not to talk to your opponent while he is contemplating his move. Sometimes it helps to keep the frequency clear if two or three games are going on at the same time. It may be a little hectic at the beginning, but after the moves start slowing down, you'll be able to maintain the frequency since someone will be making a move more frequently than if only two were playing, and it won't seem like the frequency is clear. Explain to polite hams who ask if the frequency is in use that you are playing chess and are quiet between moves.

Don't rule out CW for your games. They can be just as rewarding as phone. Also, look out for the ladies. They play, too, and some are excellent players.

When you get established, why not go for PAS – Played All States? DX hounds will find overseas players, though the bands may not hold up for the length of the game. You may want to adjourn a lengthy game and finish another day, another reason to write down the moves. No reason not to try SSTV or RTTY either.

And who knows? When you get a winning streak going, try for a phone patch to Bobby Fischer. ■

Digital Timer Goes Mobile

- - battery power keeps it trucking !

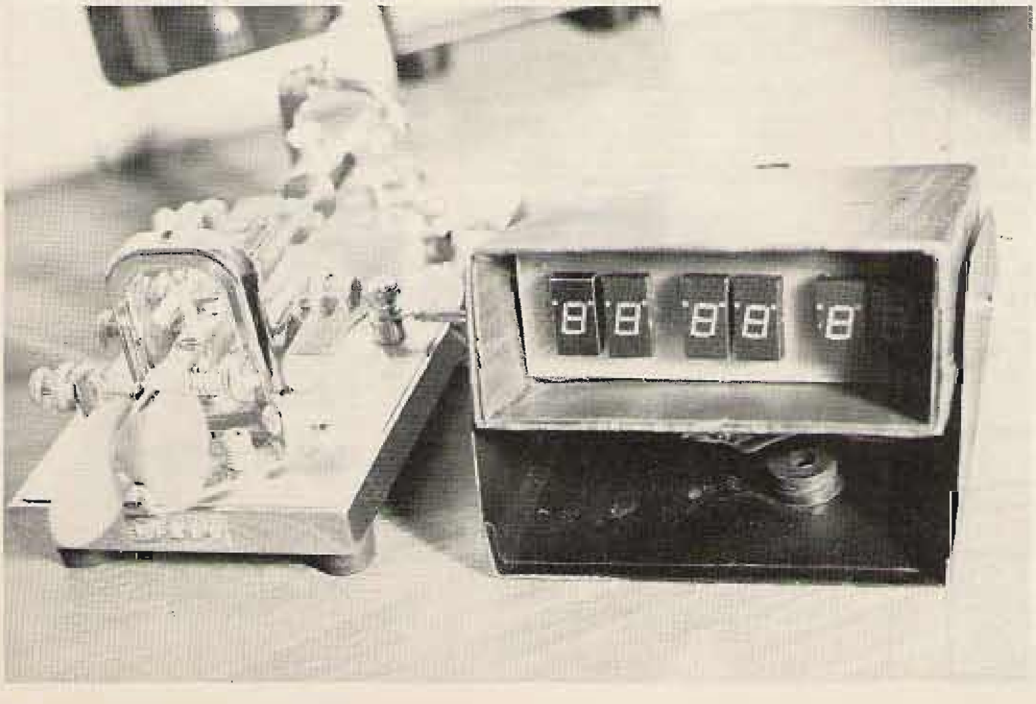
Frank W. Knottingham K7QCM
P.O. Box 734
Gold Beach OR 97444

Having built the frequency counter written up by Thomas Harper and published in the August '73 issue of *73 Magazine*, three alarm clocks from the 50250 chip outward and five of the 5314 kits, I was captivated by the flying numbers, and it was easy to convince myself that I needed a time period counter in my service truck.

So I built up out of 7400 series ICs a 3 digit timer to count the time I was on a service call. This worked quite well until the engine of the truck was started during the counting period. Then the readouts would maybe show correct time interval or maybe not. So back to the old think tank and, lo, the perfect interval counter was born.

An order was sent off to S.D. Sales for their current clock kit using a 50250 chip and a 60 Hz CMOS timebase, which was the one being advertised at the time. The two kits were assembled and mounted in a small 10¼ cm wide by 4 cm high by 11 cm long metal box hinged to a base at the lower rear corners. Two switches were installed in the bottom of the box. A push-button switch as used in a table lamp turned the 12 volts from the car battery on and off at a touch of the top of the metal box. At the same time a microswitch made up of two miniature micros fastened together and operated by a common push-button served to momentarily connect the hours-set and minute-set pins of the clock chip to the positive supply voltage which then would start the seconds counting. This interval timer has been in use for a couple months now and has not been caught giving a false reading.

Photo by Wally Blackburn K7SEG



When power is interrupted, a 50250 clock chip will return to either 12:00:00 or all zeros, depending on whether it is used as 12 hour time with a 60 Hz timebase or 24 hour time with a 50 Hz timebase. Some day I will get a CMOS 50 Hz timebase and go for the 24 hour format. At the present, starting at 12:00:00 is a bit awkward, especially around noon time.

Why didn't the original timer work? My best guess is that since the 7400 series ICs needed 5 volts, which were obtained through a 309 regulator IC which requires at least 10 volts for stable regulation, then probably the starter pulled the voltage down to or near this point and caused the confusion.

The clock chip and timebase use 12 volt supply direct and are quite tolerant of low voltage.

A cabinet to house a project such as this always presents as much problem as the circuitry, to me at least. What really took place there was that during the first lash-up and test period I found a box made of thin cardboard that just fit the circuit boards. The timebase was wrapped in crumpled newspaper and shoved down in this cardboard box. Then came the main circuit board with the clock chip on it, and the readout board was last with the readout board plugging the whole box top and the switches dangling. This lash-up was tied to the steering post and put through the smoke test in this unfinished condition. When it looked like everything would work, a metal box was made to just cover the cardboard box; a hole drilled through this received the push-push power switch, which in turn held the works in the metal box. Another hole permitted the power wires to be led out and the two microswitches to be wired outside of the box.

The choice of switches is a determining factor in the placement of the micro-switches and the lever arrangement. In this case the two microswitches were lightly hinged to the box by putting small screws in the plate of the switch pair and the push-buttons of the switches up against the box. The wires are stiff enough to provide the necessary force to close the switches. If the larger microswitches requiring more force to trip them were used, it would be necessary to provide a spring to supply this force, as a push-push switch needs an overrun on the stroke to trip it. The hours and minutes switch can be closed first, but has to give down enough for the push-push switch to turn the power on.

The current available 50250 clock chip seems to have turned into a 50252, possibly an updated version. There may be other clock chips which will work, but remember the requirement: The readouts must go to zero when the power switch is opened and closed again. Many of the clock chips will show some random number which, of course, is unsatisfactory.

A one finger push down toward the base will start this timer counting the seconds, and another push will turn the whole thing off again. ■

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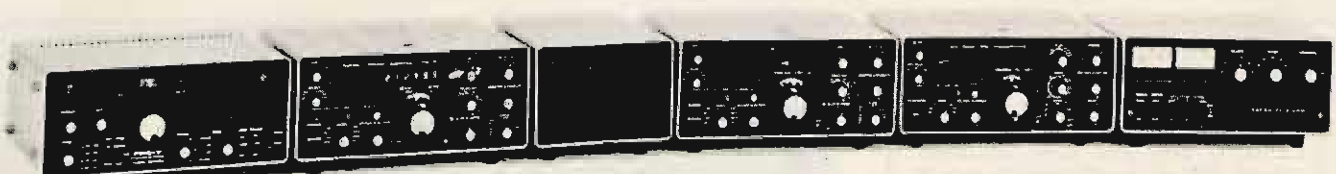
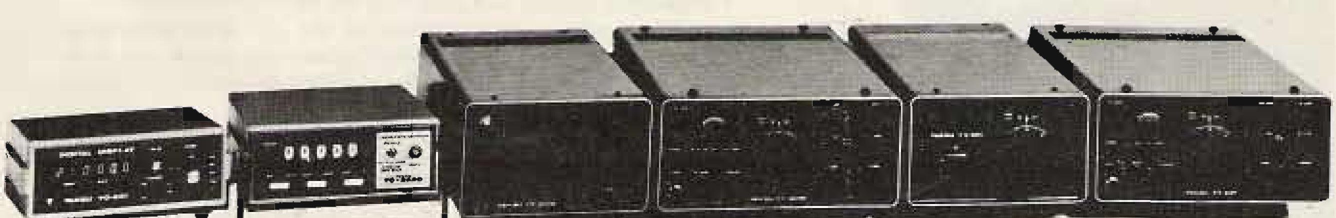


Left to right – FRG-7, Solid State Synthesized Communications Receiver • FR-101 Digital, Solid State Receiver • SP-101B, Speaker • FR-101, Digital Solid State Receiver • FL-101, 100 W Transmitter • FL-2100B, 1200 W PEP Input Linear Amplifier

Left to right – FT-620B, 6 Meter Transceiver • YP-150, Dummy Load Wattmeter • YO-100, Monitor Scope • FTV-250, 2 Meter Transverter • FTV-650, 6 Meter Transverter • FV-101B, External VFO • FT-101E 160-10 M Transceiver



Left to right – YC-601, Digital Frequency Display • YC-355D, Frequency Counter • FP-301, AC Power Supply • FT-301S Digital, All Solid State Transceiver • FV-301, External VFO • FT-221, 144-148 All Solid State All Mode Transceiver

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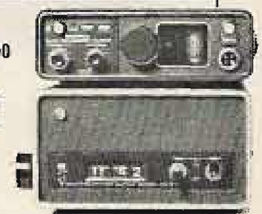

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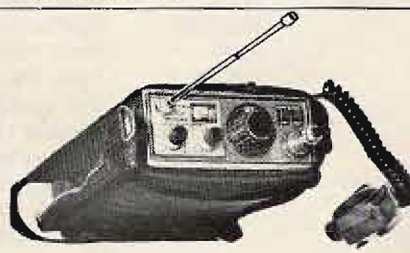

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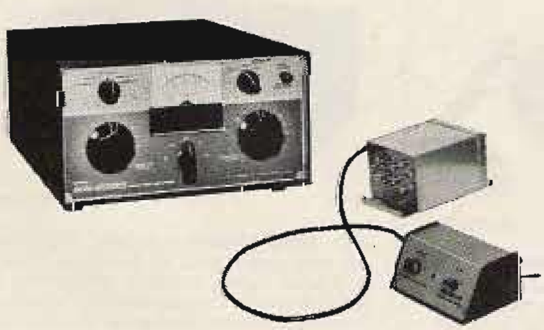

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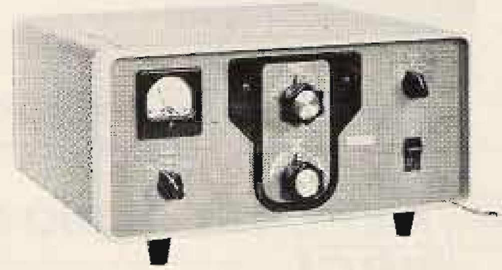

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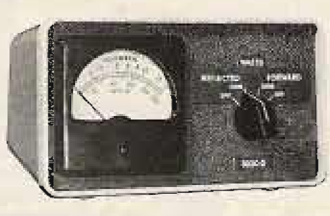

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STANDARD ELEMENTS

Power Range	Frequency Bands (MHz) 2-30	25-60	50-125	100-250	200-500	400-1000
5 watts	—	5A	5B	5C	5D	5E
10 watts	—	10A	10B	10C	10D	10E
25 watts	—	25A	25B	25C	25D	25E
50 watts	50H	50A	50B	50C	50D	50E
100 watts	100H	100A	100B	100C	100D	100E
250 watts	250H	250A	250B	250C	250D	250E
500 watts	500H	500A	500B	500C	500D	500E
1000 watts	1000H	1000A	1000B	1000C	1000D	1000E
2500 watts	2500H					
5000 watts	5000H					

Table 2
LOW-POWER ELEMENTS

1 watt	Cat. No.	2.5 watts	Cat. No.
60-80 MHz	060-1	60-80 MHz	060-2
80-95 MHz	080-1	80-95 MHz	080-2
95-125 MHz	095-1	95-150 MHz	095-2
110-160 MHz	110-1	150-250 MHz	150-2
150-250 MHz	150-1	200-300 MHz	200-2
200-300 MHz	200-1	250-450 MHz	250-2
275-450 MHz	275-1	400-850 MHz	400-2
425-850 MHz	425-1	800-950 MHz	800-2
800-950 MHz	800-1		

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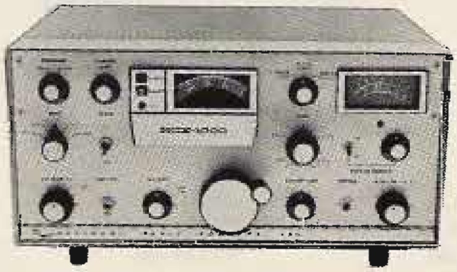

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311	Plug-In Auxiliary Crystal Oscillator for 350-XL	135.00
350-PS	AC Pwr Supply w/Spkr & Phone Jack for 350-XL	195.00
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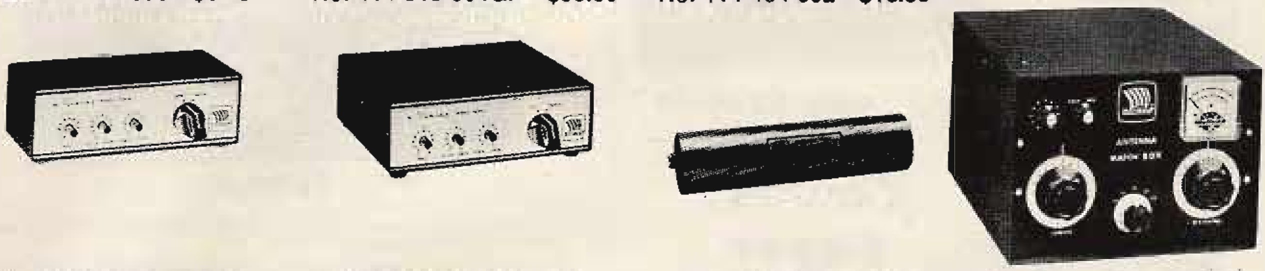

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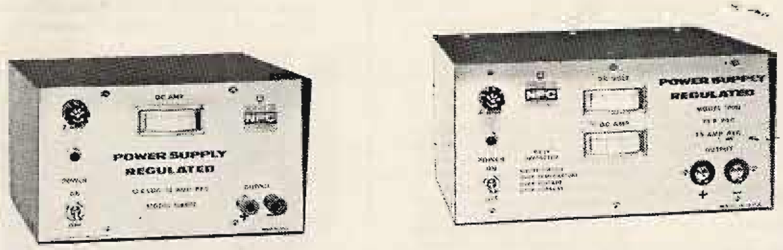

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80	200
40	entire band

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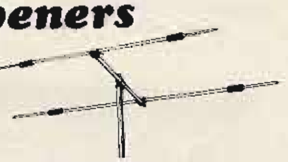

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The antenna your neighbors will love. The new DenTron Trim-Tenna with 20 meter beam is designed for the discriminating amateur who wants fantastic performance in an environmentally appealing beam. It's really loaded! Up front there's a 13 foot 6 inch director with precision Hy-Q coils. And, 7 feet behind is a 16 foot driven element fed directly with 52 ohm coax. The Trim-Tenna mounts easily and what a difference in on-the-air performance between the Trim-Tenna and that dipole, long wire or inverted Vee you've been using. 4 & 6 Forward Gain Over Dipole.

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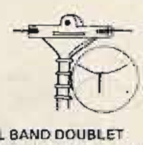

ALL BAND DOUBLET

This All Band Doublet or inverted Type Antenna covers 160 thru 10 meters. Has total length of 130 feet (14 ga. stranded copper) although it may be made shorter if necessary. This tuned Doublet is center fed through 100 feet of 450 ohm PVC covered balanced transmission line. The assembly is complete. Add rope to the ends and pull up into position. Tune with the DenTron Super Tuner and you're on 10 through 160 meters with one antenna! Now just for the DenTron All Band Doublet.

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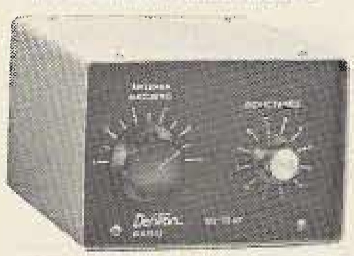

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- "L" network
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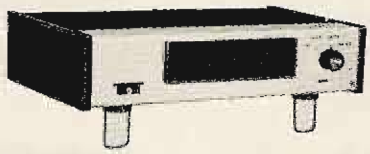

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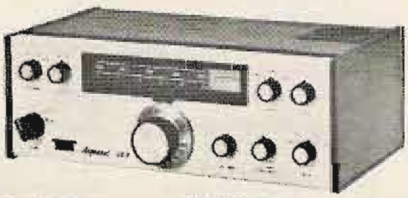

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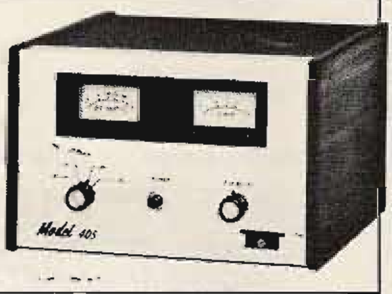

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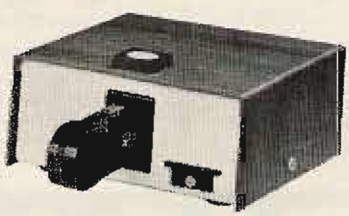

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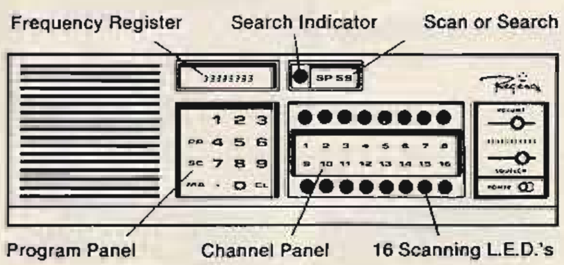

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Straining the Wind

- - simple wind speed indicator

73 Magazine *Staff*

This article describes a simple wind speed indicator which can be built very inexpensively and is complete within itself. It can be constructed as just a fun project or can have a serious application in functioning as an alarm indicator to indicate that a certain wind speed is being exceeded and a beam should be lowered. For those who desire to build a more precise anemometer, refer to the article "Inherit the Wind," *73* for March, 1976. It describes a very good home brew wind speed indicator. Its advantages are accuracy and the detection of low wind speeds. It requires a bit of circuitry, a power supply and a frequency counter as an indicator. The wind speed article described in this article is far from that elaborate, however; it requires no power supply, is a self-contained unit, and can serve the basic purpose of "saving your beam."

The heart of any wind speed indicator is a device that will generate and/or transmit a voltage proportional to the speed at which the wind vanes are rotating. Quite by accident, it was discovered that the dc motors found in cassette tape players make excellent little dc voltage generators when their shaft is externally rotated. These motors are inexpensive but relatively well-made as a mass-produced item. Their bearings are good enough that they should last for several years of service and of low enough friction that a moderate size wind vane will start the shaft turning in anything more than a gentle breeze. They can be purchased from various surplus outlets for a few dollars, or almost any serviceman will have a few available from discarded cassette tape players. Don't confuse this type of motor, however, with the "cheapie" dc motors used in toys. The latter type of motor will work also as a dc voltage generator, but will last only a short while in continuous rotational service.

The motor-turned-generator can be secured to a mast with a large hose clamp, or a much neater mast mounting arrangement can be made using a bell-type reducing joint. The latter can be found in plumbing supply houses. They are meant to join pipes with fairly great thread diameter changes. Usually one can be found which will mate with a desired mast diameter, and the large end of the bell joint then forms a cup into which the dc generator can be snugly fitted and glued into place.

The construction of the wind vanes can be as simple or as elaborate as one desires. The overall dimensions shown in Fig. 1 yielded good results with winds ranging from a bit more than a light breeze to gale force winds. The principal requirement is that the vanes turn in one direction only or else the generator will not always produce a voltage of the same polarity. To ensure this, some sort of cup or cone assembly is needed at the end of each vane. The assembly shown in Fig. 1 is about as simple as one can get. The center piece of the vane assembly is a plastic cover from a large glass jar. It serves two purposes. One is to act as a central mounting piece for the vanes, and it also serves, because of its shape, as a weather cover for the upper part of the generator. The generator used had a pulley permanently attached to the shaft, and apparently most all cassette motors come this way. The end of the pulley was filed flat and then the jar cover fastened to it with epoxy cement. The individual vanes are simply plastic sauce strainers found in a household goods store. The strainer holes are sealed up by painting them, and the handle end is secured to the jar cover by some screws. The whole assembly does look a bit funny, to say the least, but it works. It can be made a bit more professional-looking by a good overall aluminum spray painting. Also, once it is up in the air, the simple components of its construction are no longer as obvious.

The generator voltage is transferred by regular line cord to a remote indicator. The remote indicator can be a simple meter or something more elaborate, like a digital readout. The generator will turn fast enough to easily activate a microampere meter even over long transfer line lengths. In very high winds, enough voltage will be generated to activate an LED. Fig. 2 shows a remote indicator circuit using a 150 uA meter. An adjustment potentiometer allows the meter to be set for full scale with a strong wind blowing. The optoisolator circuit (an LED and a switching transistor in an IC package) can be used to switch on a buzzer or bell when a particularly high wind gust is sensed. The main value of this feature is that one can be alerted, usually during the night, of the presence of a high wind condition. The meter can be approximately calibrated in wind speed values by comparing its reading to locally broadcast weather reports under various wind conditions. ■

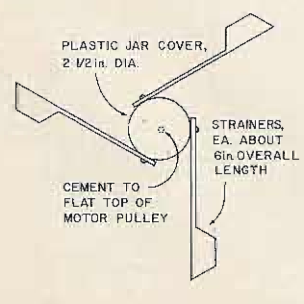

Fig. 1. Advanced design wind vane assembly.

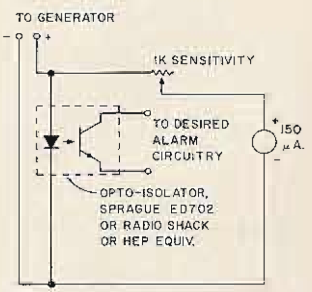

Fig. 2. Remote indicator. Alarm circuitry might be a 6 volt battery in series with a Mallory Sonalert, for example.

Ralph A. Giffone N2RG
963 E. 105 Street
Brooklyn NY 11236

Find That Meter Resistance

-- with this simple bridge

There comes a time in every ham's life when he must seek that unknown meter resistance. Here's a simple solution to that age-old problem. The schematic is shown in Fig. 1. It's equivalent circuit is shown in Figs. 2(a) and 2(b).

In Fig. 2(b), R2 is equal to R2, and R_{BP} is the equivalent parallel resistance of branch 1 and branch 2. Neglecting R_{BP}, the current through R2 would be 1.5 (E)/ 1500 (R) = .001 A or 1 mA, the full-scale reading of most meters. Thus, when we reinsert R_{BP}, we know that the current is less than 1 mA. This keeps the current through each branch (Fig. 1) less than 1 mA, protecting both meters.

In Figs. 1 and 2(a), when the resistance of branch one is equal to the resistance of branch two, the currents through both are equal. Thus, you know that when the reading on the meter under test and the current reading on your meter are equal, the resistances of the two branches are equal.

The resistance of branch one is equal to the resistance of M1 (which *must* be known) plus R1, a potentiometer with a calibrated dial. If we select Rx so that it is equal to R_{M1}, then, when R1 is equal to $R_{M\text{-test}}$, the resistances of the branches are equal. If the resistances of each branch are equal, the currents through them are equal.

To find the meter resistance, one must plug in the meter under test and rotate R1 until the currents through both meters are equal. Then we know that R1 = $R_{M\text{-test}}$ and its resistance can be read directly off the calibrated dial.

The smaller the value of potentiometer R1, the more accurate is the measurement of $R_{M\text{-test}}$. This is because the dial can be calibrated in smaller units.

As an option, a more accurate circuit is shown in Fig. 3. A rotary switch can select different values of resistance to be added to R1. Thus, R1 can be made as small as you wish. $R_{M\text{-test}}$ is now equal to R1 plus the switched-in resistance.

Let's say you wanted to measure a meter's resistance using only R1 (Fig. 1). If your dial was calibrated with 100 notches, the result would be 5 Ohms per notch. If we use the circuit in Fig. 3, the potentiometer is only 200 Ohms, leaving 2 Ohms per notch on the same calibrated dial. Thus, we see how there is more accuracy in a circuit such as the one shown in Fig. 3.

I would suggest that you choose a meter with a low resistance. Also, if you prefer, you can use an ohmmeter to read the resistance of R1, thus saving yourself the trouble of finding a calibrated dial.

As you can see, the circuit is a flexible one and can be customized by the builder. All that is needed is a pen, paper and E = IR. ■

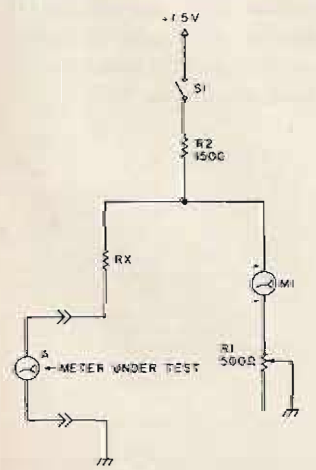

Fig. 1.

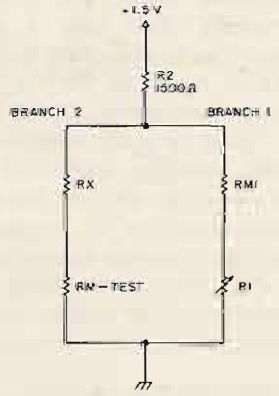

Fig. 2(a).

Fig. 2(b).

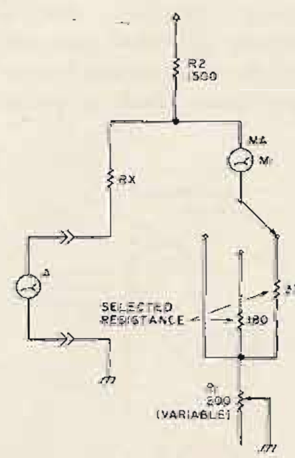

Fig. 3.

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TEN-TEC Century 21 novice/CW transceiver

Features: • Full break-in • 70 watts input • Solid-state • Built-in speaker • Receives CW or SSB • Instant band change • Offset receiver tuning • Overload protection • Sidetone with adjustable level • Regulated power supply • 80 thru 20 meters with crystals supplied.

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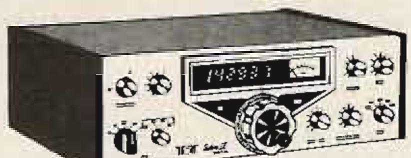

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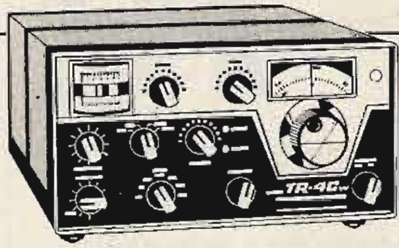

DRAKE TR-4CW transceiver

TR-4CW covers 80 thru 10 meters • Modes: SSB, AM, CW • 300 watts PEP input: SSB, 260 watts: AM & CW • Transceive or separate PTO • Wide range receiving AGC • Solid-state VFO • CW semi-break-in • VOX or PTT • Shifted-carrier CW • Constant calibration mode to mode.

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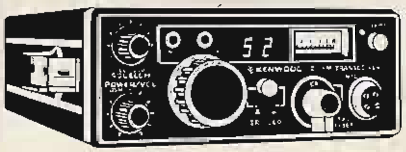

KENWOOD TR-7500 2m transceiver

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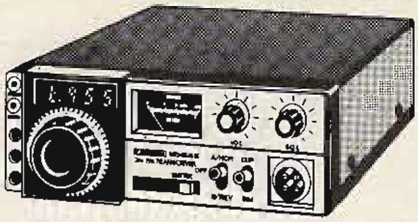

ICOM IC-245 2m transceiver

IC-245 has: • LSI synthesizer PLL • 4-digit LED readout • Transmit & receiver frequencies are independently programmable on any separation • TX output: 10 W PEP • Receiver front-end is a balance of low-noise, high-gain MOS FET & a 5 section filter.

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144 to 148 MHz coverage in 8 bank segments • Built-in AC/DC power supply • Modes: SSB, CW, FM, AM • VOX • CW break-in • PLL circuitry • Noise blanker • External touch pad connector • 11 crystal channels (88 total channels) • Selectable 600 KHz repeater offset.

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WILSON 1405 SM 2m hand-held radio

6 channel operation • 0.3 micro volt sensitivity • 12 KHz ceramic filter • Individual trimmers on all TX/RX crystals • 10.7 & 445 KHz IF • Switchable 5W or 1W output • Touch-tone pad included • Recharger base available.

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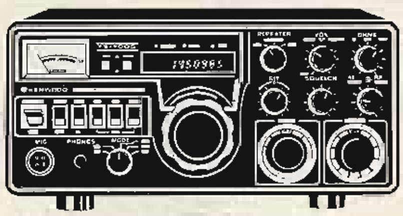

The NEW KENWOOD TS-700S 2m transceiver

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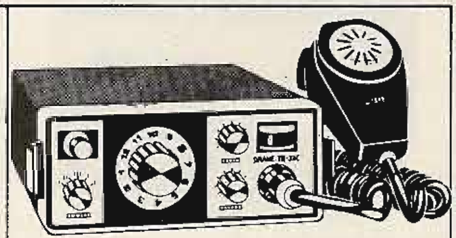

DRAKE TR-33C 2m transceiver

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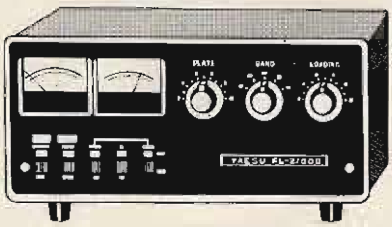


YAESU FL-2100B linear amplifier

The FL-2100B has: • 1200 W PEP • Input on 80-10 meters • Primary voltage change 117 to 234 VAC • Dual meters for plate current voltage • Adj. SWR meter • Individually tuned input coils on each band • Drive requirement: 30 to 100 W.

399.00 list price. Call for quote.

DENTRON MLA-2500 linear amplifier

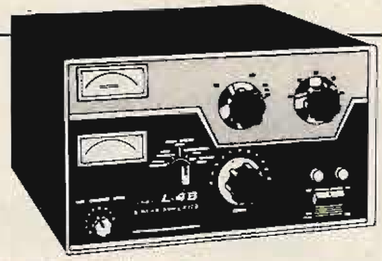
Features: • Continuous duty power supply • 160 thru 10 meters • 2000-plus watts PEP on SSB • 1000 watts DC input on CW, RTTY, SSTV • Variable forced air cooling • 2 external-anode ceramic metal triodes operating in grounded grid • Covers MARS without modifications.

799.50 list price. Call for quote.

DENTRON MLA-1200 linear amplifier

The MLA-1200 is designed to fill the gap between your barefoot transceiver & a full 2 KW amplifier. • Single external-anode ceramic/metal triode yields 1200 watts PEP on SSB & 1000 W DC on CW • Most other features same as MLA 2500 • AC power supply is list priced at 159.50. • DC power supply available.

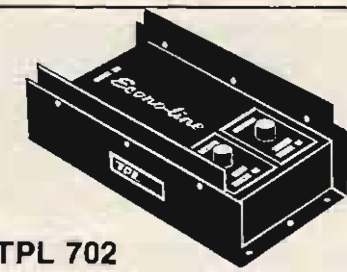
399.50 list price. Call for quote.



DRAKE L-4B linear amplifier

The L-4B features: 2000 watts PEP on SSB, 1000 watts DC on CW, AM, & RTTY • High efficiency Class B grounded grid circuit • Transmitting AGC • Broad-band tuned input • Directional wattmeter • RF neg. feedback • 2 taut-band suspension meters • Solid state power supply.

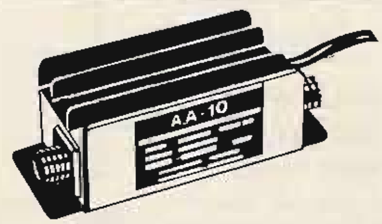
895.00 list price. Call for quote.



TPL 702 2m RF amplifier

TPL 702 has: • Solid-state • Linear switch (FM/SSB) • Broad band • Input: 10W to 20W, output: 50W to 90W • Typical: 10W in/70W out • Frequency coverage: 143 to 149 MHz. 702B (list price: 179.00) available, typical: 1W in/70W out. Input 1W to 5W, output: 60W to 80W.

149.00 list price. Call for quote.



DRAKE AA-10 2m power amplifier

The AA-10 power amplifier is made for use with the Drake TR-22C or any transceiver with up to 1.8 watts output power. • 10 dB power increase • At least 10 watts output @ 13.8 VDC • No relays—automatic transmit/receive switching • Compact.

49.95 list price. Call for quote.

Remember, you can call TOLL-FREE: **1-800-633-3410** in U.S.A. or call **1-800-292-8668** in Alabama for our low price quote. Store hours: 9:00 AM til 5:30 PM, Monday thru Friday.

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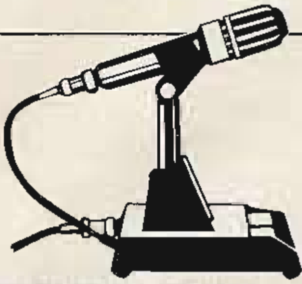
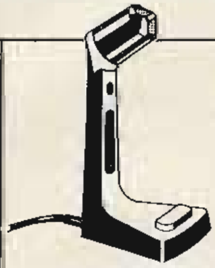
Call Toll Free 1-800-633-3410 for microphones



KENWOOD MC-50 desk microphone

The MC-50 dynamic mike has been designed expressly for amateur radio operation. • Complete with PTT & LOCK switches • Easy conversion from HI to LOW impedance • Unidirectional • Mike plug on coil cord for instant hook-up to any Kenwood rig.

39.95 list price. Call for quote.

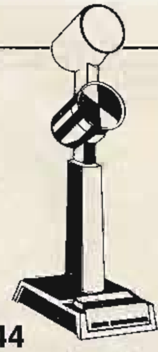


OVER 50% OFF

ELECTRO-VOICE 719 desk microphone

The 719 has two talk switch positions, grip-to-talk & push-to-talk. Features: • 80 to 7000 Hz frequency response • Ceramic generating element • High Z output impedance • Omnidirectional polar pattern. Simple instructions included for change of talk switch position.

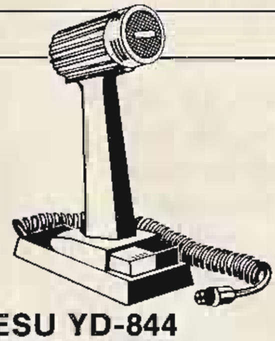
19.00 45.00 list price.



SHURE 444 adjustable desk mike

The Shure 444 microphone head can be raised or lowered approx. 2½" for the most comfortable talking position. PTT switch with optional locking feature. Omnidirectional polar pattern, frequency response: 300 to 3000 Hz.

58.50 list price. Call for quote.



YAESU YD-844 desk microphone

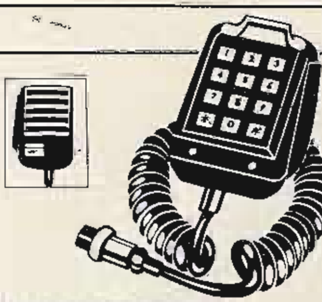
The YD-844 is designed for use with your Yaesu transceiver or transmitter. • Dynamic generating element • Frequency response: 350 to 2700 Hz • PTT switch & lock switch • 50 K ohm • Coil cord and microphone input plug for instant hook-up.

29.00 list price. Call for quote.

SHURE 414A compact hand mike

The 414A is ideal for your portable transceiver. • One-half the size of most hand mikes • Omnidirection polar pattern • Frequency response: 400 to 4000 Hz • High impedance • Output level 54.5 dB • 5½ foot coil cord with input plug.

45.50 list price. Call for quote.



DRAKE 1525 EM hand microphone

The 1525 EM is an auto-patch encoder & mike in one compact unit. • High accuracy IC tone generator, no frequency adjustments • Digitran® keyboard • Low output impedance • 4-pin plug & coiled cord allows use on most transceivers.

49.95 Call today for yours.

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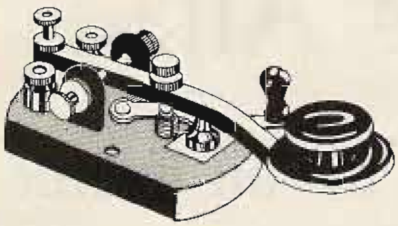
Call Toll Free 1-800-633-3410 for accessories

ESI POS-1220Z power supply

This one really works! • 13.8 VDC regulated power supply • Current rating: 20 amps continuous, 30 amps surge • Fuse protected • LED power indicator • ON/OFF switch on front panel. This unit will power a TR-7400A AND a KLM 160 watt 2m amplifier!

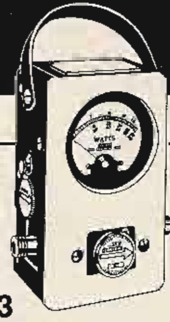
69.95 Call for yours today.



NYE VIKING 114-320-003 key

This heavy-duty key is constructed on a heavy die-cast base. The hardware is nickel-plated. Has smooth adjustable bearings and heavy-duty coin silver contacts. Black wrinkle finished base, switch and Navy knob.

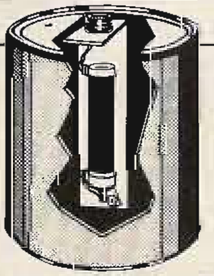
10.60 Call for yours today.



BIRD Model 43 Thruline® wattmeter

The model 43 features: • 50 ohms nominal impedance • VSWR insertion with N connectors: 1.05 max. • Accuracy: plus or minus 5% of full scale • Shock mounted 30 microamp meter has 3 expanded scales of 25, 50, & 100 to permit direct reading of full scale power from 100 milliwatts to 10,000 watts • Plug-in elements are optional. 2 to 30 MHz, 42.00. 25 to 1000 MHz, 36.00. Other elements and accessories are available.

120.00 list price. Call for quote.

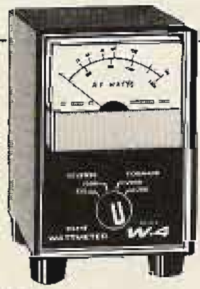


NEW!

The NEW DENTRON BIG DUMMY

Now you can tune-up off the air with Dentron's Big Dummy load. A full power dummy load, it has a flat SWR, full frequency coverage from 1.8 to 300 MHz and a high grade industrial cooling oil furnished with the unit. Built to last! Fully assembled and warrantied. Help cut out the QRM factor now!

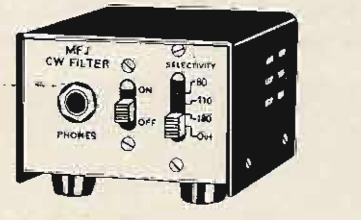
29.50 Call for yours today.



DRAKE W-4 RF directional wattmeter

W-4 covers 2 thru 30 MHz • 2000 watts continuous duty power capability • Line impedance: 50 ohm resistive • VSWR insertion: no more than 1.05 to 1 • Accuracy: plus or minus 5% of reading • 4 position switch selects: scale, forward, or reflected power.

72.00 list price. Call for quote.



MFJ 2BX super CW filter

The MFJ CW filter has: • Selectable band width: 80, 110, 180 Hz • 60 dB down one octave from center frequency of 750 Hz for 80 Hz BW • Reduces noise 15 dB • 9 V battery • Plugs in between receiver and phones • 8-pole active IC filter.

29.95 Call for yours today.

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A. Sturko VE8NS
Ft. Smith NWT
Canada

VE6 DXer Tells All!

-- what to do all winter

During the fall of 1971, I took the opportunity to transfer from VE6 land to VE8 land to work in what was at that time the largest national park in the world, a total of 17,300 square miles of wilderness.

Wood Buffalo National Park straddles the boundary between the Province of Alberta and the Northwest Territories. The park holds the distinction of having the largest herd of free-roaming bison in the world and the nesting site of the endangered whooping crane.

We arrived in the small community of Fort Smith, N.W.T., with an approximate population of 2,500, on January 12, 1972; it was -40° C. After traveling for 1400 miles on winter roads with a house cat and a back seat full of house plants which were still alive, it was a godsend to be at our new home. It was a land not very well known by the average North American, let alone the average radio ham.

From left to right: VE8NS, VE8LG and VE8RZ.

The area is located in the northwest extremity of the Great Northern Plains, well within the Boreal Forest Region. It is a land of sharp contrasts, 24-hour daylight, a semiarid region with 10-12 inches of precipitation per year, and hordes of mosquitoes and black flies that could drive a human being crazy in hours. It's a land of northern lights, -50° C., dog teams, hunting and trapping still a way of life, short winter days, and ice crystals to brighten the way.

At the time of my arrival, Terry Keime VE8OK was an avid DXer. I enjoyed the bands from this QTH. VE8s were in demand, which made DXing interesting. With the eventual arrival of VE8OO and VE8RO on the same block, would you believe we had QRM alley in VE8 land? There it was in full bloom. I checked out the ham population, and, according to the list, there were 82 licensed operators, with approximately 20 active hams. And three of them were on the same block.

Time was the pacifier until the opportunity presented itself – a move to the other side of town. Now was my chance to get away from rf burns on everything I touched.

Once we were settled in, with beds on the floor and boxes piled everywhere, my thoughts turned towards an antenna structure. The days were becoming shorter and colder rapidly. The concrete base was poured by candlelight, and prayers were said for a warm weekend, just one good weekend to put up the structure. God was willing, and the antenna was on top with hours to spare. The following week proved how unpredictable the weather can be – snow and wind with minus 10° C. (It's a smug feeling to have all the outside work done.) The antenna performed as expected, loaded well, and all that was left was to pile up the DX.

But my rule of the roost was soon to be shattered with the arrival of an old friend, Gerry VE8LG, a graduate from an electronics school and now a radio inspector with the Department of Communications in Fort Smith, N.W.T. The die was cast. Gerry was moving in next door! How is this possible with 2 million square miles of VE8 land? Two DXers squeezed into an area of 1,000 square feet made me wonder at the mathematical odds and shake my head.

Once the initial shock was over and I became somewhat rational, we discussed old times, invariably getting around to amateur radio. A plot was formed. VE8LG had intentions of purchasing a Wilson 520 (for the uninitiated, the Wilson 420 has 4 elements on a 30' boom; the 520 has 5 elements on a 40' boom) and a self-supporting 64' tower to support the beam (with a Ham II rotator to turn it). The entire construction procedure went well and 5 elements were soon up.

The area of residence of VE8NS and VE8LG was taking on an air of space age mystery. In the space of 100', two 64' towers and one 40' tower, supporting a Wilson 520, 420, and 415, and an inverted vee for 40 and 80, were serving two amateur radio stations — the VE8LG Kenwood twins and the VE8NS TR-3 Drake line. We were rather amused whenever people or vehicles passed by. Invariably they slowed down to look at all the flying aluminum and shake their heads, with quizzical looks as if to say, "What is going on here?" Thank goodness for rather nonstringent town bylaws, or we would not have been allowed to proceed.

Tests were started immediately, and, as expected, the beam performed according to specifications. We decided to hook both transmission lines to an antenna switch. Since VE8NS' beam was only 50' away, it presented no problem to extend a coax a little bit.

VE8NS contemplating the job.

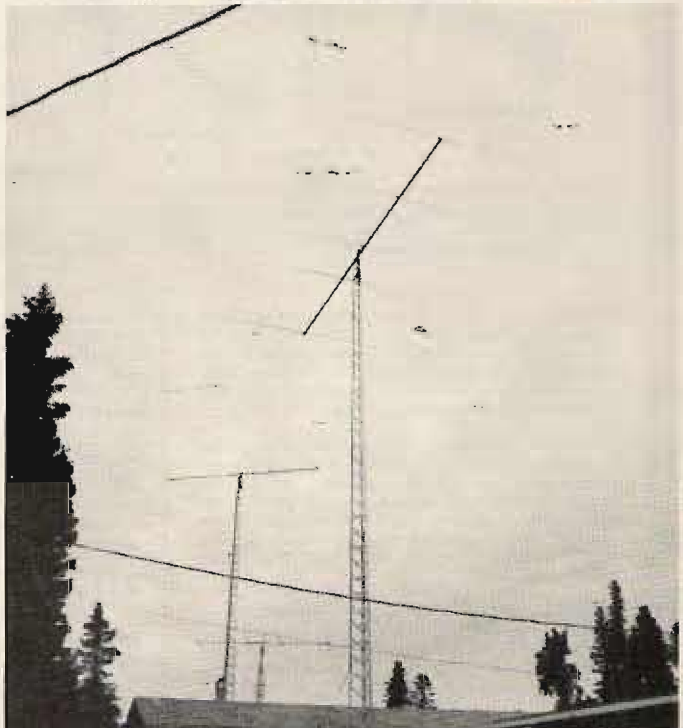
The results from the experiment were confusing. With both beams pointing to Europe, transmitted signal strengths were basically the same in all cases. However, on received signals the 520 beam registered as much as 3 S-units over the 420 beam. In some cases we were unable to copy signals on the 420 beam which were an S2 on the 520 beam.

With beams pointing toward ZL-VK land, again we were in for a surprise. ZLs were consistently giving better reports from the 420 beam than from the 520 beam, by as much as 1 S-unit. At no time were the transmitted signals better on the 520 beam. Received signals were better by as much as 3 S-units on the 520 beam. Perhaps further experiments will be carried out to determine whether adjustments to both beams may change the present pattern. However, the experiments were a lot of fun. Maybe the old adage, "the bigger the better," does not hold true in this case.

It is impossible to work on the same band. However, with 15m openings, VE8NS is able to operate with minimum QRM. If all the bands are out, then work is continued on the 2 accu-keyers, with one working and one more to go. But that's another story.

A matter of interest to hams looking for contacts in zone 1 VE8 land — VE8RZ, VE8LG, VE8OV and VE8NS are active on 20, both CW and SSB. VE8NS is the QSL bureau manager for VE8 land.

A thought just occurred to me, I haven't noticed any rf burns at this QTH. Could it be there never were any? ■



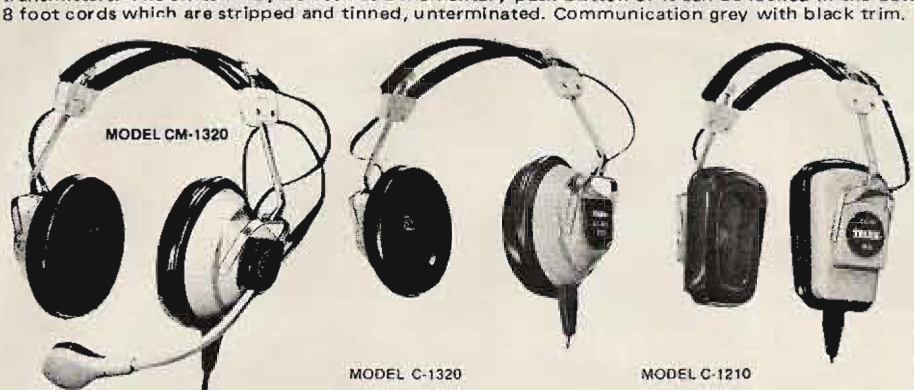
From front to back: the Wilson 520, the Wilson 415, and the Wilson 420.

TELEX® PROFESSIONAL HEADPHONES & HEADSETS

BOOM MIC HEADSETS

For the ultimate in communications convenience and efficiency select a boom mic headset. Long-time favorites of professional communications, boom mic headsets allow more personal mobility while always keeping the mic properly positioned for fast, precise voice transmission. Boom microphones are completely adjustable to allow perfect positioning. And, boom mic headsets leave both hands free to perform other tasks.

All models are supplied with "close-talking" microphones to limit ambient noise pick-up and provide superior intelligibility. Each model has a convenient, inline push-to-talk switch, which can be wired for either push-to-talk relay control or mic circuit interrupt for voice operated transmitters. The switch may be used as a momentary push-button or it can be locked in the down position. All models have tough, flexible, 8 foot cords which are stripped and tinned, unterminated. Communication grey with black trim.



MODEL CM-1320 MODEL C-1320 MODEL C-1210

MODEL C-610

MODEL C-610 Economical, dual receiver magnetic headphone. Delivers clear reception. Lightweight and comfortable yet ruggedly constructed for daily use. Earcushions seal out distracting noise and are removable for cleaning. Price: $9.95

MODEL SWL-610 Similar to Model C-610 but with 2000 ohm impedance. Ideal for shortwave receivers requiring high impedance headphones. Price: $9.95

MODEL C-1210 Medium priced, dual receiver dynamic headphone. Precise sound reproduction. Deluxe foam-filled earcushions are extremely comfortable for those long sessions. The removable cushions reduce ambient noise penetration and concentrate signal strength. Great for noisy environments or for digging out weak signals. Price: $28.30

MODEL C-1320 Our finest communications headphone. Audiometric-type dual dynamic receivers assure the ultimate in reception and performance stability. Extremely sensitive receivers provide high output levels even from weak signals. Luxurious foam filled circumaural earcushions are removable for cleaning. Price: $37.90

Dealer Programs NOW Available

MODEL CM-1210 MODEL CM-610 MODEL CM-1320S

DUAL MUFF HEADPHONES

The following headphones offer outstanding sound quality and superb comfort for long term wearing. All the models have circumaural earcushions to seal out distracting ambient noise and concentrate the signal at your ear. Foam filled vinyl earcushions on Models C-1210 and C-1320 add an extra margin of comfort. Adjustable headbands and self-aligning earcups assure proper fit. All models are equipped with a five foot cord terminating in a standard .250" diameter phone plug and have 3.2 to 20 Ohm impedance. Communication grey with black trim.

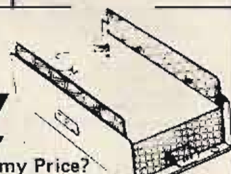
MODEL CM-610 Lightweight, dual receiver magnetic headphone (similar to Model C-610). Ceramic boom microphone with -51 dB output. Can be used with any mobile or base station with high Z mic input and 3.2 to 20 ohm audio output. Price: $42.80.

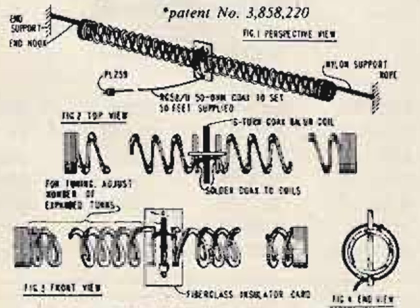
MODEL CM-1320 Deluxe dual receiver dynamic headphone with audiometric-type headphone elements (similar to Model C-1320). Ceramic boom microphone with -51 dB output. For use with any mobile or base station requiring high impedance mic input and 3.2 to 20 ohm audio output. Price: $68.30.

MODEL CM-1210 Rugged, reliable, dual receiver dynamic headphone (similar to Model C-1210). Ceramic boom microphone with -51 dB output. For use with any mobile or base station with high Z input and 3.2 to 20 ohm audio output. Price: $56.90.

MODEL CM-1320S Deluxe single receiver dynamic headphone with audiometric-type headphone element (similar to Model C-1320). Ceramic boom microphone with -51 dB output. For use with any mobile or base station requiring high impedance mic input and 3.2 to 20 ohm audio output. Price: $54.50.

MODEL	C-610	SWL-610	C-1210	C-1320	CM-610	CM-1210	CM-1320	CM-1320S
Headphone Sensitivity Ref. .0002 Dynes/cm² @1mW input, 1kHz	103dB SPL ±5dB	103dB SPL ±5dB	103dB SPL ±3dB	105dB SPL ±5dB	103dB SPL ±5dB	103dB SPL ±3dB	105dB SPL ±5dB	105dB SPL ±5dB
Headphone Frequency Response (useable)	40-15,000 Hz	40-15,000 Hz	20-20,000 Hz	20-20,000 Hz	40-15,000 Hz	20-20,000 Hz	20-20,000 Hz	20-20,000 Hz
Headphone Impedance	3.2-20 ohms	2000 ohms	3.2-20 ohms	3.2-20 ohms	3.2-20 ohms	3.2-20 ohms	3.2-20 ohms	3.2-20 ohms
Microphone Frequency Response	–	–	–	–	50-8000 Hz	50-8000 Hz	50-8000 Hz	50-8000 Hz
Microphone Impedance	–	–	–	–	High	High	High	High
Microphone Sensitivity Below 1 volt/microbar at 1kHz	–	–	–	–	–51dB ±5dB	–51dB ±5dB	–51dB ±5dB	–51dB ±5dB
Cord	5'	5'	5'	5'	8' (2.4m)	8'	8'	8'
Plug	.250" dia	.250" dia	.250" dia	.250" dia	unterminated	unterminated	unterminated	unterminated
Gross Weight	8 oz. (227g)	8 oz.	12 oz. (341g)	15 oz. (426g)	12 oz.	15 oz.	18 oz. (511g)	12 oz. (341g)
Catalog Number	61630-063	61630-062	61210-031	61320-012	61630-064	61200-058	61320-013	61320-015





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MODEL	NET PRICE		
12V4	$19.95	103R	$39.95
600	$20.50	*13 HM 4	$41.95
102	$24.95	104R	$49.95
612	$27.95	12/115	$69.95
107	$28.95	108RA	$79.95
12 HM 4	$29.95	108RM	$99.95
		109R	$149.95

MODEL 12HM4

NPC 2.5 Amp Regulated Power Supply. Solid State. Short Circuit Protected.

Low cost regulated power supply quietly converts 115 volts AC to 13.5 volts DC ±200 millivolts. 1.5 amps continuous, 2.5 amps reg. Ideally suited for operating mobile CB transceivers in your home or office base station.

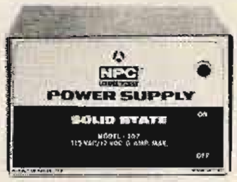
ALSO! Available as 13 HM 4 with built-in loudspeaker.

	TYPICAL	MAXIMUM
Output Voltage	13.5 + .5VDC	14VDC
Continuous Current	1.5 Amp	
Regulation	2.5 Amp	
Ripple/Noise	5 mV RMS	10 mV RMS

Case: 3" (H) x 4" (W) x 5¼" (D). Shipping Weight: 3 lbs.

MODEL 107

NPC 4 Amp Power Supply, 6 Amp Max. Solid State. Overload Protected



Functions silently in converting 115 volts AC to 12 volts DC. 4 amps continuous, 6 amps max. Enables anyone to enjoy CB radio, car 8-track cartridge, cassette player or car radio in a home or office.

Continuous Current (Full Load)	4 Amp
Output Voltage (No Load)	16 V max
Output Voltage (Full Load)	12 V min
Filtering Capacitor	10,000 uF
Ripple (Full Load)	.5 V RMS
Short Circuit Protection	Thermal Breaker

Case: 3" (H) x 4¾" (W) x 5¾" (D). Shipping Weight: 5 lbs.

MODEL 103R

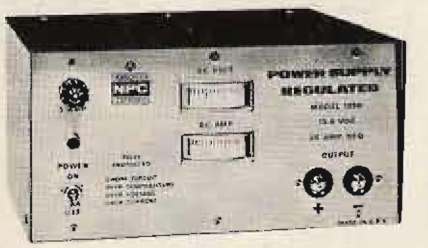
NPC 4 Amp Regulated Power Supply. Solid State. Dual Overload Protection.

Converts 115 volts AC to 13.6 volts DC ±200 millivolts. Handles 2.5 amps continuous and 4 amps max. Ideally suited for applications where no hum and DC stability are important such as CB transmission, small Ham radio transmitter, and high quality eight-track car stereos. Can also be used to trickle-charge 12 volt car batteries.

	TYPICAL	MAXIMUM
Output Voltage	13.6 ±.2 VDC	13.6 ±.3 VDC
Line/Load Regulation	20 mV	50 mV
Ripple/Noise	2 mV RMS	5 mV RMS
Transient Response	20 uSec	
Current Continuous	2.5 Amp	
Current Limit	4 Amp	
Current Foldback	1 Amp	

Case: 3" (H) x 4½" (W) x 5¼" (D). Shipping Weight 4 lbs.

MODEL 109R



NPC 25 Amp Regulated Power Supply. 4-Way Protected. Output Voltage and Current Meters.

Extra heavy-duty unit quietly converts 115 volts AC to 13.6 volts DC ±200 millivolts. 10 amps continuous, 25 amps max. All solid state. Features dual current overload, overvoltage and thermal protection. Ideally suited for operating mobile Ham radio and linear amplifier in your home or office. Excellent bench power supply for testing and servicing of mobile communications equipment

	TYPICAL	MAXIMUM
Output Voltage	13.6 ±.2VDC	13.6 ±.3VDC
Line/Load Regulation	50 mV	100 mV
Ripple Noise	5 mV RMS	10 mV RMS
Transient Response	20 uSec	
Current Continuous	10 Amp	
Current Limit	26 Amp	
Overvoltage Protection	14.5 V	15 V
Thermal Overload	180°F	

Case: 4¾" (H) x 9" (W) x 8½" (D). Shipping Weight: 15 lbs.

MODEL 12V4

NPC 1.75 Amp Power Supply. 3 Amp Max.

Functions silently in converting 115 volts AC to 12 volts DC. Ideally suited for most applications including 8-track stereo, burglar alarm, car radio and cassette tape player within power rating.

Continuous Current (Full Load)	1.75 Amp
Output Voltage (No Load)	16 V max
Output Voltage (Full Load)	12 V min
Filtering Capacitor	5,000 uF
Ripple (Full Load)	.4 V RMS
Short Circuit Protection	Thermal Breaker

Case: 3" (H) x 4" (W) x 5¼" (D). Shipping Weight: 3 lbs.

MODEL 108RM

NPC 12 Amp Regulated Power Supply. Solid State. 3-Way Protected. Current Meter.

This heavy duty unit quietly converts 115 volts AC to 13.6 volts DC ±200 millivolts. 8 amps continuous, 12 amps max. All solid state. Features dual current overload and overvoltage protection. Ideally suited for operating mobile Ham radio 2 meter AM-FM-SSB transceivers in your home or office. Can also be used to trickle-charge 12 volt car batteries

	TYPICAL	MAXIMUM
Output Voltage	13.6 ±.2VDC	13.6 ±.3VDC
Line/Load Regulation	20 mV	50 mV
Ripple/Noise	2 mV RMS	5 mV RMS
Transient Response	20 uSec	
Current Continuous	8 Amp	
Current Limit	12 Amp	
Current Foldback	2.5 Amp	
Overvoltage Protection	14.5 V	15 V

Case: 4¼" (H) x 7½" (W) x 5⅞" (D). Shipping Weight: 9.5 lbs.

ALSO AVAILABLE AS MODEL 108RA WITHOUT METER AND OVERVOLTAGE PROTECTION.

MODEL 104R

NPC 6 Amp Power Supply Regulated. Solid State. Dual Overload Protection.

Converts 115 volts AC to 13.6 volts DC ±200 millivolts. Handles 4 amps continuous and 6 amps max. Ideally suited for applications where excellent DC stability is important, such as CB transmission, small Ham radio transmitter, and high quality eight-track car stereos. Can be used to trickle-charge 12 volt car batteries.

	MAXIMUM	TYPICAL
Output Voltage	13.6 ± 2 VDC	13.6 ±.3 VDC
Line/Load Regulation	20 mV	50 mV
Ripple/Noise	2 mV RMS	5 mV RMS
Transient Response	20 uSec	
Current Continuous	4 Amp	
Current Limit	6 Amp	
Current Foldback	2 Amp	

Case: 3½" (H) x 5½" (W) x 6½" (D). Shipping Weight: 6 lbs.

MODEL 102

NPC 2.5 Amp Power Supply. 4 Amp Max. Solid State. Overload Protected.

Functions silently in converting 115 volts AC to 12-volts DC. 2.5 amps continuous, 4 amps max. Enables anyone to enjoy CB radio, car 8-track cartridge, cassette tape player or car radio in a home or office.

Continuous Current (Full Load)	2.5 Amp
Output Voltage (No Load)	16 V max
Output Voltage (Full Load)	12 V min
Filtering Capacitor	5,000 uF
Ripple (Full Load)	.6 V RMS
Short Circuit Protection	Thermal Breaker

Case: 3" (H) x 4¾" (W) x 5¼" (D). Shipping Weight 4 lbs

- **General Multi-purpose V-O-Ms**
- **Drop Resistant**
- **Hand Size**
- **Model 310 V-O-M**
- **Type 3.**

1. **Drop-resistant, hand-size V-O-M with high-impact thermoplastic case.**
2. **20,000 Ohms per volt DC and 5,000 Ohms per volt AC; diode overload protection with fused Rx1 Ohms range.**
3. **Single range switch; direct reading AC Amp range to facilitate clamp-on AC Ammeter usage.**

RANGES

DC Volts: 0-3-12-60-300,1,200 (20,000 Ohms per Volt).

AC Volts: 0-3-12-60-300-1,200 (5,000 Ohms per Volt).

Ohms: 0-20k-200k-2M Ω-20M Ω (200 Ohm center scale on low range).

DC Microamperes: 0-600 at 250 mV.

DC Milliamperes: 0-6-60-600 at 250 mV.

Accuracy: ± 3% DC; ± 4% AC; (full scale).

Scale Length: 2-1/8".

Meter: Self-shielded; diode overload protected; spring backed jewels.

Case: Molded, black, high impact thermoplastic with slide latch cover for access to batteries and fuse, 2-3/4" w x 1-5/16" d x 4-1/4" h.

Batteries: NEDA 15V 220 (1), 1½V 910F (1): Complete with 42" leads, alligator clips, batteries and instruction manual. Shpg. Wt. 2 lbs.

Model 310 Cat. No. 3018 .... $53.00

Dealer Programs NOW Available

ARGONAUT #509

AMPLIFIER #405

TEN-TEC

Dealer Programs NOW Available

ARGONAUT, MODEL 509
Covers all Amateur bands 10-80 meters. 9 MHz crystal filter. 2.5 kHz bandwidth. 1.7 shape factor @ 6/50 dB points. Power required 12-15 VDC @ 150 mA receive, 800 mA transmit at rated output. Construction: aluminum chassis, top and front panel, molded plastic end panels. Cream front panel, walnut vinyl top and end trim. Size: HWD 4½" x 13" x 7". Weight 6 lbs.

LINEAR AMPLIFIER, MODEL 405
Covers all Amateur bands 10-80 meters. 50 watts output power, continuous sine wave. RF wattmeter. SWR meter. Power required 12-15 VDC @ 8 A, max. Construction: aluminum chassis, top and front panel, molded plastic side panels. Cream front panel, walnut vinyl top and end trim. Size: HWD 4½" x 7" x 8". Weight 2½ lbs.

Argonaut, Model 509 ..... $359.00
Linear Amplifier, Model 405 . 159.00
Power Supply, Model 251
(Will power both units) 85.00
Power Supply, Model 210
(Will power Argonaut only) .. 30.00

The new ultra-modern fully solid-state TRITON makes operating easier and a lot more fun, without the limitations of vacuum tubes.

For one thing, you can change bands with the flick of a switch and no danger of off-resonance damage. And no deterioration of performance with age.

But that's not all. A superlative 8-pole i-f filter and less than 2% audio distortion, transmitting and receiving, makes it the smoothest and cleanest signal on the air.

The TRITON IV specifications are impeccable. For selectivity, stability and receiver sensitivity. And it has features such as *full* CW break-in, pre-selectable ALC, off-set tuning, separate AC power supply, 12 VDC operation, perfectly shaped CW wave form, built-in SWR bridge and on and on.

For new standards of SSB and CW communication, write for full details or talk it over with your TEN-TEC dealer. We'd like to tell you why "They Don't Make 'Em Like They Used To" makes Ham Radio even more fun.

TRITON IV $699.00

ACCESSORIES:
Model 240 One-Sixty Converter....$ 97.00
Model 244 Digital Readout 197.00
Model 245 CW Filter $25.00
Model 249 Noise Blanker 29.00
Model 252G Power Supply 109.00
Model 262G Power Supply/VOX .. 139.00

TEN-TEC
TRITON IV
Digital Model 544
$869.00

KR20-A ELECTRONIC KEYER
A fine instrument for all-around high performance electronic keying. Paddle actuation force is factory adjusted for rythmic smooth keying. Contact adjustments on front. Weighting factor factory set for optimum smoothness and articulation. Over-ride "straight key" conveniently located for emphasis, QRS sending or tune-up. Reed relay output. Side-tone generator with adjustable level. Self-completing characters. Plug-in circuit board. For 117 VAC, 50-60 Hz or 6-14 VDC. Finished in cream and walnut vinyl. Price $69.50

KR5-A ELECTRONIC KEYER
Similar to KR20-A but without side-tone oscillator or AC power supply. Ideal for portable, mobile or fixed station. A great value that will give years of troublefree service. Housed in an attractive case with cream front, walnut vinyl top. For 6-14 VDC operation. Price $39.50

KR1-A DELUXE DUAL PADDLE
Paddle assembly is that used in the KR50, housed in an attractive formed aluminum case. Price $35.00

KR2-A SINGLE LEVER PADDLE
For keying conventional "TO" or discrete character keyers, as used in the KR20-A. Price $17.00

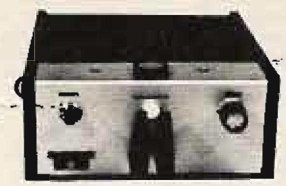
KR50 ELECTRONIC KEYER
A completely automatic electronic keyer fully adjustable to your operating style and preference, speed, touch and weithting, the ratio of the length of dits and dahs to the space between them. Self-controlled keyer to transmit your thoughts clearly, articulately and almost effortless. The jambic (squeeze) feature allows the insertion of dits and dahs with perfect timing.

An automatic weighting system provides increased character to space ratio at slower speeds, decreasing as the speed is increased, keeping the balance between smoothness at low speeds and easy to copy higher speed. High intelligibility and rythmic transmission is maintained at all speeds, automatically.

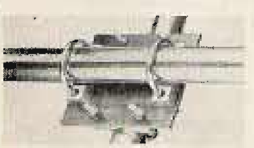
Memories provided for both dits and dahs but either may be defeated by switches on the rear panel. Thus, the KR50 may be operated as a full iambic (squeeze) keyer, with a single memory or as a conventional type keyer. All characters are self-completing. Price $110.00

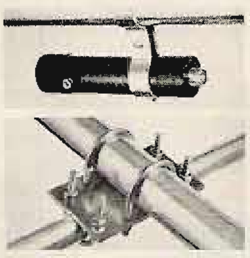
SPECIFICATIONS
Speed Range: 6-50 w.p.m.
Weighting Ratio Range: 50% to 150% of classical dit length.
Memories: Dit and dah. Individual defeat switches.
Paddle Actuation Force: 5-50 gms.
Power Source: 117VAC, 50-60 Hz, 6-14 VDC.
Finish: Cream front, walnut vinyl top and side panel trim.
Output: Reed relay. Contact rating 15 VA, 400 V. max.
Paddles: Torque drive with ball bearing pivot.
Side-tone: 500 Hz tone.
Adjustable output to 1 volt.
Size HWD: 2½" x 5½" x 8¼"
Weight: 1¾ lbs.

TEN-TEC



KR50





cushcraft 4 ELEMENT BEAM • 10-15-20 METERS Price : $239.95

From one package you receive every component to quickly and easily assemble your beam. ATB-34's rugged construction, full power handling capability, broad band coverage, and four active elements will give you superior performance on all three bands. Our new coaxial traps are very high Q, resulting in extremely low ohmic losses and longer full performance elements. They are rated for 2KW power handling. Feed is direct 52 ohm through the 1-1 balun, supplied at no extra cost.

SPECIFICATIONS

FREQUENCY COVERAGE	[illegible] MHz	NOMINAL INPUT IMPEDANCE	50 OHMS [illegible]	ASSEMBLED WEIGHT	[illegible]
Three Active Elements on Each Band	[illegible] MHz	BOOM DIA/LENGTH	[illegible]	SHIPPING WEIGHT	[illegible]
	[illegible] MHz	ELEMENT DIA/MAX LENGTH	[illegible]	[illegible] WIND SURVIVAL	[illegible]
FORWARD GAIN	7.5 dBd ALL BANDS		tapered [illegible]	ELEMENT/BOOM MATERIAL	[illegible] HARD DRAWN
FRONT TO BACK RATIO	30 dB OPTIMUM	TURNING RADIUS	[illegible]		BRIGHT FINISH ALUMINUM
V.S.W.R.	1.5 to 1 OR LESS AT RESONANCE	MAXIMUM SUPPORT MAST DIA	[illegible]		TUBING
POWER HANDLING	2000 WATTS PEP	WIND SURFACE AREA	[illegible]	Balun	[illegible]

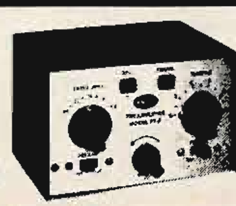
Now You Can Receive The Weak Signals With The ALL NEW AMECO PREAMPLIFIER

Model PT-2 is a continuous tuning 6-160 meter Pre-Amp specifically designed for use with a transceiver. The PT-2 combines the features of the well-known PT with new sophisticated control circuitry that permits it to be added to virtually any transceiver with No modification. No serious ham can be without one.

- Improves sensitivity and signal-to-noise ratio.
- Boosts signals up to 26 db.
- For AM or SSB.
- Bypasses itself automatically when the transceiver is transmitting.
- FET amplifier gives superior cross modulation protection.
- Advanced solid-state circuitry.
- Simple to install.
- Improves immunity to transceiver front-end overload by use of its built-in attenuator.
- Provides master power control for station equipment.

MODEL PT-2

$69.95



BIRD

The indispensable BIRD model 43 THRULINE® Wattmeter

Dealer Programs NOW Available

Read RF Watts Directly.

0.45-2300 MHz, 1-10,000 watts ±5%, Low Insertion VSWR—1.05.

Unequalled economy and flexibility: Buy only the element(s) covering your present frequency and power needs, add extra ranges later if your requirements expand.

Table 1 STANDARD ELEMENTS (CATALOG NUMBERS)

Power Range	Frequency Bands (MHz) 2-30	25-60	100-250	200-500	400-1000
5 watts	–	5A	5C	5D	5E
10 watts	—	10A	10C	10D	10E
25 watts	—	25A	25C	25D	25E
50 watts	50H	50A	50C	50D	50E
100 watts	100H	100A	100C	100D	100E
250 watts	250H	250A	250C	250D	250E
500 watts	500H	500A	500C	500D	500E
1000 watts	1000H	1000A	1000C	1000D	1000E
2500 watts	2500H				
5000 watts	5000H				

MODEL	PRICE
43	$120
Elements (Table 1) 2-30 MHz	42
Elements (Table 1) 25-1000 MHz	36
Carrying case for Model 43 & 6 elements	26
Carrying case for 12 elements	16

(Specify Type N or SO239 connectors)

BOMAR Crystal Company

Novice Crystals (Specify Band Only)

TWO METERS

CRYSTALS IN STOCK

Motorola HT 220 Crystals In Stock!

Standard • Icom • Heathkit • Ken • Clegg • Regency • Wilson • VHF Eng • Drake • And Others!

$4.50 @ Lifetime Guarantee

Make/Model	Xmit Freq.	Rec. Freq.

THE BIG SIGNAL $12.95

"W2AU" BALUN

THE APPROVED LEADING HAM AND COMMERCIAL BALUN IN THE WORLD TODAY.

1. HANDLES FULL 2 KW PEP AND THEN SOME. Broad-Banded 3 to 40 Mc
2. HELPS TVI PROBLEMS By Reducing Coax Line Radiation
3. NOW ALL STAINLESS STEEL HARDWARE. SO239 Double Silver Plated
4. IMPROVES F/B RATIO By Reducing Coax Line Pick-Up
5. REPLACES CENTER INSULATOR. Withstands Antenna Pull of Over 600 Lbs.
6. BUILT-IN LIGHTNING ARRESTER. Helps Protect Balun — Could Also Save Your Valuable Gear
7. BUILT-IN HANG-UP HOOK. Ideal For Inverted Vees, Multi-Band Antennas, Dipoles, Beam and Quads

NOW BEING USED BY ALL BRANCHES OF THE U.S. ARMED FORCES, FAA, RCA,-CIA, CANADIAN DEFENSE DEPT. PLUS THOUSANDS OF HAMS THE WORLD OVER

THEY'RE BUILT TO LAST...

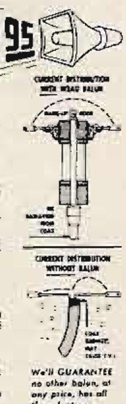
BIG SIGNALS DON'T JUST HAPPEN— GIVE YOUR ANTENNA A BREAK

Comes in 2 models. 1:1 matches 50 or 75 ohm unbalanced (coax line) to 50 or 75 ohm balanced load. 4:1 model matches 50 or 75 ohm unbalanced (coax line) to 200 or 300 ohm balanced load.

AVAILABLE AT ALL LEADING DEALERS. IF NOT, ORDER DIRECT

The big signal W2AU Balun reflects the type of quality that has kept our product out front and number 1 in Baluns the world over for the past 10 years.

The originator of the Balun with a built-in lightning arrester and hang up hook.



SERIES 31 — BNC CONNECTORS

Amphenol's BNC connectors are small, lightweight, weatherproof connectors with bayonet action for quick disconnect applications.

Shells, coupling rings and male contacts are accurately machined from brass. Springs are made of beryllium copper. All parts in turn are ASTRO-plated® to give you connectors that can take constant handling, high temperatures and resist abrasion.

BNC BULKHEAD RECEPTACLE 31-221-385 UG-1094 Mates with any BNC plug. Receptacle can be mounted into panels up to 104" thick. $1.25

BNC (M) TO UHF (F) ADAPTER 309-2900-385 UG 255 Adapts any BNC jack to any UHF plug. $3.63

DOUBLE MATE ADAPTER 83-877-385 Both coupling rings are free turning. Connects 2 female components. $2.72

JACK ADPATER $1.95 575-102-385 Adapts 83-1SP-385 to Motorola type auto antenna jack or pin jack.

PANEL RECEPTACLE 83-1R-385 SO239 Mounts with 4 fasteners in 21/32" diameter hole. $1.17

PANEL RECEPTACLE 83-878-385 SO239SH Mounts in single 21/32" diameter hole. Knurled lock nuts prevent turning. $1.59

BNC ANGLE ADAPTER 31-009-385 UG-306 Adapts any BNC plug for right angle use. $4.23

BNC TEE ADAPTER 31-008-385 UG-274 Adapts 2 BNC plugs to 31-003-385 or other female BNC type receptable. $4.56

BNC(F) TO UHF (M) ADAPTER 31-028-385 UG-273 Adapts any BNC plug to any UHF jack. $2.39

PUSH-ON 83-5SP-385 Features an unthreaded, springy shell to push fit on female connectors. $2.27

LIGHTNING ARRESTOR 575-105-385 Eliminates static build-up from antenna. Protects your valuable equipment against lightning damage. $4.80

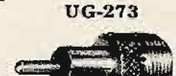
BNC PLUG 31-002-385 UG-88 Commonly used for communications antenna lead cables. For RG 55/U & RG 58/U cables. $1.59

BNC STRAIGHT ADAPTER 31-219-385 UG-914 1 9/32" long, allows length of cables to be joined. Mates with BNC plugs. $2.12

BNC PANEL RECEPTACLE 31-003-385 UG-290 Mounts with 4 fasteners in 29/64" diameter hole. $1.74

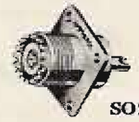

UG-1094


UG-273

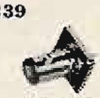

575-102-385


83-877-385

PL-259 ... 90¢
UG-175 (Adapter for RG 58U) ... 25¢


SO239

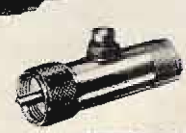

SO239SH


UG-290

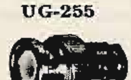

UG-274

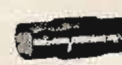

83-5SP-385


UG-306


575-105-385

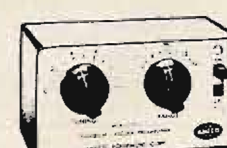

UG-255


UG-88


UG-914

AMECO

ALL BAND PREAMPLIFIERS



- 6 THRU 160 METERS
- TWO MODELS AVAILABLE
- RECOMMENDED FOR RECEIVER USE ONLY
- INCLUDES POWER SUPPLY

MODEL PLF employs a dual gate FET providing noise figures of 1.5 to 3.4 db., depending upon the band. The weak signal performance of most receivers as well as image and spurious rejection are greatly improved. Overall gain is in excess of 20 db. Panel contains switching that transfers the antenna directly to the receiver or to the Preamp. Model PLF 117V AC, 60 Hz. Wired & Tested $44.00

Model PCLP Uses nuvistor $44.00

Now It's Crystal Clear

Yes, now ICOM helps you steer clear of all the hassles of channel crystals. The new **IC-22S** is the same surprising radio you've come to know and love as the **IC-22A**, except that it is totally crystal independent. **Zero crystals.** Solid state engineering enables you to program 23 channels of your choice without waiting. Now the ICOM performance you've demanded comes with the convenience you've wanted, with your new **IC-22S**. *Price: $299.00*

IC-245 Transceiver
The VFO Revolution goes mobile with the unique, ICOM developed LSI synthesizer with 4 digit LED readout. The IC-245 offers the most for mobile on the market. The easy to use tuning knob moves accurately over 50 detent steps and assures excellent control as easily as steering the vehicle. With its optional adapter, the IC-245 puts you into all mode operation on 12V DC power with a compact dash-mounted transceiver. In FM, the synthesizer command frequency is displayed in 5 kHz steps from 146 to 148 MHz, and with the side band adapter the step rate drops to 100 Hz from 144 to 146 MHz. For maximum repeater flexibility, the transmit and receive frequencies are independently programmable on any separation. The IC-245 even comes equipped with a multiple pin Molex connector for remote control. The IC-245 is a product of the revolution in VFO design, from its new style front panel, to its excellent mechanical rigidity and Large Scale Integrated Circuitry. Your IC-245 will give you the most for mobile. $499.00

THE NEW ICOM 4 MEG, MULTI-MODE, 2 METER RADIO — IC 211
ICOM introduces the first of a great new wave of amateur radios, with new styling, new versatility, new integration of functions. You've never before laid eyes on a radio like the IC-211, but you'll recognize what you've got when you first turn the single-knob frequency control on this compact new model. The IC-211 is fully synthesized in 100 Hz or 5 kHz steps, with dual tracking, optically coupled VFOs displayed by seven-segment LED readouts, providing any aplit. The IC-211 rolls through 4 megahertz as easily as a breaker through the surf. With its unique ICOM developed LSI synthesizer, the IC-211 is now the best "do everything" radio for 2 meters, with FM, USB, LSB and CW operation. $749.00

Hold it!

Take hold of SSB with these two low cost twins. ICOM'S new portable **IC-202** and **IC-502** put it within your reach wherever you are. You can take it with you to the hill top, the highways, or the beach. Three portable watts PEP on two meters or six!

Hello, DX! The ICOM quality and excellent receiver characteristics of this pair make bulky converters and low band rigs unnecessary for getting started in SSB-VHF. You just add your linear amp, if you wish, connect to the antenna, and DX! With the **202** you may talk through OSCAR VI and VII! Even transceive with an "up" receiving converter! The **IC-502**, similarly, makes use of six meters in ways that you would have always liked but could never have before. In fact, there are so many things to try, it's like opening a new band.

Take hold of Single Side Band. Take hold of some excitement. Take two.

IC-202
2 Meter SSB • 3 Watts PEP • True IF Noise Blanker
Switched Dial Lights • Internal Batteries • 200KHz
VXO Tuning • 144.0, 144.2 + 2 More! • RIT!
Price: $259.00

IC-502
6 Meter SSB • 3 Watts PEP • True IF Noise Blanker
Switched Dial Lights • Internal Batteries • 800KHz
VFO • RIT!
Price: $249.00

Now ICOM Introduces 15 Channels of FM to Go!

The New IC-215: the FM Grabber

This is ICOM's first FM portable, and it puts good times on the go. Change vehicles, walk through the park, climb a hill, and ICOM quality FM communications go right along with you. Long lasting internal batteries make portable FM really portable, while accessible features make conversion to external power and antenna fast and easy.

Grab for flexibility with the new **IC-215 FM** portable.

- Front mounted controls and top mounted antenna
- Narrow filter (15KHz — compatible spacing)
- 15 channels (12 on dial / 3 priority)
- Fully collapsible antenna
- Compatible mount feature for flexible antenna
- Dual power (3 watts high / 400 mw low, nominal)
- External power and antenna easily accessible
- Lighted dial and meter

Price: $229.00

Your new **IC-215** comes supplied with: 5 popular channels; handheld mic. with protective case; shoulder strap; connectors for external power and speaker; 9 long-life C batteries.

ICOM

TUFTS RADIO CATALOG — TUFTS RADIO

model 333 dummy load wattmeter

Favorite Lightweight Portable—250 WATT RATING—Air Cooled

Ideal field service unit for mobile 2-way radio—CB, marine, business band. Best for QRP amateur use. CB, with zero to 5 watts full scale low power range.

▪ specifications

Frequency Range	DC to 300 MHz
VSWR	Less than 1.3:1 to 230 MHz
Power Range	250 watts intermittent
Wattmeter Ranges	0–5, 0–50, 0–125, 0–250
Connector	SO-239
Size	4" x 7" x 8"
Shipping Weight	2 lbs.
Price	$98.50

model 374 dummy load wattmeter

Top of the Line—1500 WATT RATING—Oil Cooled

Our highest power combination unit. Rated to 1500 watts input (intermittent). Meter ranges are individually calibrated for highest accuracy.

▪ specifications

Frequency Range	DC to 300 MHz
VSWR	Less than 1.3:1 to 230 MHz
Power Range	1500 watts DC intermittent. Warning light* signals maximum heat limit.
Wattmeter Ranges	0–15, 0–50, 0–300, 0–1500
Input Connector	SO-239 (hermetically sealed)
Size	4-3/4" x 9" x 10-1/4"
Shipping Weight	12 lbs.
Price	$215.00

LITTLE DIPPER

model 331A

transistor dip meter

Portable RF single generator, signal monitor, or absorption wavemeter. Lightweight (1 pound, 6 ounces with all coils), battery-powered unit is ideal for field use in testing transceivers, tuning antennas, etc. Can also be used to measure capacity, inductance, circuit Q, and other factors. Indispensable for experimenters, it is easily the most versatile instrument in the shop. Continuous coverage from 2 MHz to 230 MHz in seven ranges.

Unit consists of a transistorized RF dip oscillator and 100-microampere meter circuit. Meter circuit uses a single-transistor DC amplifier with a potentiometer in the emitter circuit to control meter sensitivity. A 3-position slide switch connects the meter circuit to the oscillator for dip measurements, to a diode for absorption wavemeter peak measurements, or provides audio modulation of the RF signal.

Frequency dial has a calibrated reference point for Q and bandwidth measurements. Each coil has its own frequency dial: there's no confusion with multiple markings or small, hard-to-read scales near the center of the dial.

▪ specifications

Frequency Coverage	2 MHz to 230 MHz in 7 overlapping ranges by plug-in coil assemblies: 2 MHz–4 MHz, 4 MHz–8 MHz, 8 MHz–16 MHz, 16 MHz–32 MHz, 32 MHz–64 MHz, 50 MHz–110 MHz, 110 MHz–230 MHz
Accuracy	±3%
Modulation	1000 Hz, 25% to 40%
Power	9-volt transistor battery, Burgess 2U6 or equivalent
Size	7" x 2-1/4" x 2-1/2"
Shipping Weight	1 lb., 6 oz.
Price	$120.00

B&W BARKER & WILLIAMSON, INC.

Economy High Power Load—1500 WATT RATING—Oil Cooled

model 384 dummy load

For high power when all you need is the load.

▪ specifications

Frequency Range	DC to 300 MHz
VSWR	Less than 1.3:1 to 230 MHz
Power Range	1500 watts intermittent. Warning light* signals maximum heat limit.
Connector	SO-239 (hermetically sealed)
Size	4-3/4" x 9" x 10-1/2"
Shipping Weight	12 lbs.
Price	$94.50

High Power—1000 WATT RATING—Oil Cooled

model 334A dummy load wattmeter.

Our most popular combination unit. Handles full amateur power. Meter ranges individually calibrated. Can be panel mounted.

▪ specifications

Frequency Range	DC to 300 MHz
VSWR	Less than 1.3:1 to 230 MHz
Power Range	1000 watts CW intermittent. Warning light* signals maximum heat limit.
Wattmeter Ranges	0–10, 0–100, 0–300, 0–1000
Input Connector	SO-239 (hermetically sealed)
Size	4-3/4" x 9" x 10-1/4"
Shipping Weight	12 lbs.
Price	$174.00

WIDE RANGE ATTENUATOR

Model 371-1

Protect your receiver or converter from overload, or provide step attenuation of low-level RF signals from signal generators, preamplifiers, or converters. Seven rocker switches provide attenuation from 1 dB to 61 dB in 1-dB steps. Switches are marked in dB, 1-2-3-5-10-20-20. Sum of actuated switches (IN position) gives attenuation. With all switches in OUT position, there is NO insertion loss. Attenuator installs in coaxial line using UHF connectors.

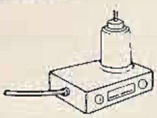
▪ specifications

Power Capacity	1/4 watt
VSWR	1.3:1 maximum, DC to 225 MHz
Impedance	50 ohms
Accuracy	1 dB/dB, DC to 60 MHZ; 0.1 dB/dB ±0.5 dB, DC to 160 MHz; 0.1 dB/dB +1.0 dB, DC to 225 MHz
Size	8-1/2" x 2-1/2" x 2-1/4"
Shipping Weight	1-1/2 lbs.
Price	$49.50

• Handle full 200 watts • low-low V.S.W.R. • Deliver 3 dB gain and more! • Pick the one that best fits your needs:

Larsen Külrod® Antennas

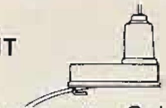
MAGNETIC MOUNT



stays put even at 100 mph!

MM-JM-150 for 144 MHz use
MM-JM-220 for 220 MHz use
MM-JM-440 for 440 MHz use
Only **$38.50** complete

TRUNK LID MOUNT



No holes and low silhouette too!

TLM-JM-150 for 144 MHz use
TLM-JM-220 for 220 MHz use
TLM-JM-440 for 440 MHz use
Only **$38.50** complete

And 1/4 wave antenna for trunk and magnetic mount – $18.50

ROOF or FENDER MOUNT

Goes on quick and easy in 3/8" or 3/4" with fewest parts.

JM-150-K for 144 MHz use
JM-220-K for 220 MHz use
JM-440-K for 440 MHz use
Only **$31.50** complete

And 1/4 wave antenna for roof and fender mounts $11.50

Above antennas all complete with mounting hardware, coax, connector plug, allen wrench and complete instructions.

---

model 372 CLIPREAMP

Model 372 – $27.50

Get maximum legal modulation without danger of splatter. Solid-state speech preamplifier and clipper for transmitters, public-address systems, and tape recorders needs no external power.

▪ specifications

Input Impedance	100,000 ohms
Input Levels	5 millivolts to 20 millivolts
Voltage Gain	10 dB
Output Level	60 millivolts
Ouput Impedance	50,000 ohms
Power	9-volt transistor battery, Burgess 2U6 or equivalent
Size	2-3/4" x 3" x 4-1/2"
Shipping Weight	7 oz.
Connectors	Terminal strip

COAXIAL ANTENNA CHANGEOVER RELAY

model 377

Model 377 – $17.95

Economical and reliable. Can be operated from VOX circuit for completely automatic operation or from PTT or manual T/R switch. Receiver input is automatically grounded when the relay is in the Transmit position. Wide AC operating voltage range and low operating current.

▪ specifications

Power Rating	1000 watts CW (2000 watts SSB)
VSWR	Less than 1.15:1, DC to 150 MHz
Power Requirements	0.015 Ampere, 48 to 130 volts AC
Connectors	UHF Type SO-239
Dimensions	3-1/2" x 1-1/2"
Shipping Weight	1 lb.

UNIVERSAL HYBRID COUPLER II PHONE PATCH

model 3002W and model 3001W

Connect your station to the telephone lines. Five switch-selectable modes give complete flexibility for patching the station to the line and for tape recording and playback to or from the line or the station. The hybrid circuit provides for effortless VOX operation of the phone patch. A built-in *Compreamp* speech preamplifier/limiter (in Model 3002W) increases the level of weak phone signals and also prevents overmodulation when the local telephone is used as the station microphone. (The *Compreamp* also functions as a preamplifier/limiter with the station microphone, if desired.)

▪ specifications

Inputs from:	
Line	600 ohms
Receiver	4 ohms
Microphone	High impedance (50,000 ohms) crystal or dynamic
Tape Recorder	4 ohms
Outputs to:	
Transmitter	50,000 ohms
Receiver Speaker	4 ohms
Tape Recorder	0.5 megohm
Size	6-1/2" x 7-1/2" x 3"
Shipping Weight	3-1/2 lbs.
Power	9-volt battery, Burgess 2U6 or equivalent
Connectors	Phono

Model 300 2W with *Compreamp* – $125.00

Model 300 1W without *Compreamp* – $85.00

B&W

BARKER & WILLIAMSON, INC.

Model 359 – $37.50

Dealer Programs NOW Available

Increase your transmitter's effective speech power up to four times. Or use it with your tape recorder or public address system for improved performance. This two-stage, transistorized Audio Preamplifier/Limiter can be used with all types of transmitters. Powered by a long-lasting dry-cell battery—no external power needed. Installs without any wiring changes in your transmitter. Just connect the *Compreamp* between your microphone (50,000-ohm dynamic or high-impedance ceramic) and your transmitter's microphone input connector. Front-panel rocker switch lets you bypass the *Compreamp* when you want to. Compression level is adjustable, too.

▪ specifications

Input Impedance	100,000 ohms
Input Level	5 millivolts to 20 millivolts
Voltage Gain	10 dB
Output Level	60 millivolts
Output Impedance	50,000 ohms
Power	9-volt transistor battery, Burgess 2U6 or equivalent
Size	2-3/4" x 3" x 4-1/2"
Shipping Weight	6-1/2 oz.
Connectors	Terminal strip

COAXIAL SWITCHES AND ACCESSORIES

for antenna selection and RF switching

These high-quality switches have set the standard for the industry for years. Ceramic switches with silver-alloy contacts and silver-plated conductors give unmatched performance and reliability from audio frequencies to 150 MHz.

B&W coaxial switches are designed for use with 52- to 75-ohm non-reactive loads, and are power rated at 1000 watts AM, 2000 watts SSB Connectors are UHF type. Insertion loss is negligible, and VSWR is less than 1.2:1 up to 150 MHz.

Crosstalk (measured at 30 MHz) is -45 dB between adjacent outlets and -60 dB between alternate outlets.

Models are available for desk, wall, or panel mounting, and with or without protective grounding of inactive outputs. Radial (side-mounted) connector models can be either wall or panel mounted; axial (backplate-mounted) connector models are for panel mounting only, save panel space.

Use the selector chart below to choose the models you need.


Model 550A


Model 590


Model 590G

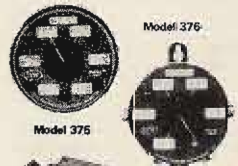

Model 551A


Model 592


Model 595

COAXIAL SWITCH SELECTOR CHART

Model	PRICE	Outputs	Connector Placement	Mounting			Automatic Grounding	Dial Plate	Remarks
				Panel	Wall	Desk			
375	18.95	6	Axial	x			x	Supplied	PROTAX switch. Grounds all except selected output circuit.
376	18.95	5	Radial	x	x		x	Supplied	PROTAX switch. Grounds all except selected output circuit. Sixth switch position grounds *all* outputs.
550A	14.00	5	Radial	x	x			DP-5	
550A-2	12.50	2	Radial	x	x			DP-2	
551A	17.50	2	Radial	x	x			DP-2	Special 2-pole, 2-position switch used to switch any RF device in or out of series connection in a coaxial line. See figure (over).
556	.95	–	–		x			–	Bracket only, for wall mounting of radial connector switches.
590	17.95	5	Axial	x				DP-5	
590G	17.95	5	Axial	x			x	Supplied	Grounds all except selected output circuit.
592	16.50	2	Axial	x				DP-2	
595	18.50	6	In-line		x	x	x		Grounds all except selected output circuit.


Model 376
Model 375


Model 550A-2

There is no substitute for quality, performance, or the satisfaction of owning the very best.

Hence, the incomparable Hy-Gain 3750 Amateur transceiver. The 3750 covers all amateur bands 1.8-30 MHz (160-10 meters). It utilizes advanced Phase-Lock-Loop circuitry with dual gate MOS FET's at all critical RF amplifier and mixer stages. There's a rotating dial for easy band-scanning and an electronic frequency counter with digital readout and a memory display that remembers frequencies at the flip of a switch. And that's just the beginning.

Matching speaker unit (3854) and complete external VFO (3855) also available.

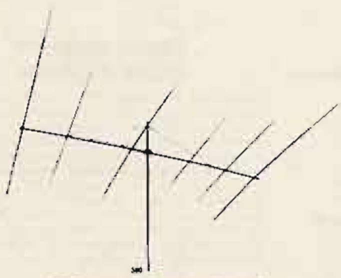
See the incomparable Hy-Gain 3750 at your radio dealer or write Department MM. There is no substitute.

3854 – $59.95 3750 – $1895.00 3855 – $495.00

There is no substitute.

hy-gain®
Amateur Radio Systems.

Dealer Programs
NOW Available



Super 3-Element Thunderbird for 10, 15 and 20 Meters Model TH3Mk3 — $199.95

Hy-Gain's Super 3-element Thunderbird delivers outstanding performance on 10, 15 and 20 meters. The TH3Mk3 features separate and matched Hy-Q traps for each band, and feeds with 52 ohm coax. Hy-Gain Beta Match presents tapered impedance for most efficient 3 band matching, and provides DC ground to eliminate precipitation static. The TH3Mk3 delivers maximum F/B ratio, and SWR less than 1.5:1 at resonance on all bands. Its mechanically superior construction features taper swaged slotted tubing for easy adjustment and larger diameter. Comes equipped with heavy tiltable boom-to-mast clamp. Hy-Gain ferrite balun BN-86 is recommended for use with the TH3Mk3.

Electrical	TH6DXX	TH3Mk3
Gain—average	8.7dB	8dB
Front-to-back ratio	25dB	25dB
SWR (at resonance)	Less than 1.5:1	Less than 1.5:1
Impedance	50 ohms	50 ohms
Power rating	Max legal	Max legal
Mechanical		
Longest element	31.1'	27'
Boom length	24'	14'
Turning radius	20'	15.7'
Wind load at 80 MPH	156 lbs.	103.2 lbs.
Maximum wind survival	100 MPH	100 MPH
Net weight	57 lbs.	36 lbs.
Mast diameter accepted	1¼" to 2½"	1¼" to 2½"
Surface area	6.1 sq. ft.	4.03 sq. ft.

6-Element Super Thunderbird DX for 10, 15 and 20 Meters Model TH6 DXX $249.95

Separate HY-Q traps, featuring large diameter coils that develop an exceptionally favorable L/C ratio and very high Q, provide peak performance on each band whether working phone or CW. Exclusive Hy-Gain beta match, factory pretuned, insures maximum gain and F/B ratio without compromise. The TH6DXX feeds with 52 ohm coaxial cable and delivers less than 1.5:1 SWR on all bands. Mechanically superior construction features taper swaged, slotted tubing for easy adjustment and re-adjustment, and for larger diameter and less wind loading. Full circumference compression clamps replace self-tapping sheet metal screws. Includes large diameter, heavy gauge aluminum boom, heavy cast aluminum boom-to-mast clamp, and heavy gauge machine formed element-to-boom brackets. Hy-Gain's ferrite balun BN-86 is recommended for use with the TH6DXX.

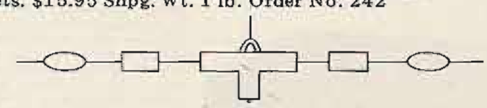
HY-GAIN'S INCOMPARABLE HY-TOWER FOR 80 THRU 10 METERS

Model 18HT
- Outstanding Omni-Directional Performance
- Automatic Band Switching
- Installs on 4 sq. ft. of real estate
- Completely Self-Supporting

By any standard of measurement, the Hy-Tower is unquestionably the finest multi-band vertical antenna system on the market today. Virtually indestructible, the Model 18HT features automatic band selection on 80 thru 10 meters through the use of a unique stub decoupling system which effectively isolates various sections of the antenna so that an electrical ¼ wavelength (or odd multiple of a ¼ wavelength) exists on all bands. Fed with 52 ohm coax, it takes maximum legal power . . . delivers outstanding performance on all bands. With the addition of a base loading coil, it also delivers outstanding performance on 160 meters. Structurally, the Model 18HT is built to last a lifetime. Rugged hot-dipped galvanized 24 ft. tower requires no guyed supports. Top mast, which extends to a height of 50 Ft., is 6061ST6 tapers aluminum. All hardware is iridite treated to MIL specs. If you're looking for the epitome in vertical antenna systems, you'll want Hy-Tower, Shpg. Wt., 96.7 lbs. Order No. 182, Price: $279.95
NEW Special hinged base assembly on Model 18HT allows complete assembly of antenna at ground level . . . permits easy raising and lowering of the antenna.

BROAD BAND DOUBLET BALUN
for 10 thru 80 meters
Model BN-86
$15.95

The model BN-86 balun provides optimum balance of power to both sides of any doublet and vastly improves the transfer of energy from feedline to antenna. Power capacity is 1 KW DC. Features weatherproof construction and built-in mounting brackets. $15.95 Shpg. Wt. 1 lb. Order No. 242

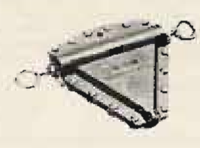


MULTI-BAND HY-Q TRAP DOUBLETS
Hy-Q Traps

- Install Horizontally or as Inverted V
- Super-Strength Aluminum Clad Wire
- Weatherproof Center and End Insulators

Installed horizontally or as an inverted V, Hy-Gain doublets with Hy-Q traps deliver true half wavelength performance on every design frequency. Matched traps, individually pretuned for each band feature large diameter coils that develop an exceptionally favorable L/C ratio and very high Q performance. Mechanically superior solid aluminum trap housings provide maximum protection and support to the loading coil. Fed with 52 ohm coax, Hy-Gain doublets employ super-strength aluminum clad single strand steel wire elements that defy deterioration from salt water and smoke . . . will not stretch . . . withstand hurricane-like winds. SWR less than 1.5:1 on all bands. Strong, lightweight, weatherproof center insulators are molded from high impact cyolac. Hardware is iridate treated to MIL specs. Heavily serrated 7-inch end insulators molded from high impact cycolac increase leakage path to approximately 12 inches.

MODEL 2BDQ for 40 and 80 meters. 100' 10½" overall. Takes maximum legal power. Shpg. Wt., 7.5 lbs $49.95
Order No. 380
MODEL 5BDQ for 10, 15, 20, 40 and 80 meters. 94' overall. Takes maximum power. Shpg. Wt., 12.2 lbs. $79.95
Order No. 383

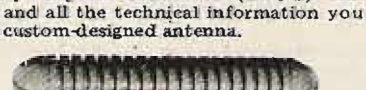


CENTER INSULATOR for Multi-Band Doublets Model CI

Strong lightweight, weatherproof Model CI is molded from high impact cycolac. Hardware is iridite treated to MIL specs. Accepts ¼" or ¾" coaxial. Shpg. Wt., 0.6 lbs. $5.95 Order No. 155

MULTI-BAND ANTENNA
Dipole Antenna — Model DIV-80
$13.95
For 10 thru 80 meters — choice of one band

A dipole antenna for the individuals who prefer the "do-it-yourself" flexibility of custom-designing an antenna for your specific needs. (Work the frequencies you wish in the 10 through 80 meters bands).
The DIV-80 features: Durable Copperweld wire for greater strength, Mosley Dipole Connector (DPC-1) for RG-8/U or RG-58/U coax and all the technical information you will need to construct your custom-designed antenna.

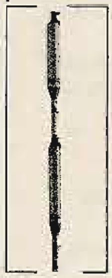


END INSULATORS for Doublets Model EI
Rugged 7-inch end insulators are molded from high impact cycolac that is heavily serrated to increase leakage path to approximately 12 inches. Available in pairs only. Shpg. Wt., 0.4 lbs. $3.95 Order No. 156

WIDE BAND VERTICAL for 80-10 Meters Hy-Gain's 18 AVT/WB

Take the wide band, omni-directional performance of Hy-Gain's famous 14AVQ/WB, add 80 meter capability plus extra-heavy duty construction—and you have the unrivalled new 18AVT/WB. In other words, you have quite an antenna.

- Automatic switching, five band capability is accomplished through the use of three beefed-up Hy-Q traps (featuring large diameter coils that develop an exceptionally favorable L/C ratio).
- Top loading coil.
- Across-the-band performance with just one furnished setting for each band (10 through 40).
- True 1/4 wave resonance on all bands.
- SWR of 2:1 or less at band edges.
- Radiation pattern has an outstandingly low angle whether roof top or ground mounted.

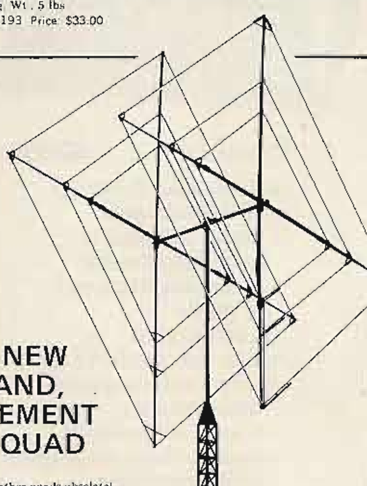


CONSTRUCTION . . . of extra-heavy duty tapered swaged seamless aluminum tubing with full circumference, corrosion resistant compression clamps at slotted tubing joints . . . is so rugged and rigid that, although the antenna is 25' in height, it can be mounted without guy wires, using a 12" double grip mast bracket, with recessed coax connecter.

Order No. 386 Price: $97.00

The Versatile Model 18V for 80 thru 10 Meters

The Model 18V is a low-cost, highly efficient vertical antenna that can be tuned to any band 80 thru 10 meters by a simple adjustment of the feed point on the matching base inductor. Fed with 52 ohm coax, this 18 ft radiator is amazingly efficient for DX or local contact. Constructed of heavy gauge aluminum tubing, the Model 18V may be installed on a short 1⅝ inch mast driven into the ground. It is also adaptable to roof or tower mounting. Highly portable, the Model 18V can be quickly knocked down to an overall length of 5 ft and easily re-assembled for field days and camping trips. Shpg. Wt., 5 lbs.
Order No. 193 Price: $33.00



ALL NEW 3–BAND, 2 ELEMENT HY–QUAD

- Makes all other quads obsolete!
- Complete - nothing else to buy
- High strength, low wind load

The Hy-Quad from Hy-Gain makes all other quads obsolete! Here's why:
First, it's the only quad that is complete. There is nothing more to shop for or buy.
Secondly, it is uniquely designed so that it overcomes all of the previously undesirable features inherent in quads.
The all aluminum structure stays up! The single feed line and diamond shape simplifies feed line routing.
Hy-Gain's all new Hy-Quad will outdo all other quads because it's engineered to do just that. The Hy-Quad is new, it's superior, it's complete. It's the first quad to have everything: spreaders are broken up at strategic electrical points with Cycolac insulators / tri-band 2 element construction with individually resonated elements with no interaction / Hy-Quad requires only one feed line for all three bands / individually tuned gamma matches on each band with Hy-Gain exclusive vertex feed / full wave element loops require no tuning stubs, traps, loading coils or baluns / heavy duty mechanical construction of strong swaged aluminum tubing and die formed spreader-to-boom clamps / extra heavy duty universal boom-to-mast clamp that tilts and mounts on any mast 1¼" to 2½" in diameter / aluminum stranded wire. You can open and close the bands with this antenna. You'll experience the thrill of real DX.

Order No. 244 Price: $219.95

SPECIFICATIONS

Overall length of spreaders	25'5"	Forward gain	8.5 db
Turning radius	13'6"	Input impedance	52 ohms
Weight	42 lbs	VSWR	1.2:1 or better at resonance on all bands
Boom diameter	2"		
Boom length	8'	Power	Maximum legal
Mast diameter	1¼" to 2½"		
Wind survival	100 mph	Front-to-back ratio	25-35 db depending upon electrical height
Surface area	6.4 sq. ft.		
Wind load at 100 mph	256.0 lbs	Polarization	Horizontal

hy-gain — For 10, 15, and 20 Meters New Hy-Gain Model 12 AVQ

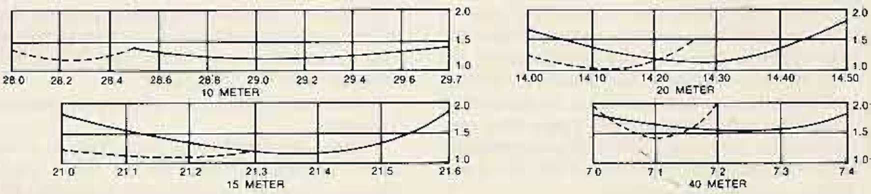
Completely self-supporting, the Model 12AVQ features Hy-Q traps...12" double-grip mast bracket...taper swaged seamless aluminum construction with full circumference compression clamps at tubing joints. It delivers outstanding low angle radiation. SWR is 2:1 or less on all bands. Overall height is 13'6". Shipping weight 7.2 lbs. Price: $47.00
Order No. 384

New, improved successor to the world's most popular vertical! Hy-Gain Model 14 AVQ/WB for 40-10 Meters.

- Wide band performance with one setting (optimum settings for top performance furnished)
- New Hy-Q Traps • New 12" Double-Grip Mast Bracket • Taper Swagged Seamless Aluminum Construction

The Model 14AVQ/WB, new improved successor to the world famous Model 14AVQ, is a self-supporting, automatic band switching vertical that delivers omni-directional performance on 40 through 10 meters. Three separate Hy-Q traps featuring large diameter coils that develop an exceptionally favorable L/C ratio and a very high Q, provide peak performance by effectively isolating sections of the antenna so that a true 1/4 wave resonance exists on all bands. Outstandingly low angle radiation pattern makes DX and other long haul contacts easy. Superior mechanical features include solid aluminum housing for traps using air dielectric capacitor...heavy gauge taper swaged seamless aluminum radiator...full circumference compression clamps at tubing joints that are resistant to corrosion and wear...and a 12" double-grip mast bracket that insures maximum rigidity whether roof-top or ground mounted. The Model 14AVQ/WB also delivers excellent performance on 80 meters using Hy-Gain Model LC-80Q Loading Coil. Overall height is 18 feet. Shipping weight 9.2 lbs. Unsurpassed portability...outstanding for permanent installations. Price: $67.00
Order No. 385

TYPICAL 14AVQ/WB VSWR CURVES



ROOF MOUNTING KIT—Model 14RMQ provides rugged support for Model 14AVQ/WB.
Order No. 184. Price: $28.95

Hy-Gain REEL TAPE PORTABLE DIPOLE for 10 thru 80 Meters Model 18TD

The most portable high performance dipole ever...

The Model 18TD is unquestionably the most foolproof high performance portable doublet antenna system ever developed. It has proven invaluable in providing reliable communications in vital military and commercial-applications throughout the world. Two stainless steel tapes, calibrated in meters, extend from either side of the main housing up to a total distance of 132 feet for 3.5 mc operation. 25 ft. lengths of polypropylene rope attached to each tape permits installation to poles, trees, buildings...whatever is available for forming a doublet antenna system. Integrated in the high impact housing is a frequency to length conversion chart calibrated to meter measurements on the tapes...makes installation foolproof. Feeds with 52 ohm coax. Delivers outstanding performance as a portable or permanent installation. Measures 10x5½x2 inches retracted. Wt., 4.1 lbs.
Order No. 228 Price: $94.95

DenTron MLA-2500 $799.50

DenTron Radio has packed all the features a linear amplifier should have into their new MLA-2500. Any Ham who works it can tell you the MLA-2500 really was built to make amateur radio more fun.

- ALC circuit to prevent overloading
- 160 thru 10 meters
- 1000 watts DC input on CW, RTTY or SSTV Continuous Duty
- Variable forced air cooling system
- Self-contained continuous duty power supply
- Two EIMAC 8875 external anode ceramic/metal triodes operating in grounded grid
- Covers MARS frequencies without modifications
- 50 ohm input and output impedance
- Built-in RF wattmeter
- 117V or 234V AC 50-60 hz
- Third order distortion down at least 30 db
- Frequency range: 1.8MHz (1.8-2.5) 3.5MHz (3.4-4.6) 7MHz (6.0-9.0) 14MHz (11.0-16.0) 21MHz (16.0-22.0) 28MHz (28.0-30.0)
- 40 watts drive for 1 KW DC input
- Rack mounting kit available (19" rack)
- Size: 5½" H x 14" W x 14" D Wt. 47 lbs.

Pipo Communications TROUBLE FREE TOUCH-TONE ENCODER

POSITIVE TOUCH (KEYS DEPRESS) • MOBILE • HANDHELD
DESK MOUNT • NO POTTED PARTS (SERVICEABLE)
MIL. SPEC. COMPONENTS • NO RFI • SELF CONTAINED
XTAL CONTROLLED • LEVEL ADJUSTABLE FROM FRONT

Pat. Pend.

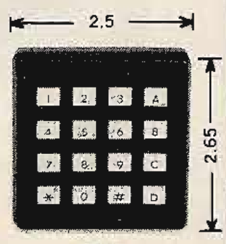
PP-1

M series is for mounting to surfaces inaccessable from the rear, walls - mobiles - systems interface - panels - test equipment, etc.

K series is self contained with a relay inside the encoder. When Keys are pressed contact closer occurs with a 2 sec. delay, (adjustable). Contacts are rated at 110ma @ 28 Volts switched, 500ma carry. PP-2K contains delay exclusion for the forth column. However, by jumpering D-5, 4th column delay is restored.

Pipo Communications has developed a trouble free reliable instrument to be free of any defects for years. Unit is constructed with the best components available, without compromise in quality. Unit is operable from 4.5 - 60 Volts at temperatures from below 0 to + 140°F. Output level will drive any transmitter or system. Adjustable output level is controlled with an extremely stable multiturn trimpot, with access from the front of the encoder (not behind), saving time for level setting, which amounts to hours when involved with a system.

PP-1	$55	12 Keys	PP-2	$58	16 Keys	PP-1A	$68 For Standard Comm. Hand Held
PP-1m	$55	Lettering Optional	PP-2m	$58	Lettering Optional		
PP-1K	$66	Add $1.00	PP-2K	$69	Add $1.00		



PP-2

TUFTS RADIO CATALOG TUFTS RADIO

-C – LINE AMATEUR EQUIPMENT DRAKE® —COMMUNICATIONS RECEIVERS—

Drake R-4C

Solid State Linear permeability-tuned VFO with 1 kHz dial divisions. Gear driven dual circular dials. High mechanical, electrical and temperature stability.

Covers ham bands with crystals furnished. Covers all of 80, 40, 20 and 15 meters, and 28.5-29.0 MHz of 10 meters.

Covers 160 meters with accessory crystal. In addition to the ham bands, tunes any fifteen 500 kHz ranges between 1.5 and 30 MHz, 5.0 to 6.0 MHz not recommended. Can be used for MARS, WWV, CB, Marine and Shortwave broadcasts.

Superior selectivity: 2.4 kHz 8-pole filter provided in ssb positions. 8.0 kHz, 6 pole selectivity for a-m. Optional 8-pole filters of .25, .5, 1.5 and 6.0 kHz bandwidths available.

Tunable notch filter attenuates carriers within passband.

Smooth and precise passband tuning.

Transceive capability: may be used to transceive with the T-4X, T-4XB or T-4XC Transmitters. Illuminated dial shows which PTO is in use.

Usb, lsb, a-m and cw on all bands.

Agc with fast attack and two release times for ssb and a-m or fast release for break-in cw. Agc also may be switched off.

New high efficiency accessory noise blanker that operates in all modes.

Crystal lattice filter in first i-f prevents cross-modulation and desensitization due to strong adjacent channel signals.

Excellent overload and intermodulation characteristics.

25 kHz Calibrator permits working closer to band edges and segments.

Scratch resistant epoxy paint finish.

Price: $599.00

Drake T-4XC

Solid State Linear permeability-tuned VFO with 1 kHz dial divisions. Gear driven dual circular dials. High mechanical, electrical and temperature stability.

Covers ham bands with crystals furnished. Covers all of 80, 40, 20 and 15 meters, and 28.5-29.0 MHz of 10 meters.

Covers 160 meters with accessory crystal. Four 500 kHz ranges in addition to the ham bands plus one fixed-frequency range can be switch-selected from the front panel.

Two 8-pole crystal lattice filters for sideband selection.

Transceives with the R-4, R-4A, R-4B, R-4C and SPR-4 Receivers. Switch on the T-4XC selects frequency control by receiver or transmitter PTO or independently. Illuminated dial shows which PTO is in use.

Usb, lsb, a-m and cw on all bands.

Controlled-carrier modulation for a-m is compatible with ssb linear amplifiers.

Automatic transmit-receive switching. Separate VOX time-delay adjustments for phone and cw. VOX gain is independent of microphone gain.

Choice of VOX or PTT. VOX can be disabled by front panel switch.

Adjustable pi network output.

Transmitting agc prevents flat-topping.

Meter reads relative output or plate current with switch on load control.

Built-in cw sidetone.

Spotting function for easy zero-beating.

Easily adaptable to RTTY, either fsk or afsk.

Compact size; rugged construction. Scratch resistant epoxy paint finish.

Price: $599.00

Drake SPR-4 – $629.00

- **Programmable to meet specific requirements: SWL, Amateur, Laboratory, Broadcast, Marine Radio, etc.**
- **Direct frequency dialing: 150-500 kHz plus any 23 500 kHz ranges, 0.5 to 30 MHz**
- **FET circuitry, all solid state**
- **Linear dial, 1 kHz readout**
- **Band-widths for cw, ssb, a-m with built-in LC filter**
- **Crystals supplied for LW, seven SW, and bc bands**
- **Notch filter**
- **Built-in speaker**

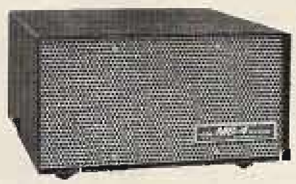
Drake DSR-2 – $2950.00

- **Continuous Coverage 10 kHz to 30 MHz**
- **Digital Synthesizer Frequency Control**
- **Frequency Displayed to 100 Hz**
- **All Solid State**
- **A-m, Ssb, Cw, RTTY, Isb**
- **Series Balanced Gate Noise Blanker**
- **Front End Protection**
- **Optional Features Available on Special Order**

Power Supplies

Power Supplies for T-4, T-4X, T-4XB or T-4XC (The AC-4 can be housed in an MS-4 speaker cabinet).

Model No. 1501 Drake AC-4 $120.00
Model No. 1505 Drake DC-4 $135.00



Drake MS-4

Drake MS-4 Matching Speaker for use with R-4, R-4A, R-4B and R-4C Receivers. (Has space to house AC-3 and AC-4 Power Supplies)

Price: $30.00

Accessories

DRAKE MICROPHONES

Wired for use with Drake transmitters and transceivers, for either push-to-talk or VOX. Type of operation is determined by the VOX control setting of the transmitter.

Desk Type Model No. 7075

• **Type:** Heavy Duty Ceramic Desk Top • **Cable:** Four Foot, 3-Conductor, One Shield. • **Output Level:** Minus 54 dB (0 dB = 1 volt/microbar) • **Frequency Response:** 80-7000 Hz • **Switching:** Adapts to either push-to-talk or VOX. **Price: $39.00**

Hand-Held Type Model No. 7072

• **Type:** Ceramic, hand held • **Cable:** 11" Retracted, 5' extended, PVC 3 Cord, 1 shielded, Coil Cord • **Case:** Cycolac • **Finish:** Grey • **Output Level:** Minus 65 dB (0 dB = 1 volt/microbar) • **Frequency Response:** 300-3000 Hz • **Switching:** Adapts to either push-to-talk or VOX.

Price: $19.00

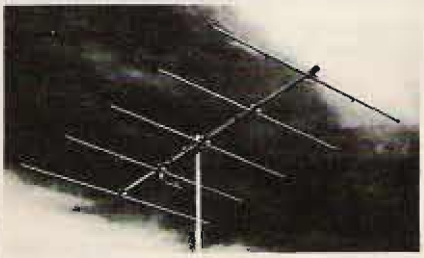
Drake FS-4
Digital Synthesizer – $250.00

The new solid state Drake FS-4 Synthesizer opens the door to a new world of continuous-tuning short wave! Combines synthesized general coverage flexibility with the selectivity, stability, frequency readout and reliability of the Drake R-4C or SPR-4 Receivers.

• Interfaces with all R-4 series receivers and T-4X series transmitters: (R-4, R-4A, R-4B, R-4C, SPR-4, T-4, T-4X, T-4XB and T-4XC), without modification. • MHz range is set on FS-4, with kHz readout taken from receiver dial. • Complete general coverage—no range crystals to buy. • T-4/T-4X series transmitters transceive on any FS-4 frequency, when used with R-4 series receivers. • Readout 1 kHz with Drake PTO.

Price: $250.00

6 METER BEAMS



3 - 5 - 6 - 10 ELEMENTS

Proven performance from rugged, full size, 6 meter beams. Element spacings and lengths have been carefully engineered to give best pattern, high forward gain, good front to back ratio and broad frequency response.

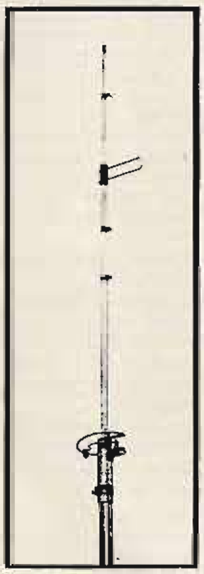
Booms are .058 wall and elements are 3/4" - 5/8" .049 wall seamless chrome finish aluminum tubing. The 3 and 5 element beams have 1 3/8" - 1 1/4" booms. The 6 and 10 element beams have 1 5/8" - 1 1/2" booms. All brackets are heavy gauge formed aluminum. Bright finish cad plated bolts are adjustable for up to 1 5/8" mast on 3 and 5 element and 2" on 6 and 10 element beams. All models may be mounted for horizontal or vertical polarization.

New features include adjustable length elements, kilowatt Reddi Match and built-in coax fitting for direct 52 ohm feed. These beams are factory marked and supplied with instructions for quick assembly.

Description	3 element	5 element	6 element	10 element
Model No.	A50 3	A50 5	A50 6	A50 10
Boom Lngth	6'	12'	20'	24'
Longest El.	117"	117"	117"	117"
Turn Radius	6'	7' 6"	11'	13'
Fwd. Gain	7.5 dB	9.5 dB	11.5 dB	13 dB
F/B Ratio	20 dB	24 dB	26 dB	28 dB
Weight	7 lbs.	11 lbs	18 lbs	25 lbs

new

RINGO RANGER for FM



4.5 dB* – 6 dB**

Omnidirectional GAIN BASE STATION ANTENNAS

FOR MAXIMUM PERFORMANCE AND VALUE

Cush Craft has created another first by making the world's most popular 2 meter antenna twice as good. The new Ringo Ranger is developed from the basic AR-2 with three half waves in phase and a one eighth wave matching stub. Ringo Ranger gives an extremely low angle of radiation for better signal coverage. It is tunable over a broad frequency range and perfectly matched to 52 ohm coax.

ARX-2, 137-160 MHz, 4 lbs., 112"
ARX-220, 220-225 MHz, 3 lbs., 75"
ARX-450, 435-450 MHz, 3 lbs., 39"

* Reference ½ wave dipole.
** Reference ¼ wave whip used as gain standard by many manufacturers.

Work full quieting into more repeaters and extend the radius of your direct contacts with the new Ringo Ranger.

You can up date your present AR-2 Ringo with the simple addition of this extender kit. The kit includes the phasing network and necessary element extensions. The only modifications required are easy to make saw slits in the top section of your antenna.

ARX-2K CONVERSION KIT

2 METER ANTENNAS FM

A-FM RINGO 3.75 dB Gain (reference ¼ wave whip). Half wave length antennas with direct dc ground, 52 ohm feed takes PL-259, low angle of radiation with 1-1 SWR. Factory preassembled and ready to install, 6 meter partly preassembled, all but 450 MHz take 1¼" mast. There are more Ringos in use than all other FM antennas combined.

Model Number	AR-2	AR-25	AR-6	AR-220	AR-450
Frequency MHz	135-175	135-175	50-54	220-225	440-460
Power—Hdlg. Watts	100	500	100	100	250
Wind area sq. ft.	.21'	.21'	.37'	.20'	.10'

B-4 POLE Up to 9 dB Gain over a ½ wave dipole. Overall antenna length 147 MHz — 23' 220 MHz — 15', 435 MHz — 8', pattern 360° — 6 dB gain, 180° — 9 dB gain, 52 ohm feed takes PL 259 connector. Package includes 4 complete dipole assemblies on mounting booms, harness and all hardware. Vertical support mast not supplied.

AFM-4D 144 - 150 MHz, 1000 watts, wind area 2.58 sq. ft.
AFM-24D 220 - 225 MHz, 1000 watts, wind area 1.85 sq. ft.
AFM-44D 435 - 450 MHz, 1000 watts, wind area 1.13 sq. ft.

D-POWER PACK The big signal (22 element array) for 2 meter FM, uses two A147-11 yagis with a horizontal mounting boom, coaxial harness and all hardware. Forward gain 16 dB, F/B ratio 24 dB, ½ power beamwidth 42°, dimensions 144" x 80" x 40", turn radius 60", weight 15 lbs., 52 ohm feed takes PL-259 fitting.

A147-22 146 - 148 MHz, 1000 Watts, wind area 2.42 sq. ft.

D-YAGI STACKING KITS VPK includes horizontal mounting boom, harness, hardware and instructions for two vertically polarized yagis gives 3 dB gain over the single antenna.

A14-VPK	complete 4 element stacking kit
A14-SK	4 element coax harness only
A147-VPK	complete 11 element stacking kit
A147-SK	11 element coax harness only
A449-SK	6 + 11 element coax harness only

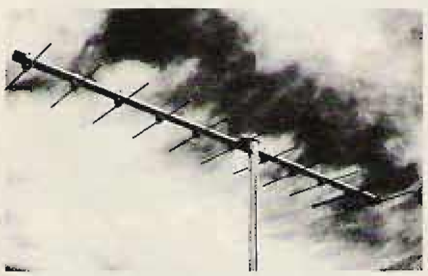
E-4-6-11 ELEMENT YAGIS The standard of comparison in VHF-UHF communications, now cut for FM and vertical polarization. The four and six element models can be tower side mounted. All are rated at 1000 watts with direct 52 ohm feed and PL-259 connectors.

Model Number	A147-11	A-147-4	A449-11	A449-6	A220-11
Boom/Longest ele	144"/40"	44"/40"	60"/13"	35"/26"	102"/26"
Wght./Turn radius	6 lbs., 72"	3 lbs., 44"	4 lbs., 60"	3 lbs., 18"	5 lbs., 51"
Gain/F/B ratio dB	13.2/28	9/20	13.2/28	11/25	13.2/28
½ Power beam	48°	66°	48°	60°	48°
Wind area sq. ft	1.21	.43	.39	.30	.50
Frequency MHz	146-148	146-148	440-450	440-450	220-225

F-FM TWIST 12.4 dB Gain: Ten elements horizontal polarization for low end coverage and ten elements vertical polarization for FM coverage. Forward gain 12.4 dB, F/B ratio 22 dB, boom length 130", weight 10 lbs., longest element 40", 52 ohm Reddi Match driven elements take PL-259 connectors, uses two separate Feed lines.

A147-20T 145 - 147 MHz, 1000 watts, wind area 1.42 sq. ft.

HIGH PERFORMANCE VHF YAGIS



3/4 , 1-1/4, 2 METER BEAMS

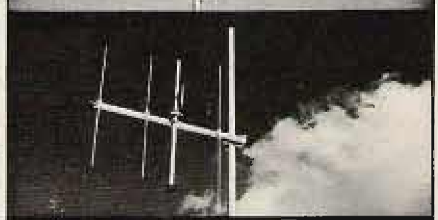
The standard of comparison in amateur VHF/UHF communications Cush Craft yagis combine all out performance and reliability with optimum size for ease of assembly and mounting at your site.

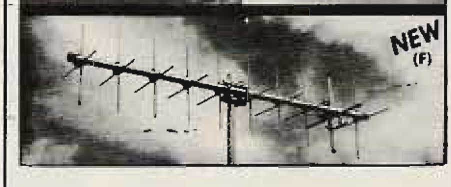
Lightweight yet rugged, the antennas have 3/16" O. D. solid aluminum elements with 5/16" center sections mounted on heavy duty formed brackets. Booms are 1" and 7/8" O. D. aluminum tubing. Mast mounts of 1/8" formed aluminum have adjustable u-bolts for up to 1-1/2" O. D. masts. They can be mounted for horizontal or vertical polarization. Complete instructions include data on 2 meter FM repeater operation.

New features include a kilowatt Reddi Match for direct 52 ohm coaxial feed with a standard PL-259 fitting. All elements are spaced at .2 wavelength and tapered for improved bandwidth.

Model No.	A144 7	A144 11	A220 11	A430 11
Description	2m	2m	1¼m	¾m
Elements	7	11	11	11
Boom Lngth	98"	144"	102"	57"
Weight	4	6	4	3
Fwd. Gain	11 dB	13 dB	13 dB	13 dB
F/B Ratio	26 dB	28 dB	28 dB	28 dB
Fwd. Lobe @ ½ pwr. pt.	46	42	42	42
SWR @ Freq.	1 to 1	1 to 1	1 to 1	1 to 1

cushcraft CORPORATION





VHF/UHF BEAMS

A50-3	$ 32.95	A144-7	21.95
A50-5	49.95	A144-11	32.95
A50-6	69.95	A430-11	24.95
A50-10	99.95		

AMATEUR FM ANTENNAS

A147-4	$ 19.95	AFM-44D	54.95
A147-11	29.95	AR-2	21.95
A147-20T	54.95	AR-6	32.95
A147-22	84.95	AR-25	29.95
A220-7	21.95	AR-220	21.95
A220-11	27.95	AR-450	21.95
A449-6	21.95	ARX-2	32.95
A449-11	27.95	ARX-2K	13.95
AFM-4D	59.95	ARX-220	32.95
AFM-24D	57.95	ARX-450	32.95

	144 MHz.		220 MHz.		432 MHz.	
Description:	Model:	Price:	Model:	Price:	Model:	Price:
20 Element DX-Array	DX-120	42.95	DX-220	37.95	DX-420	32.95
Frame & Harness (40 El.)	DXK-140	59.95	DXK-240	54.95	DXK 440	39.95
Frame & Harness (80 El.)	DXK-180	109.95	DXK-280	89.95	DXK-480	79.96
1-1 52-ohm balun	DX-1BN	12.95	DX-2BN	12.95	DX-4BN	12.95
Vert. Pol. Bracket (20 El.)	DX-VPB	9.95	DX-VPB	9.95	DX-VPB	9.95

why waste watts?

(SWR-1A $25.95)

SWR-1 guards against power loss

If you're not pumping out all the power you're paying for, our little SWR-1 combination power meter and SWR bridge will tell you so. You read forward and reflected power simultaneously, up to 1000 watts RF and 1:1 to infinity VSWR at 3.5 to 150 MHz.

Got it all tuned up? Keep it that way with SWR-1. You can leave it right in your antenna circuit.

SWAN® ELECTRONICS
A subsidiary of Cubic Corporation

DELUXE 742 TRI-BAND MOBILE ANTENNA

- Automatically adjusts to proper resonance for 20, 40 and 75 meters.
- Power rated at 500 Watts P.E.P.
- Includes base section, automaticoil and whip top section. 742 Antenna

Price: $109.95

EXCLUSIVE DELUXE 5-BAND MOBILE 45 ANTENNA

- All band manual switching antenna for 10, 15, 20, 40 and 75 meters.
- Power rated at 1000 Watts P.E.P.
- Includes base section with mobilecoil and six foot whip top section. 45 Antenna

Price: $119.95

SWAN METERS HELP YOU GET IT ALL TOGETHER

These wattmeters tell you what's going on.

With one of these in-line wattmeters you'll know if you're getting it all together all the time. Need high accuracy? High power handling? Peak power readings? For whatever purpose we've got the wattmeter for you. Use your Swan credit card. Applications at your dealer or write to us.

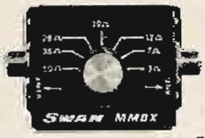
WM2000 In-Line Wattmeter With Muscle. Scales to 2000 watts. New flat-response directional coupler for maximum accuracy. $59.95

WM3000 Peak-reading Wattmeter. Reads RMS power, then with the flick of a switch, true peak power of your single-sideband signal. That's what counts on SSB. $79.95

WM1500 High-Accuracy In-Line Wattmeter. 10% full scale accuracy on 5, 50, 500 and 1500 watt scales, 2 to 30 MHz. Forward and reflected power. Use it for trouble-shooting, too. $74.95

SWAN® ELECTRONICS
A subsidiary of Cubic Corporation

SWAN LINEAR AMPLIFIERS A Mark II 2000 watt P.E.P. full legal input power unit or the 1200X matching Cygnet 1200 watt P.E.P. input powerhouse with built-in power supply. The choice is yours. $849.95



NEW Swan MMBX Mobile Impedance Matcher
It keeps your transmitter and your speaking terms for a song. Price: $23.9

CYGNET 1200X PORTABLE LINEAR AMPLIFIER

To quadruple the output of the 300B Cygnet *de novo*, simply add this matching unit for more than a kilowatt of power. Complete with self-contained power supply and provision for external ALC, this Cygnet offers exceptionally high efficiency and linearity. $349.95

Additional Swan products include: fixed and mobile antennas, VFO's telephone patch, VOX, wattmeter, microphones and mounting kits. As another extra service, only Swan Electronics offers factory-backed financing to the amateur radio community. Visit an authorized Swan Electronics dealer for complete details

SWAN ELECTRONICS

JMR MOBIL-EAR™

Two-way-radio headset with superior fidelity Electret-Capacitor boom microphone and palm-held talk switch.

$69.95

FOR BROADCAST-QUALITY TRANSMISSION AND RECEPTION FOR BOTH MOBILE UNITS AND BASE STATIONS.

- Boom-mounted electret-capacitor microphone delivers studio-quality, undistorted voice reproduction. Variable gain control lets you adjust for optimum modulation.
- Cushioned earcup lets you monitor in privacy -- no speaker blare to disturb others. Blocks out environmental noises, too. Made of unbreakable ABS plastic.
- Headband self-adjusts for comfortable wear over long hours. Spring-flex hinge lets you slip headset on and off with just one hand. Reversible for right or left ear.
- Headset can be hung on standard microphone clip.
- Compact palm-held talk switch lets you keep *both* hands on the wheel for safer driving. Made of unbreakable ABS plastic.
- Built-in FET transistor amplifier adapts microphone output to any transceiver impedance.
- Compatible with most two-way radios including 40-channel CB units.
- Built-in Velcro pad for easy mounting of the talk switch.
- Made in U.S.A.

SPECIFICATIONS

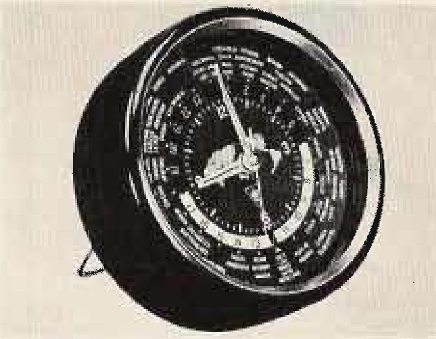
Earphone impedance and type:	8 ohms, dynamic
Microphone type:	Electret capacitor
Microphone frequency response:	200–6000 Hz
Amplifier type:	FET transistor, variable gain
Amplifier battery power:	7-volt Mallory TR-175
Switching:	Relay or electronic

IDEAL FOR EVERY TWO-WAY RADIO COMMUNICATIONS NEED . . .

CB operators • Amateur radio operators • Police and fire vehicles • Ambulances and emergency vehicles • Taxis and truckers • Marine pleasure and work boats • Construction and demolition crews • Industrial communications • Security patrols • Airport tower and ground crews • Remote broadcast and TV-camera crews • Foresters and fire-watch units •

A new precision clock which tells time anywhere in the world at a glance, has been announced by **Yaesu Electronics Corporation**. The time in any principal city or time zone can be simultaneously coordinated with local time on a 24 hour basis. After the initial setting, as the clock runs, a Time Zone Hour Disc advances automatically, showing correct time all over the world without further adjustment. The clock is especially designed to withstand shock and may be hung on a wall or placed on its desk mount. The clock will run an entire year on a single 1.5 volt flashlight battery and the mechanism starts as soon as the battery is inserted. It measures six inches in diameter by two and one half inches deep. An excellent item for the business office, ham radio operator, short wave listener, boat owner, and others who want an accurate dependable clock.

Price: $30.00 Amateur net.



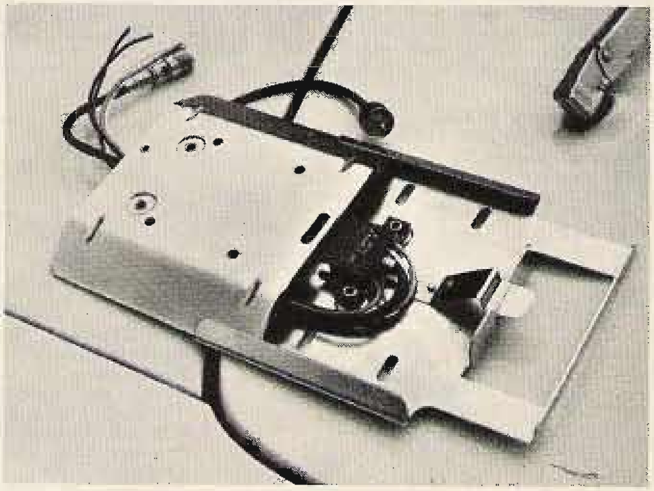
NYE VIKING CODE PRACTICE SET

No. 114-404-002

Get the RIGHT START!

With a NYE VIKING Code Practice Set you get a sure, smooth, Speed-X model 310-001 transmitting key, a linear circuit oscillator and amplifier, with a built-in 2" speaker, all mounted on a heavy duty aluminum base with non-skid feet. Operates on standard 9V transistor type battery (not included). Units can be connected in parallel so that two or more operators can practice sending and receiving to each other. List price, $18.50.

STOP A THIEF! SAVE YOUR RADIO!



DESIGNED FOR COMMERCIAL USE UP TO 1000 MHZ.

The **TUFTS SAVE-YOUR-RADIO** bracket can save you a bundle . . . and a lot of hassle. Why worry about rig ripoff? The **TUFTS SYR** bracket mounts quickly and easily in your car and makes it possible to snap your rig out of its bracket when you park and put it out of sight.

The connector system has a special coaxial cable connector which will provide you with a lossless connection right up to 1000 MHz! No loss! In addition to the quick coax connector there are also four power and accessory connections which are made automatically when the rig is slid into its bracket . . . just what you need for feeding power and loudspeaker connections to the set.

This is a rugged bracket and connector system . . . it'll take a beating. There is a hole on each side of the 16 gauge steel plate for a padlock in case you want to leave the rig for short periods in its bracket. They'll have to rip out the dash to get it . . . and it won't be the first time for that.

With two of these brackets you can bring the mobile rig into the house and use it in seconds. On trips you can take an AC supply for the rig and use it in your hotel room. Price: $29.95

MOR-GAIN

Manufactured & Guaranteed by
MOR-GAIN
2200T South 4th Street
Leavenworth, Kansas 66048
(913) 682-3142

Fully Air Tested – Thousands Already in Use

#16 40% Copper Weld wire annealed to it handles like soft Copper wire – Rated for better than full legal power AM/CW or SSB-Coaxial or Balanced 50 to 75 ohm feedline – VSWR under 1.5 to 1 at most heights – Stainless Steel hardware – Drop Proof Insulators – Terrific Performance – No coils or traps to break down or change under weather conditions – Completely Assembled ready to put up – Guaranteed 1 year – ONE DESIGN DOES IT ALL.

MODEL	BANDS (Meters)	PRICE	WEIGHT (Oz/Kg)	LENGTH (Ft/Mtrs)
40-20 HD	40/20	$49.50	26/.73	36/10.9
40-10 HD	40/20/15/10	59.50	36/1.01	36/10.9
80-40 HD	80/40 + 15	57.50	41/1.15	69/21.0
75-40 HD	75/40	55.00	40/1.12	66/20.1
75-40 HD (SP)	75/40	57.50	40/1.12	66/20.1
75-20 HD	75/40/20	66.50	44/1.23	66/20.1
75-20 HD (SP)	75/40/20	66.50	44/1.23	66/20.1
75-10 HD	75/40/20/15/10	74.50	48/1.34	66/20.1
75-10 HD (SP)	75/40/20/15/10	74.50	48/1.34	66/20.1
80-10 HD	80/40/20/15/10	76.50	50/1.40	69/21.0

NO TRAPS – NO COILS – NO STUBS – NO CAPACITORS

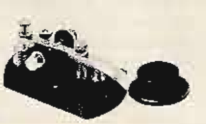
MOR-GAIN HD DIPOLES . . . • One half the length of conventional half-wave dipoles. • Multi-band, Multi-frequency. • Maximum efficiency — no traps, loading coils, or stubs. • Fully assembled and pre-tuned — no measuring, no cutting. • All weather rated — 1 KW AM, 2.5 KW CW or PEP SSB. • Proven performance — more than 15,000 have been delivered. • Permit use of the full capabilities of today's 5-band xcvrs. • One feedline for operation on all bands. • Lowest cost/benefit antenna on the market today. • Fast QSY — no feedline switching. • Highest performance for the Novice as well as the Extra-Class Op.

EXCLUSIVE 66 FOOT, 75 THRU 10 METER DIPOLES

NOTES

- All models above are furnished with crimp/solder lugs.
- All models can be furnished with a SO-239 female coaxial connector at additional cost. The SO-239 mates with the standard PL-259 male coaxial cable connector. To order this factory installed option, add the letter 'A' after the model number. Example: 40-20 HD/A.
- 75 meter models are factory tuned to resonate at 3950 kHz. (SP) models are factory tuned to resonate at 3800 kHz. 80 meter models are factory tuned to resonate at 3650 kHz. See VSWR curves for other resonance data.

No. 114-320-003 – $9.90
No. 114-322-003 – Brass – $10.30



No. 114-320-001 – $8.30
No. 114-322-001 – Brass – $8.65

No. 114-310-003 – $8.25
No. 114-312-003 – Brass – $8.65

NYE VIKING SPEED-X KEYS

NYE VIKING Standard Speed-X keys feature smooth, adjustable bearings, heavy-duty silver contacts, and are mounted on a heavy oval die cast base with black wrinkle finish. Available with standard, or Navy knob, with, or without switch, and with nickel or brass plated key arm and hardware.

Pamper yourself with a Gold-Plated NYE VIKING KEY!

Model No. 114-31C-004GP has all the smooth action features of NYE Speed-X keys in a special "presentation" model. All hardware is heavily gold plated and it is mounted on onyx-like jet black plastic sub-base. List price is $50.00.

No. SSK-1 $23.95
No. SSK-1CP-Chrome – $29.95

NYE VIKING SQUEEZE KEY

Extra-long, finger-fitting molded paddles with adjustable spring tension, adjustable contact spacing. Knife-edge bearings and extra large, gold plated silver contacts! Nickel plated brass hardware and heavy, die cast base with non-skid feet. Base and dust cover black crackle finished. SSK-1 — $23.45.

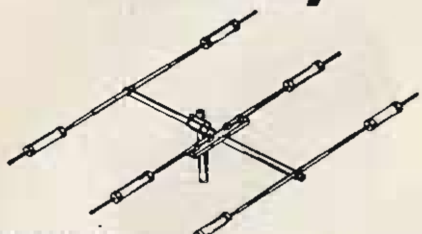
SSK-1CP has heavily chrome-plated base and dust cover. List price, $29.95.

CODE PRACTICE SET

You get a sure, smooth, Speed-X model 310-001 transmitting key, linear circuit oscillator and amplifier, with a built-in 2" speaker, all mounted on a heavy duty aluminum base with non-skid feet. Operates on standard 9V transistor type battery (not included). List price, $18.50.

PHONE PATCH Model No. 250-46-1 measures 6-1/2" wide, 2-1/4" high and 2-7/8" deep. List price, $36.50. Model 250-46-3, designed for use with transceivers having a built-in speaker, has its own built-in 2" x 6" 2 watt speaker. Measures 6-1/2" wide, 2-1/4" high and 2-7/8" deep. List price, $44.50.

Mosley



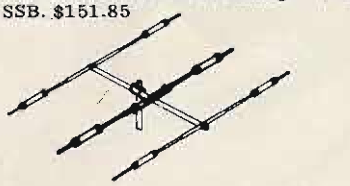
- Model TA-33
- 3 Elements
- 10.1 db Forward Gain (over isotropic source)
- 20 db Front-to-Back Ratio

The Mosley TA-33, 3-element beam provides outstanding 10, 15 and 20 meter performance. Exceptionally broadband — gives excellent results over full Ham bandwidth. Incorporating Mosley Famous Trap-Master traps. Power Rating — 2KW P.E.P. SSB. The TA-33 may also be used on 40 meters with TA-40KR conversion. Complete with hardware. $206.50

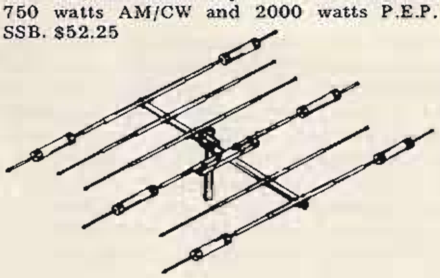
MULTI-BAND BEAMS
TRAP MASTER 33 . . . 10, 15 & 20 Meters

- Model TA-33Jr.
- 3 Elements
- 10.1 db Forward Gain (over isotropic source)
- 20 db Front-to-Back Ratio

The TA-33Jr . . . incorporates Mosley Trap-Master Junior traps. This is the low power brother of the TA-33. Power Rating — 1 KW P.E.P. SSB. $151.85



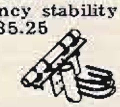
TA-33JR. POWER CONVERSION KIT MODEL MPK-3
Owners of the Mosley Trap-Master TA-33Jr. may obtain higher power without buying an entirely new antenna. The addition of the MPK-3 (power conversion kit) converts the TA-33Jr. into essentially a new antenna with 750 watts AM/CW and 2000 watts P.E.P. SSB. $52.25



TRAP MASTER 36 . . . 10, 15 & 20 Meters

- Model TA-36
- 6 Elements
- Forward Gain (over isotropic source) - 10.1 db on 15 & 20 meters, 11.1 db on 10 meters.

Front-to-Back Ratio on all bands. 20 db.
This wide-spaced, six element configuration employs 4 operating elements on 10 meters, 3 operating elements on 15 meters, and 3 operating elements on 20 meters. Automatic bandswitching is accomplished through Mosley exclusively designed high impedance parallel resonant "Trap Circuit." The TA-36 is designed for 1000 watts AM/CW or 2000 watts P.E.P. SSB. Traps are weather and dirt proof, offering frequency stability under all weather conditions. $335.25



MOSLEY AK-60 MAST PLATE ADAPTER
Mast Plate Adapter for adapting your Mosley 1½" mounted beam to fit 2" OD mast. Complete with angle and hardware. $11.15

A brilliant new 2 meter transceiver with every in-demand operating feature and convenience

KLM MULTI-2700 – $695.95

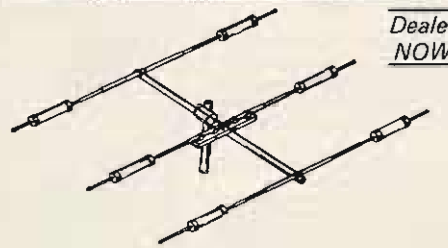
★ Synthesizer and VFO.
★ All modes: NBFM, WBFM, AM, SSB w/USB/LSB and CW.
- Frequency synthesizer (PLL) 3 Knob, 600 channels, 10 kHz steps.
- VXO, plus or minus 7 kHz.

★ LED readout on synthesizer.
- Standard 600 kHz splits plus . . .
- Two "oddball" splits.

★ OSCAR transceive 2 to 10 meter operation.
- OSCAR receiver built-in.
- Connectors on rear for separate 2 meter and 10 meter antennas.
- Built-in VFO (continuous coverage, 144-148 MHz in 1.3 MHz segments. 1 kHz readout).
- 8 pole SSB filter plus two FM filters.
- 100 kHz crystal calibrator.
- Voice operated relay (VOX) or p-t-t.

★ Audio speech compression.
- Noise blanker.
- RIT, plus or minus 5 kHz.
- Power out/"S" meter.
- FM center deviation meter.
- 10W minimum output power. NO TUNING!
- Hi-Lo power provision.
- Built-in AC/DC power supply.
- Double conversion receiver. 16.9 MHz and 455 kHz I-Fs.
- Receiver sensitivity:
  FM: 0.5µV for 28 dB S/N.
  SSB/CW: 0.25µV for 14 dB S/N.
  AM: 2µV for 10 dB S/N.
- Size: Inches: 5H, 14.88W, 12D. MM: 128H, 378W, 305D.
- Weight: 28 lbs. (13 KG).

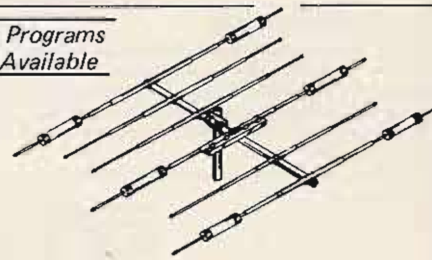
Dealer Programs NOW Available



CLASSIC-33 . . . 10, 15 & 20 Meters
Model CL-33

- 3 Elements
- 10.1 db Forward Gain (over isotropic source) on all bands.
- 20 db Front-to-Back Ratio on 15 & 20 meters, 15 db on 10 meters.

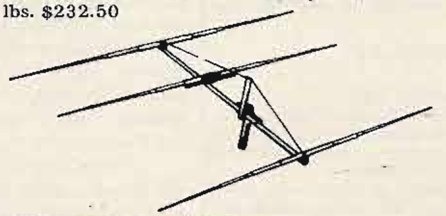
BRIDGING THE GAP . . . The Classic 33, combines the best of two Mosley systems. Incorporating Mosley Classic Feed System for a "Balanced Capacitive Matching" system with a feed point impedance of 52 ohms at resonance, and the Famous Mosley Trap-Master Traps for "weather-proof" traps with resonant frequency stability. This extra sturdy multi-band beam, Model CL-33, for operation on 10, 15 & 20 meters features improved boom to element clamping, stainless steel hardware, balanced radiation and a longer boom for even wider element spacing. Power Rating — 2 KW P.E.P. SSB. Recommended mast size — 2" OD. Wind Load — 120 lbs. at 80 MPH. Approx. shipping weight — 45 lbs. $232.50



CLASSIC-36 . . . 10, 15 & 20 Meters
Model CL-36

- 6 Elements
- 10.1 db Forward Gain (over isotropic source) on 15 & 20 meters, 11.1 db on 10 meters.
- 20 db Front-to-Back Ratio on all bands.

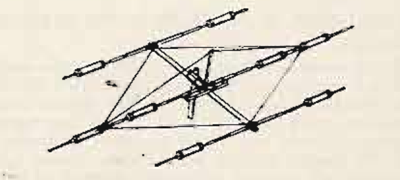
The Classic 36, like the smaller Classic 33, incorporates both the Mosley World-Famous Trap-Master Traps and the Mosley Classic Feed-System. Designed to operate on 10, 15 & 20 meters, this multi-band beam Model CL-36, employs the high standards of quality construction found in all Mosley products. The boom-to-mast clamping assures stability with a time-tested arrangement of mast plate, cast aluminum clamping blocks and stainless steel U-bolts. The exclusive "Balanced Capacitive Matching" system has a feed point impedance of 52 ohms at resonance. Wind Load — 210.1 lbs. at 80 MPH. Power Rating — 2 KW P.E.P. SSB. Recommended mast size — 2" OD. Approx. shipping weight — 71 lbs. via truck. $310.65



CLASSIC-203 . . . 20 Meters
Model CL-203
3 Elements

- 10.1 db Forward Gain (over isotropic source)
- 20 db Front-to-Back Ratio

Incorporating the Mosley patented Classic Feed System, this full size 20 meter single-band beam has 1½" to 3/8" dia. "swaged" elements wide spaced on a 2" dia. 24' boom. Maximum element length-37' 8½". The high standards in quality construction established by Mosley in over a quarter-century of manufacturing is reflected in this mono-band . . . Model CL-203. Boom-to-mast clamping assures stability with a time-tested arrangement of mast plate, cast aluminum clamping blocks and stainless steel U-bolts. The exclusive "Balanced Capacitive Matching" System has a nominal feed point impedance of 52 Ohms at 2 KW P.E.P. SSB. Recommended mast size-2" O.D. Approx. shipping wt: 42 lbs. via truck. $227.65



40 METER CONVERSION KIT MODEL TA-40KR
Work 40 meters in addition to 10, 15 & 20 meters by using a TA-40KR conversion kit on the radiator element of the TA-33 and TA-36. (Beams with broad band capacitive matching may not be converted!) Convert the TA-33Jr. with the MPK-3 (power conversion kit) before adding the TA-40KR kit. $92.25

SIGNAL-MASTER ANTENNA
Beam Antenna . . . Model S-402 for 40 meters
For a top signal needed to push through forty meter QRM, the Mosley Signal Master S-402 will do the trick! This 100% rust-proof 2-element beauty constructed of rugged heavy-wall aluminum is designed and engineered to provide the performance you need for both DX hunting and relaxing in a QRM free rag-chewing session. Beam is fed through link coupling, resulting in an excellent match over the entire bandwidth. $267.50

• *Remote*
• *Motor Controlled*

RCS-4

COAX ANTENNA SWITCH

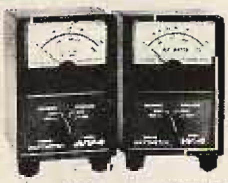
- Control unit works on 110/220 VAC, 50/60 Hz, and supplies necessary DC to motor.
- Excellent for single coax feed to multiband quads or arrays of monobanders. The five positions allow a single coax feed to three beams and two dipoles, or other similar combinations.
- Control cable (not supplied) same as for HAM-M rotator.
- Selects antennas remotely, grounds all unused antennas. GND position grounds all antennas when leaving station. "Rain-Hat" construction shields motor and switches.
- Motor: 24 VAC, 2 amp. Lubrication good to −40°F.
- Switch RF Capability: Maximum legal limit. Price: $120.00

MATCHING NETWORKS

MN-4
200 watts
Price: $120.00

MN-2000
2000 watts PEP
Price: $240.00

General: • **Integral Wattmeter** reads forward power in watts and VSWR directly; can be calibrated to read reflected power • **Matches 50 ohm transmitter output** to coax antenna feedline with VSWR of at least 5:1 • Covers ham bands 80 thru 10 meters • **Switches in or out** with front panel switch • **Size:** 5½"H, 10¾"W, 8"D (14.0 x 27.3 x 20.3 cm), MN-2000, 14¾"D (36.5 cm).
• **Continuous Duty Output:** MN-4, 200 watts; MN-2000, 1000 watts (2000 watts PEP) • **MN-2000 only:** Up to 3 antenna connectors selected by front panel switch.



RF WATTMETERS

W-4 **1.8-54 MHz** Price: $ 72.00
WV-4 **20-200 MHz** Price: $ 84.00

Reads forward and reflected power directly in watts (VSWR from nomogram). Two scales in each direction. **Size:** 5½"H, 3¾"W, 4"D (14.0 x 9.5 x 10.2 cm).

Model	Full Scale	Calibration Accuracy
W-4	200 watts	(5% of reading + 2 watts)
	2000 watts	±(5% of reading + 20 watts)
WV-4	100 watts	±(5% of reading + 1 watt)
	1000 watts	±(5% of reading + 10 watts)

DRAKE

- Synthesized • General Coverage
- Low Cost • All Solid State • Built-in AC Power Supply • Selectable Sidebands
- Excellent Performance

SSR-1 COMMUNICATIONS RECEIVER

PRELIMINARY SPECIFICATIONS: • **Coverage:** 500 kHz to 30 MHz • **Frequency** can be read accurately to better than 5 kHz • **Sensitivity** typically .5 microvolts for 10 dB S+N/N SSB and better than 2 microvolts for 10 dB S+N/N AM • **Selectable sidebands** • **Built-in power supply:** 117/234 VAC ± 20% • **If the AC power source fails** the unit switches automatically to an internal battery pack which uses eight D-cells (not supplied) • **For reduced current drain** on DC operation the dials do not light up unless a red pushbutton on the front panel is depressed.
The performance, versatility, size and low cost of the SSR-1 make it ideal for use as a stand-by amateur or novice-amateur receiver, short wave receiver, CB monitor receiver, or general purpose laboratory receiver.
Price: $350.00

GENERAL: • **All amateur bands** 10 thru 80 meters in seven 600 kHz ranges • **Solid State VFO** with 1 kHz dial divisions • **Modes** SSB Upper and Lower, CW and AM • **Built-in Sidetone** and automatic T/R switching on CW • **30 tubes and semi-conductors** • **Dimensions:** 5½"H, 10¾"W, 14¾" D (14.0 x 27.3 x 36.5 cm), **Wt.:** 16 lbs. (7.3 kg).
TRANSMIT: • **VOX** or **PTT** on SSB or AM • **Input Power:** SSB, 300 watts P.E.P.; AM, 260 watts P.E.P. controlled carrier compatible with SSB linears; CW, 260 watts • **Adjustable pi-network.**
RECEIVE: • **Sensitivity** better than ½ μV for 10 dB S/N • **I.F. Selectivity** 2.1 kHz @ 6 dB, 3.6 kHz @ 60 dB. • **AGC** full on receive modes, variable with RF gain control, fast attack and slow release with noise pulse suppression • **Diode Detector** for AM reception.

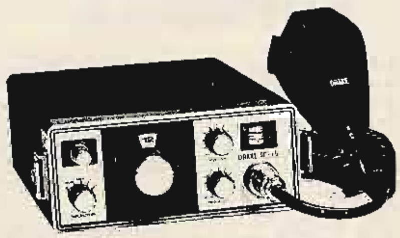
Price: $699.00

TR-4CW SIDEBAND TRANSCEIVER

34-PNB Plug-in Noise Blanker 100.00
FF-1 Crystal Control Unit 46.95
MMK-3 Mobile Mount 7.00
RV-4C Remote VFO $150.00

POWER SUPPLIES
AC-4 Power Supply $120.00
DC-4 Power Supply 135.00

2 METER FM PORTABLE TRANSCEIVER Model TR-33C



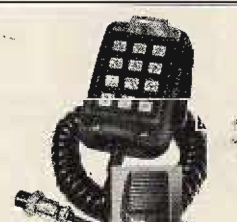
Amateur Net $229.95

- SCPC* Frequency Control
- 12 Channels with Selectable Xmtr Offsets.
- All FET Front-end and Crystal Filter for Superb Receiver Intermod Rejection.
- Expanded Antenna Choice.
- Low Receiver Battery Drain.
- Traditional R. L. Drake Service Backup.
- Single Crystal Per Channel.

LINEAR AMPLIFIER Model L-4B

L-4B Linear Amplifier 895.00
• 2000 Watts PEP-SSB • Class B Grounded-Grid — two 3-500Z Tubes • Broad Band Tuned-Input • RF Negative Feedback • Transmitting AGC • Directional Wattmeter • Two Tautband Suspension Meters • L-4B 13-15/16" W, 7-7/8" H, 14-5/16" D. Wt.: 32 lbs. • Power Supply 6-3/4" W, 7-7/8" H, 11" D, Wt.: 43 lbs.
POWER SUPPLIES
AC 4 Power Supply $120.00
DC 4 Power Supply 135.00

Touch-n-go with DRAKE 1525EM Push Button Encoding Mike

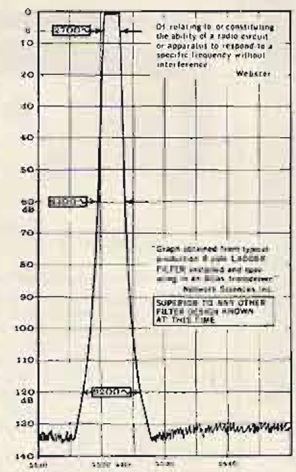


Drake 1525EM, microphone with tone encoder and connector for TR-33C, TR-22, TR-22C, ML-2 .... $49.95

- Microphone and auto-patch encoder in single convenient package with coil cord and connector. Fully wired and ready for use.
- High accuracy IC tone generator, no frequency adjustments.
- High reliability Digitran® keyboard.
- Power for tone encoder obtained from transceiver through microphone cable. No battery required. Low current drain.
- Low output impedance allows use with almost all transceivers.
- Four pin microphone plug: directly connects to Drake TR-33C without any modification in transceiver. Compatible with all previous Drake and other 2 meter units with minor modifications.
- Tone level adjustable.
- Hang-up hook supplied.

For all you hams with little cars ...

We've got the perfect mobile rig for you.



The Atlas 210x or 215x measures only 9½" wide x 9½" deep x only 3½" high, yet the above photograph shows how easily the Atlas transceiver fits into a compact car. And there's plenty of room to spare for VHF gear and other accessory equipment. With the exclusive Atlas plug-in design, you can slip your Atlas in and out of your car in a matter of seconds. All connections are made automatically.

BUT DON'T LET THE SMALL SIZE FOOL YOU!
Even though the Atlas 210x and 215x transceivers are less than half the size and weight of other HF transceivers, The Atlas is truly a giant in performance.

200 WATTS POWER RATING!
This power level in a seven pound transceiver is incredible but true. Atlas transceivers give you all the talk power you need to work the world barefoot. Signal reports constantly reflect great surprise at the signal strength in relation to the power rating.

FULL 5 BAND COVERAGE
The 210x covers 10-80 meters, while the 215x covers 15-160 meters. Adding the Atlas Model 10x Crystal Oscillator provides greatly increased frequency coverage for MARS and network operation.

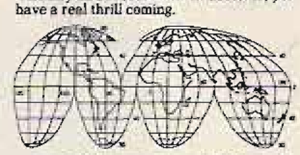
NO TRANSMITTER TUNING OR LOADING CONTROLS
with Atlas' total broadbanding. With your Atlas you get instant QSY and band change.

MOST ADVANCED STATE OF THE ART SOLID STATE DESIGN
not only accounts for its light weight, but assures you years of top performance and trouble free operating pleasure.

PLUG-IN CIRCUIT BOARDS
and modular design provides for ease of servicing.

PHENOMENAL SELECTIVITY
The exclusive 8 pole crystal ladder filter used in Atlas transceivers represents a major breakthrough in filter design, with unprecedented skirt selectivity and ultimate rejection. As the above graph shows, this filter provides a 6 db bandwidth of 2700 Hertz, 60 db down of only 4300 Hertz, and a bandwidth of only 9200 Hertz at 120 db down! Ultimate rejection is in excess of 130 db; greater than the measuring limits of most test equipment.

EXCEPTIONAL IMMUNITY TO STRONG SIGNAL OVERLOAD AND CROSS MODULATION. The exclusive front end design in the receiver allows you to operate closer in frequency to strong neighboring signals than you have ever experienced before. If you have not yet operated an Atlas transceiver in a crowded band and compared it with any other receiver or transceiver, you have a real thrill coming.



A WORLD WIDE DEALER NETWORK TO SERVE YOU.
Whether you're driving a Honda in Kansas City or a Mercedes Benz in West Germany, there's an Atlas dealer near you.

Atlas 210x or 215x	$675.00
W/Noise Blanker	719.00
ACCESSORIES:	
AC Console 110/220 V	$147.00
Portable AC supply 110/220 V	100.00
Plug-in Mobile Kit	48.00
10x Osc. less crystals	59.00
Digital Dial DD-6B	229.00

For complete details see your Atlas dealer, or drop us a card and we'll mail you a brochure with dealer list.

ATLAS RADIO INC.

HUSTLER®

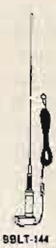
"the home of originals"

AMATEUR ANTENNAS

STANDARD GAIN MOBILES

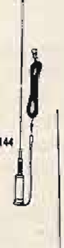
Two Meters

- 5/8 wavelength — 3.4 db gain over 1/4 wave mobile
- Frequency coverage—143 to 149 MHz
- Power rating—200 watts FM



BBLT-144

MODEL BBLT-144
47" antenna complete with easy to install, no holes to drill, trunk lip mount, impact spring and 17' MIL SPEC RG-58-U and PL-259. Antenna removable from mount.
Price: $33.75



BBL-144

MODEL BBL-144
47" antenna mounts on any flat surface, roof, deck or fender in ⅜" hole. Includes impact spring 17' MIL SPEC RG-58-U and PL-259. Antenna removable from mount.
Price: $31.65

HUSTLER "BUCK-BUSTER"

MODEL SF-2
51" two meter, 5/8 wavelength, 3.4 db gain over 1/4 wave mobile. Designed with ⅜"-24 base to fit your mount or a wide selection of Hustler mobile mounts. (Mount or cable not included)
Price: $9.00

SF-2

SUPER GAIN MOBILES

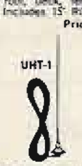
Two Meters

- 5.2 db gain over 1/4 wave mobile antenna
- Frequency coverage—143-149 MHz
- SWR at resonance—1.1:1 typical
- Power rating—200 watts FM

TWO AND SIX METERS— TRUNK LIP MOUNT
MODEL HFT
Four section telescopic antenna permits separate adjustment for simultaneous resonance on two and six meters. Operational height: 40". Complete with trunk lip mount, 17' MIL SPEC RG-58-U and factory attached PL-259.
Price: $22.55

HFT

VHF/UHF ANTENNA— ROOF MOUNT
MODEL UHT-1
Field trimmable radiator for 1/4 wave operation on any frequency from 140 to 500 MHz. Cutting chart included. Mounts on any flat surface, roof, deck, fender in ⅜" hole. Includes 15' RG-58-U.
Price: $9.95



UHT-1

CGT-144

CG-144

MODEL CGT-144
Get big signal performance, superior receiving capability with this 85" colinear antenna. Easy installation on side or edge of trunk lip without drilling — complete with 17' MIL SPEC RG-58-U and PL-259.
Price: $41.30

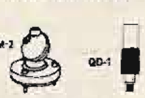
MODEL CG-144
Same characteristics as CGT-144 supplied with ⅜"-24-base to fit all mobile ball mounts — Length is 85". Mount and cable not included. Price: $25.50

VHF/UHF ANTENNA— TRUNK LIP MOUNT
MODEL THF
Field trimmable radiator permits quarter wave operation on any frequency from 140 to 500 MHz. Cutting chart included. Complete with trunk lip mount, 17' RG-58-U and PL-259. Price: $16.55

THF

RESONATOR SPRING— STAINLESS STEEL
MODEL RSS-2
Installs between Hustler mast and resonator. Absorbs shock when antenna strikes overhanging obstructions. Supplied ready for easy installation. . . . . $ 5.65

RSS-2



SSM-2

QD-1

STAINLESS STEEL BALL MOUNT FOR DECK, FENDER OR ANY FLAT SURFACE
MODEL SSM-2
Heavy 2" reinforced stainless steel 180° adjustable ball mount easily supports any amateur mobile antenna. Includes cycolac base, steel back-up plate and mounting hardware.
Price: $19.20

QUICK DISCONNECT— 100% STAINLESS STEEL
MODEL QD-1
Remove antenna from mount with easy press and twist release. Compression spring and all parts 100% stainless steel. ⅜"-24 threads—female one end, male the other.
Price: $16.95

FEED LINE MODEL L-14-240
Get expert performance, maximum shielding for minimum noise pickup in this MIL SPEC 20 length of RG-58-U cable. Supplied with connectors attached for use with ball or bumper mount and transceiver.
Price: $6.55

L-14-240

G6-144 A

MODEL G6-144A — Deluxe Two Meter Colinear for Repeater or any fixed station operation. 6 db. gain over ½ wave dipole. Maximum radiation at the horizon! Shunt fed with D.C. grounding. Radiator: ⅝ wave lower section, ¼ wave phasing ⅝ wave upper section. Height: 117". SWR at resonance: 1.2:1 or better. Power rating: 1,000 Watts FM. Wind survival: 100 MPH. Installs on vertical pipe up to 1¼" O.D. SO-239 coax connector. Price: $67.55

DELUXE MOBILE MOUNTS

For medium length, light weight antennas with ⅜" — 24 base.

TLM HLM GCM-1

MODEL TLM
Trunk lip mount for no holes installation on side or edge of trunk lid. Includes 17' RG-58-U connectors attached.
Price: $14.85

MODEL HLM
Deluxe trunk lip mount with 180 degree swivel ball for positioning antenna to vertical. Easy — no holes — installation. Includes 17' RG-58-U cable and connectors attached. Price: $17.20

MODEL GCM-1
Rain gutter mount fits all shapes, angles even latest trim line gutters. Includes 180° swivel ball. Price: $9.00

MM-1 TGM-1 C-32

MODEL MM-1
Cowl mount installs in 1" hole. Includes 180° swivel ball and SO-239 connectors.
Price: $7.50

MODEL TGM-1
Trunk groove mount installs in hidden area of groove under trunk lid. Mounting hardware included. Price: $8.00

MODEL C-32
Ball mount complete with mounting hardware.
Price: $8.20

All resonators are precision wound with optimized design for each band. Assembly includes 17-7 PH stainless steel adjustable tip rod for lowest SWR and band edge marker. Choose for medium or high power operation.

RM

RMS

STANDARD HUSTLER RESONATORS

Power Rating: 400 Watts SSB

Model	Band	Price
RM-10	10 meters	$ 6.50
RM-15	15 meters	6.95
RM-20	20 meters	7.30
RM-40	40 meters	13.20
RM-75	75 meters	15.50
RM-80	80 meters	15.95

SUPER HUSTLER RESONATORS

Power Rating: Legal Limit SSB
Supers have widest bandwidth

Model	Band	Price
RM-10S	10 meters	$11.30
RM-15S	15 meters	12.65
RM-20S	20 meters	13.00
RM-40S	40 meters	15.50
RM-75S	75 meters	30.00
RM-80S	80 meters	30.40

For 6-10-15-20-40-75-80 Meters

Fold over mast for quick and easy interchange of resonators or entering a garage. When operating, mast is held vertical with shakeproof sleeve clutch. 54" mast also serves as 1/4 wavelength 6 meter antenna. Stainless steel base has ⅜"-24 threads to fit mobile ball mount or bumper mount.

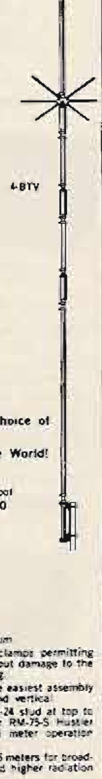
HUSTLER MASTS

The Majority Choice of Amateurs Throughout the World!

MO-1 MO-2

MODEL MO-2
For bumper mounting—Fold is at roof line 27" above base. Price: $22.00

MODEL MO-1
For deck or fender mounting—Fold is at roof line 15" above base. Price: $22.00



4-BTV

Covers 10 - 15 - 20 - 40 Meters

Only Hustler Gives One Setting for Whole Band Coverage

MODEL 4-BTV

- Lowest SWR—PLUS
- Bandwidth at its broadest! SWR 1.6 to 1 or better at band edges.
- Hustler exclusive trap covers "Spiritz" extruded to otherwise unattainable close tolerances assuring accurate and permanent trap resonance.
- Solid one inch fiberglass trap forms for optimum electrical and mechanical stability.
- Extra heavy duty aluminum mounting bracket with low loss — high strength insulators. Mounting hardware included.
- All sections 1¼" heavy wall, high strength aluminum
- Stainless steel clamps permitting adjustment without damage to the aluminum tubing.
- Guaranteed to be easiest assembly of any multi-band vertical
- Antenna has ⅜"-24 stud at top to accept RM-75 or RM-75-S Hustler resonator for 75 meter operation when desired
- Top loading on 75 meters for broader bandwidth and higher radiation efficiency!
- Feed with any length 50 ohm coax.
- Power capability—full legal limit on SSB or CW
- Mounting: Ground mount with or without radials, or roof mount with radials.

Length: 21' 5"
MODEL 4-BTV

Weight: 15 lbs.
Price: $99.95

SUPER AMP from DenTron

If the amplifier you're thinking of buying doesn't deliver at least 1000 to 1200 watts output, to the antenna, you're buying the wrong amplifier.

Our New Super Amp is sweeping the country because hams have realized that the DenTron Amplifier will deliver to the antenna, (output power), what other manufacturers rate as input power.

The Super Amp runs a full 2000 watts P.E.P. input on SSB, and 1000 watts DC on CW, RTTY or SSTV 160-10 meters, the maximum legal power.

The Super Amp is compact, low profile, has a solid one-piece cabinet assuring maximum TVI sheilding.

The heart of our amplifier, the power supply, is a continuous duty, self-contained supply built for contest performance.

We mounted the 4-572B's, industrial workhorse tubes, in a cooling chamber featuring the on-demand variable cooling system.

The hams at DenTron pride themselves on quality work, and we fight to keep prices down. That's why the dynamic DenTron Linear Amplifier beats them all

$574.50

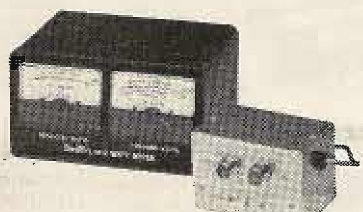
The 80-10 Skymatcher

Here's an antenna tuner for 80 through 10 meters, handles 500 w P.E.P. and matches your 52 ohm transceiver to a random wire antenna.

- Continuous tuning 3.2 - 30 mc
- "L" network
- Ceramic 12 position rotary switch
- SO—239 receptional to transmitter
- Random wire tuner
- 3000 volt capacitor spacing
- Tapped inductor
- Ceramic antenna feed thru
- 7" W. 5" H. 8" D., Weight: 5 lbs.

$59.50

Read forward and reflected watts at the same time



Tired of constant switching and guesswork?

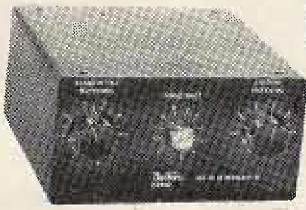
Every serious ham knows he must read both forward and reverse wattage simultaneously for that perfect match. So upgrade with the DenTron W-2 Dual in line Wattmeter.

$99.50

Match everything from 160 to 10 with the new 160-10 MAT

NEW: The Monitor Tuner was designed because of overwhelming demand. Hams told us they wanted a 3 kilowatt tuner with a built-in wattmeter, a front panel antenna selector for coax, balanced line and random wire. So we engineered the 160-10m Monitor Tuner. It's a lifetime investment at $299.50.

$299.50

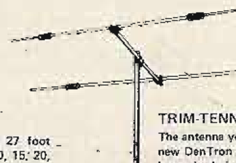


Meet the SuperTuner

The DenTron Super Tuner tunes everything from 160-10 meters. Whether you have balanced line, coax cable, random or long wire, the Super Tuner will match the antenna impedance to your transmitter. All DenTron tuners give you maximum power transfer from your transmitter to your antenna, and isn't that where it really counts?

1 KW MODEL **$129.50** 3 KW MODEL **$229.50**

The Sky Openers



SKYMASTER

A fully developed and tested 27 foot vertical antenna covers entire 10, 15, 20, and 40 meter bands using only one cleverly applied wave trap. A full 1/4 wave antenna on 20 meters. Constructed of heavy seamless aluminum with a factory tuned and sealed HQ Trap, SKYMASTER is weatherproof and withstands winds up to 80 mph. Handles 2 KW power level and is for ground, roof or tower mounting. Radials included in our low price of

$84.50

Also 80 m resonator for top mounting on SKYMASTER.

$29.50

SKYCLAW

A tunable monoband high performance vertical antenna, designed for 40, 80, 160 meter operation. SKYCLAW gives you the following spectrum coverage:

BAND (Meters)	BANDWIDTH (kHz)
160	50
80	200
40	entire band

Tuning is easy and reliable. Rugged construction assures that this self-supporting unit is weatherproof and survives nicely in 100 mph winds. Handles full legal power limit.

$79.50

EX-1

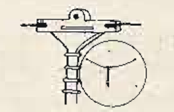
The DenTron EX-1 Vertical Antenna is designed for the performance minded antenna experimenter. The EX-1 is a full 40 meter, ¼ wave, 33', self-supporting vertical. The EX-1 is the ideal vertical for phasing.

$59.50

TRIM-TENNA

The antenna your neighbors will love. The new DenTron Trim-Tenna with 20 meter beam is designed for the discriminating amateur who wants fantsatic performance in an environmentally appealing beam. It's really loaded! Up front there's a 13 foot 6 inch director with precision Hy-Q coils. And, 7 feet behind is a 16 foot driven element fed directly with 52 ohm coax. The Trim-Tenna mounts easily and what a difference in on-the-air performance between the Trim-Tenna and that dipole, long wire or inverted Vee you've been using. 4 & 6 Forward Gain Over Dipole.

$129.50



ALL BAND DOUBLET

This All Band Doublet or inverted Type Antenna covers 160 thru 10 meters. Has total length of 130 feet (14 ga. stranded copper) although it may be made shorter if necessary. This tuned Doublet is center fed through 100 feet of 450 ohm PVC covered balanced transmission line. The assembly is complete. Add rope to the ends and pull up into position. Tune with the DenTron Super Tuner and you're on 10 through 160 meters with one antenna! Now just for the DenTron All Band Doublet.

$24.50

DenTron

DRAKE TVI FILTERS High Pass Filters for TV Sets provide more than 40 dB attenuation at 52 MHz and lower. Protect the TV set from amateur transmitters 6-160 meters.

Drake TV-300-HP
Model No. 1603
For 300 ohm twin lead
Price: $10.60

Drake TV-75-HP
Model No. 1610
For 75 ohm TV coaxial cable; TV type connectors installed
Price: $13.25

DRAKE TV-3300-LP
1000 watts max. below 30 MHz. Attenuation better than 80 dB above 41 MHz. Helps TV i-f interference, as well as TV front-end problems. Price: $26.60 Model No. 1608

LOW PASS FILTERS FOR TRANSMITTERS have four pi sections for sharp cut off below channel 2, and to attenuate transmitter harmonics falling in any TV channel and fm band. 52 ohm. SO-239 connectors built in.

DRAKE TV-5200-LP
200 watts to 52 MHz. Ideal for six meters. For operation below six meters, use TV-3300-LP or TV-42-LP. Model No. 1609 Price: $26.60

DRAKE TV-42-LP Model No. 1605
is a four section filter designed with 43.2 MHz cut-off and extremely high attenuation in all TV channels for transmitters operating at 30 MHz and lower. Rated 100 watts input. Price: $14.60

TUFTS RADIO CATALOG TUFTS RADIO TUFTS RADIO

Tufts Radio Electronics • 209 Mystic Avenue • Medford MA 02155 • (617) 395-8280

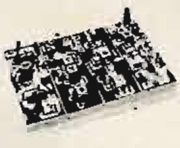
WORK ALL REPEATERS WITH OUR NEW SYNTHESIZER II

The Synthesizer II is a two meter frequency synthesizer. Frequency is adjustable in 5 kHz steps from 140.00 MHz to 149.995 MHz with its digital readout thumb wheel switching. Transmit offsets are digitally programmed on a diode matrix, and can range from 10 kHz to 10 MHz. No additional components are necessary!

Kit . . . . $169.95 Wired and tested $239.95

Also available for 220 MHz!

RECEIVERS

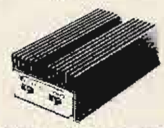


RX28C	28-35 MHz FM receiver with 2 pole 10.7 MHz crystal filter	$ 59.95
RX28C W/T . .	same as above–wired & tested . .	104.95
RX50C Kit . .	30-60 MHz rcvr w/2 pole 10.7 MHz crystal filter	59.95
RX50C W/T .	same as above–wired & tested . .	104.95
RX144C Kit .	140-170 MHz rcvr w/2 pole 10.7 MHz crystal filter	69.95
RX144C W/T .	same as above–wired & tested . .	114.95
RX220C Kit . .	210-240 MHz rcvr w/2 pole 10.7 MHz crystal filter	69.95
RX220C W/T .	same as above–wired & tested . .	114.95
RX432C Kit . .	432 MHz rcvr w/2 pole 10.7 MHz crystal filter	79.95
RX432C W/T .	same as above–wired & tested . .	124.95
RXCF	accessory filter for above receiver kits gives 70 dB adjacent channel rejection	8.50
RF28 Kit . . .	10 mtr RF front end 10.7 MHz out	12.50
RF50 Kit . . .	6 mtr RF front end 10.7 MHz out	12.50
RF144D Kit . .	2 mtr RF front end 10.7 MHz out	17.50
RF220D Kit . .	220 MHz RF front end 10.7 MHz out	17.50
RF432 Kit . .	432 MHz RF front end 10.7 MHz out	27.50
IF 10.7F Kit .	10.7 MHz IF module includes 2 pole crystal filter	27.50
FM455 Kit . . .	455 KHz IF stage plus FM detector	17.50
AS2 Kit	audio and squelch board	15.00

TRANSMITTERS

TX50	transmitter exciter, 1 watt, 6 mtr .	39.95
TX50 W/T . . .	same as above–wired & tested . .	59.95
TX144B Kit . .	transmitter exciter–1 watt–2 mtrs	29.95
TX144B W/T .	same as above–wired & tested. . .	49.95
TX220B Kit . .	transmitter exciter–1watt–220 MHz	29.95
TX220B W/T .	same as above–wired & tested . .	49.95
TX432B Kit . .	transmitter exciter 432 MHz . . .	39.95
TX432B W/T .	same as above–wired & tested . .	59.95
TX150 Kit . . .	300 milliwatt, 2 mtr transmitter .	19.95
TX150 W/T . .	same as above–wired & tested . .	29.95

POWER AMPLIFIERS



PA2501H Kit .	2 mtr power amp–kit 1w in–25w out with solid state switching, case, connectors	59.95
PA2501H W/T.	same as above–wired & tested . .	74.95
PA4010H Kit .	2 mtr power amp–10w in–40w out–relay switching	59.95
PA4010H W/T.	same as above–wired & tested . .	74.95
PA50/25 Kit .	6 mtr power amp, 1w in, 25w out, less case, connectors & switching .	49.95
PA50/25 W/T .	same as above, wired & tested . . .	69.95
PA144/15 Kit .	2 mtr power amp–1w in–15w out–less case, connectors and switching	39.95
PA144/25 Kit .	same as PA144/15 kit but 25w . .	49.95
PA220/15 Kit .	similar to PA144/15 for 220 MHz	39.95
PA432/10 Kit .	power amp–similar to PA144/15 except 10w and 432 MHz	49.95
PA140/10 W/T	10w in–140w out–2 mtr amp . .	179.95
PA140/30 W/T	30w in–140w out–2 mtr amp . .	159.95

Blue Line . . . RF power amp, wired & tested, emission–CW-FM-SSB/AM

Model	Frequency	Power Input	Power Output	
BLB 3/150	45- 55MHz	3W	150W	TBA
BLC 10/70	140-160MHz	10W	70W	139.95
BLC 2/70	140-160MHz	2W	70W	159.95
BLC 10/150	140-160MHz	10W	150W	259.95
BLC 30/150	140-160MHz	30W	150W	239.95
BLD 2/60	220-230MHz	2W	60W	159.95
BLD 10/60	220-230MHz	10W	60W	139.95
BLD 10/120	220-230MHz	10W	120W	259.95
BLE 10/40	420-470MHz	10W	40W	139.95
BLE 2/40	420-470MHz	2W	40W	159.95
BLE 30/80	420-470MHz	30W	80W	259.95
BLE 10/80	420-470MHz	10W	80W	289.95

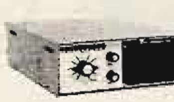
POWER SUPPLIES

PS15C Kit . . .	15 amp–12 volt regulated power supply w/case, w/fold-back current limiting and overvoltage protection . .	79.95
PS15C W/T . .	same as above–wired & tested . .	94.95
PS25C Kit . . .	25 amp–12 volt regulated power supply w/case, w/fold-back current limiting and ovp	129.95
PS25C W/T . .	same as above–wired & tested . .	149.95
PS25M Kit . . .	same as PS25C with meters	149.95
PS25M W/T . .	same as above–wired & tested . .	169.95
O.V.P.	adds over voltage protection to your power supplies, 15 VDC max. . .	9.95
PS3A Kit . . .	12 volt–power supply regulator card with fold-back current limiting . .	8.95
PS3012 W/T .	new commercial duty 30 amp 12 VDC regulated power supply w/case, w/fold-back current limiting and overvoltage protection	239.95

REPEATERS

RPT50 Kit . . .	repeater–6 meter	465.95
RPT50	repeater–6 meter, wired & tested	695.95
RPT144 Kit . .	repeater–2 mtr–15w–complete (less crystals)	465.95
RPT220 Kit . .	repeater–220 MHz–15w–complete (less crystals)	465.95
RPT432 Kit . .	repeater–10 watt–432 MHz (less crystals)	515.95
RPT144 W/T .	repeater–15 watt–2 mtr.	695.95
RPT220 W/T .	repeater–15 watt–220 MHz. . . .	695.95
RPT432 W/T .	repeater–10 watt–432 MHz. . . .	749.95
DPLA50	6 mtr close spaced duplexer	575.00
DPLA144 . . .	2 mtr. 600 KHz spaced duplexer, wired and tuned to frequency . . .	379.95
DPLA220 . . .	220 MHz duplexer, wired and tuned to frequency	379.95
DPLA432 . . .	rack mount duplexer	319.95
DSC-U	double shielded duplexer cables with PL259 connectors (pr.) . . .	25.00
DSC-N	same as above with type N connectors (pr.)	25.00

TRANSCEIVERS



TRX50 Kit . .	Complete 6 mtr FM transceiver kit, 20w out, 10 channel scan with case (less mike and crystals).	249.95
TRX144 Kit .	same as above, but 2 mtr & 15w out	219.95
TRX220 Kit .	same as above except for 220 MHz	219.95
TRX432 Kit .	same as above except 10 watt and 432MHz	254.95
TRC-1	transceiver case only	19.95
TRC-2	transceiver case and accessories . .	39.95

SYNTHESIZERS

SYN II Kit . . .	2 mtr synthesizer, transmitt offsets programmable from 100 KHz–10 MHz, (Mars offsets with optional adapters)	169.95
SYN II W/T . .	same as above–wired & tested . .	239.95
MO-1 Kit. . . .	Mars/cap offset optional	2.50
TO-1 Kit	18 MHz optional tripler	2.50

WALKIE-TALKIES

HT 144B Kit .	2 mtr, 2w, 4 channel, hand held receiver with crystals for 146.52 simplex .	129.95
NICAD	battery pack, 12 VDC, ½ amp. . .	29.95
BC12	battery charger for above	5.95
Rubber Duck .	2 mtr, with male BNC connector .	8.95

OTHER PRODUCTS BY VHF ENGINEERING

CD1 Kit	10 channel receive xtal deck w/diode switching.	$ 6.95
CD2 Kit	10 channel xmit deck w/switch and trimmers	14.95
CD3 Kit	UHF version of CD1 deck, needed for 432 multi-channel operation	12.95
COR2 Kit . . .	carrier operated relay	19.95
SC3 Kit	10 channel auto-scan adapter for RX with priority	19.95
Crystals	we stock most repeater and simplex pairs from 146.0-147.0 (each) . .	5.00
CWID Kit . . .	159 bit, field programmable, code identifier with built-in squelch tail and ID timers	39.95
CWID	wired and tested, not programmed	54.95
CWID	wired and tested, programmed .	59.95
MIC 1	2,000 ohm dynamic mike with P.T.T. and coil cord	12.95
TS1 W/T	tone squelch decoder	59.95
TS1 W/T	installed in repeater, including interface accessories	89.95
TD3 Kit	2 tone decoder	29.95
TD3 W/T . . .	same as above–wired & tested	39.95
HL144 W/T . .	4 pole helical resonator, wired & tested, swept tuned to 144 MHz ban	24.95
HL220 W/T . .	same as above tuned to 220 MHz ban	24.95
HL432 W/T . .	same as above tuned to 432 MHz ban	24.95

THE WORLD'S MOST COMPLETE LINE OF VHF-FM KITS AND EQUIPMENT

Dealer Programs NOW Available

Tufts Radio Electronics • 209 Mystic Avenue • Medford MA 02155 • (617) 395-8280

KLM RF Power Amplifiers

- A simple, add-on-immediately RF amplifier.
- Merely coax-connect amplifier between antenna and transceiver.
- No tuning! Efficient strip-line broad band design.
- Automatic! Internal RF-sensor-controlled relay connects amplifier whenever transmitter is switched on. Manual, remote-position switching is optional.
- Models for 6,2,1¼ meters, 70CM amateur bands plus MARS coverage.
- Two types: **Class C** for FM/CW. **Linear** for SSB/AM/FM/CW.
- Negligible insertion loss on receive.
- American made by KLM.

Highest quality, American-made "brand" transistors are fully protected for VSWR, short and overload, reverse polarity. Highly effective heat sinking assures long life, reliable performance. Black anodized containers...exclusive KLM extrusions, **have seven, full length fins on both sides!**

FREQ. (MHz)	MODEL NUMBER	PWR INP. (watts)	NOM. PWR OUT. (watts)	NOM. CUR. (amps)†	SIZE	PRICE
50-54	PA4-80AL	4	80	10A	C*	164.95
144-148	PA2-12B	1-4	12	2	A	59.95
"	PA2-70B	1-4	70	10	C*	159.95
"	PA2-70BL○	1-4	70	10	C*	169.95
"	PA2-140B	1-4	140	20	D	229.95
"	PA10-40B	5-15	40	5	B	83.95
"	PA10-40BL○	5-15	40	5	B*	94.95
"	PA10-70B	5-15	70	8	C*	139.95
"	PA10-70BL○	5-15	70	8	C*	149.95

FREQ. (MHz)	MODEL NUMBER	PWR INP. (watts)	NOM. PWR OUT (watts)	NOM. CUR. (amps)†	SIZE	PRICE
144-148	PA10-80BL	5-15	80	10	C*	159.95
"	PA10-140B	5-15	140	18	D*	199.95
"	PA10-140BL○	5-15	140	18	D*	215.95
"	PA10-160BL○	5-15	160	22	D*	229.95
"	PA30-140B	15-45	140	15	D*	179.95
"	PA30-140BL○	15-45	140	15	D*	189.95
219-226	PA2-70BC	1-4	70	10	C*	169.95
"	PA10-60BC	5-15	60	8	C	149.95
"	PA30-120BC	15-45	120	15	D*	189.95

FREQ. (MHz)	MODEL NUMBER	PWR INP. (watts)	NOM. PWR OUT (watts)	NOM. CUR. (amps)†	SIZE	PRICE
400-470	PA2-40C	1-4	40	7	C*	149.95
"	PA10-35C	5-15	35	6	B*	119.95
"	PA10-35CL○	5-15	35	6	B*	139.95
"	PA10-70C	5-15	70	13	D*	229.95
"	PA10-70CL○	5-15	70	18	D*	249.95

SIZES: Inches: *A. 2.25 × 5 × 2 *B. 6.5 × 5 × 2 *C. 6.5 × 7.5 × 2 *D. 6.5 × 10 × 2
MM: 57 × 127 × 50.8 165 × 127 × 50.8 165 × 190 × 50.8 165 × 254 × 50.8
○LINEAR AMPLIFIER †At 13.5VDC.

TEMPO

Dealer Programs NOW Available

THE TEMPO 2020

- Phase lock-loop (PLL) oscillator circuit minimizes unwanted spurious responses
- Hybrid Digital Frequency Presentation.
- Advanced Solid-state design...only 3 tubes.
- Built-in AC and 12 VDC power supplies.
- CW filter standard equipment...not an accessory.
- Rugged 6146-B final amplifier tubes.
- Cooling fan standard equipment...not an accessory.
- High performance noise-blanker is standard equipment...not an accessory.
- Built-in VOX and semi-break in CW keying
- Crystal Calibrator and WWV receiving capability.
- Microphone provided.
- Dual RIT control allows both broad and narrow tuning
- All band 80 through 10 meter coverage
- Multi-mode USB, LSB, CW and AM operation.
- Extraordinary receiver sensitivity (.3u S/N 10 db) and oscillator stability (100 Hz 30 min. after warm-up)
- Fixed channel crystal control on two available positions.
- RF Attenuator.
- Adjustable ALC action.
- Phone patch in and out jacks
- Separate PTT jack for foot switch
- Built-in speaker.
- The TEMPO 2020...$759.00.
- Model 8120 external speaker...$29.95. Model 8010 remote VFO...$139.00.

ATLAS 350-XL

- ALL SOLID STATE
- SSB TRANSCEIVER
- 350 WATTS P.E.P. OR CW INPUT
- 10 THROUGH 160 METER COVERAGE

Illustrated with optional AC supply, Auxiliary VFO, and Digital Dial.

The all new Atlas 350-XL has all the exciting new features you want, plus superior performance and selectivity control never before possible. Price: $995.00

● 10-160 METERS
Full coverage of all six amateur bands in 500 kHz segments. Primary frequency control provides highly stable operation. Also included is provision for adding up to 10 additional 500 kHz segments between 2 to 22 MHz by plugging in auxiliary crystals.

● 350 WATTS
P.E.P. and CW input. Enough power to work the world barefoot!

IDEAL FOR DESKTOP OR MOBILE OPERATION
Measuring just 5 in. high x 12 in. wide x 12½ in. deep, and weighing only 13 pounds, the Atlas 350-XL offers more features, performance and value than any other transceiver, regardless of size, on the market today!

- 350-PS matching AC supply — $195.00
- DD-6XL plug-in digital dial readout $195.00
- 305 plug-in auxiliary VFO — $155.00
- 311 plug-in crystal oscillator — $135.00
- DMK-XL plug-in mobile mounting kit — $65.00

TEMPO VHF/ ONE PLUS

The Tempo/ONE PLUS offers full 25 watt output or a selectable 3 to 15 watt low power output, remote tuning on the microphone, sideband operation with the SSB/ONE adapter, MARS operation capability, 5 KHz numerical LED, and all at a lower price than its time tested predecessor... the Tempo VHF ONE.

The Tempo VHF/One Plus is a VHF/FM transceiver for dependable communication on the 2 meter amateur band ● Full 2 meter coverage, 144 to 148 MHz for both transmit and receive ● Full phase lock synthesized (PLL) ● Automatic repeater split — selectable up or down ● Two built-in programmable channels ● All solid state ● 800 selectable receive frequencies with simplex and +600 kHz transmit frequencies for each receive channel. Price: $399.00

TEMPO ONE HF Transceiver. 80-10M. USB, CW & AM — $399.00
AC/ONE Power supply for TEMPO ONE — $99.00
VF/ONE External VFO for TEMPO ONE — $199.00

TEMPO SSB/ONE
SSB adapter for the Tempo VHF/One
• Selectable upper or lower sideband. • Plugs directly into the VHF/One with no modification. • Noise blanker built-in. • RIT and VXO for full frequency coverage. • $225.00

This NEW MFJ Super Antenna Tuner . . . matches everything from 160 thru 10 meters: dipoles, inverted vees, random wires, verticals, mobile whips, beams, balance lines, coax lines. Up to 200 Watts RF OUTPUT. Built-in balun, too!

With the NEW MFJ Super Antenna Tuner you can run your full transceiver power output — up to 200 watts RF power output — and match your transmitter to **any** feedline from 160 thru 10 Meters whether you have coax cable, balance line, or random wire.

You can tune out the SWR on your dipole, inverted vee, random wire, vertical, mobile whip, beam, quad, or whatever you have.

You can even operate all bands with just one existing antenna. No need to put up separate antennas for each band.

Increase the usable bandwidth of your mobile whip by tuning out the SWR **from inside your car.** Works great with all solid

Quality five way binding posts are used for the balance line inputs (2), random wire input (1), and ground (1).

state rigs (like the Atlas) and with all tube type rigs.

It travels well, too. Its ultra compact size 5x2x6 inches fits easily in a small corner of your suitcase.

The secret of this tiny, powerful tuner is a wide range 12 position variable inductor made from two stacked toroid cores and high quality capacitors manufactured especially for MFJ. For balanced lines a 1:4 (unbalanced to balanced) balun is built-in. Made in U.S.A. by MFJ Enterprises.

This beautiful little tuner is housed in a deluxe eggshell white Ten-Tec enclosure with walnut grain sides.

SO-239 coax connectors are provided for transmitter input and coax fed antennas.

Price: $69.95

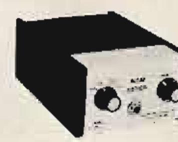
THE HAM-KEY

NOW 5 MODELS

Dealer Programs NOW Available

NEW MODEL HK-5 ELECTRONIC KEYER

$69.95



- Iambic circuit for squeeze keying.
- Self completing dots & dashes.
- Dot memory.
- Battery operated with provisions for external power.
- Built-in side-tone monitor.
- Speed, Volume, tone & weight controls.
- Grid-block or direct keying.
- Use with external paddle such as HK-1.

Model HK-1 $29.95

- Dual lever squeeze paddle.
- Use with HK-5 or any electronic keyer.
- Heavy base with non-slip rubber feet.
- Paddles reversible for wide or close finger spacing.

Model HK-2 $19.95

- Same as HK-1, less base for those who wish to incorporate in their own Keyer.

Model HK-3 $16.95

- Deluxe straight key.
- Heavy base, no need to attach to desk.
- Velvet smooth action.

Model HK-4 $44.95

- Combination on HK-1 & HK-3 on same base.

This Digital Alarm Clock is also an ID Timer. Assembled, too!

You can get an ID buzz every 9 minutes (up to one hour). Simply set the alarm time to the beginning of your QSO. Then tap the ID/doze button.

You can also set the alarm to the exact minute to remind you of a SKED or simply to wake you up in the morning automatically every 24 hours (no need to remember every night to set the alarm).

Four large .63 inch digits provide precise time to the minute. Seconds appear at the touch of the ID/doze button.

Pressing the ID/doze and fast set buttons reset and hold the seconds to zero for precise setting to WWV until the fast set button is released.

The separate AM or PM LED indicators blink at a 1 Hz rate if the power goes off momentarily. For longer power outs it resets to 12:00 AM and the AM LED blinks.

Setting the time and alarm is simple and fast with the fast and slow set buttons. Even the XYL will find it fun.

110 VAC, 60 Hz. 3-1/8 x 3 3/4 x 3 3/8 inches. One year warranty.

Price: $19.95

400% MORE RF POWER
PLUGS BETWEEN YOUR MICROPHONE AND TRANSMITTER

$49.95

LSP-520BX. 30 db dynamic range IC log amp and 3 active filters give clean audio. RF protected. 9 V battery. 3 conductor, ¼" phone jacks for input and output. 2-3/16 x 3-1/4 x 4 inches.

$59.95

LSP-520BX II. Same as LSP-520BX but in a beautiful 2-1/8 x 3-5/8 x 5-9/16 inch Ten-Tec enclosure with uncommitted 4 pin Mic jack, output cable, rotary function switch.

SUPER LOGARITHMIC SPEECH PROCESSOR

Up to 400% More RF Power is yours with this plug-in unit. Simply plug the MFJ Super Logarithmic Speech Processor between your microphone and transmitter and your voice is suddenly transformed from a whisper to a **Dynamic Output.**

Your signal is full of punch with power to slice through QRM and you go from barely readable to "solid copy OM."

$29.95

CWF-2BX Super CW Filter

By far the leader. Over 5000 in use. Razor sharp selectivity. 80 Hz bandwidth, extremely steep skirts. No ringing. Plugs between receiver and phones or connect between audio stage for speaker operation.

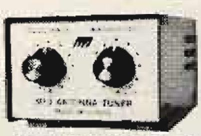
• Selectable BW: 80, 110, 180 Hz • 60 dB down one octave from center freq. of 750 Hz for 80 Hz BW • Reduces noise 15 dB • 9 V battery • 2-3/16 x 3-1/4 x 4 in.

$54.95

CMOS-8043 Electronic Keyer

State of the art design uses CURTIS-8043 Keyer-on-a-chip.

• Built-in Key • Dot memory • Iambic operation with external squeeze key • 8 to 50 WPM • Sidetone and speaker • Speed, volume, tone, weight controls • Ultra reliable solid state keying +300 volts max • 4 position switch for TUNE, OFF, ON, SIDETONE OFF • Uses 4 penlight cells • 2-3/16 x 3-1/4 x 4 inches



39.95 NEW

MFJ-16010 Antenna Tuner

Now you can operate all band — 160 thru 10 Meters — with a single random wire and run your full transceiver power output — up to 200 watts RF power OUTPUT.

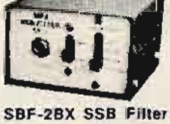
• Small enough to carry in your hip pocket, 2-3/16 x 3-1/4 x 4 inches • Matches low and high impedances by interchanging input and output • SO-239 coaxial connectors • Unique wide range, high performance, 12 position tapped inductor. Uses two stacked toroid cores

$17.95 NEW

CPO-555 Code Oscillator

For the Newcomer to learn the Morse code.
For the Old Timer to polish his fist.
For the Code Instructor to teach his classes.

• Send crisp clear code with plenty of volume for classroom use • Self contained speaker, volume, tone controls, aluminum cabinet • 9 V battery • Top quality U.S. construction • Uses 555 IC timer • 2-3/16 x 3-1/4 x 4 inches

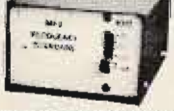


$29.95

SBF-2BX SSB Filter

Dramatically improves readability.

• Optimizes your audio to reduce sideband splatter, remove low and high pitched QRM, hiss, static crashes, background noise, 60 and 120 Hz hum • Reduces fatique during contest, DX, and ragchewing • Plugs between phones and receiver or connect between audio stage for speaker operation • Selectable bandwidth IC active audio filter • Uses 9 volt battery • 2-3/16 x 3-1/4 x 4 inches



$27.95

MFJ-200BX Frequency Standard

Provides strong, precise markers every 100, 50, or 25 KHz well into VHF region.

• Exclusive circuitry suppresses all unwanted markers • Markers are **gated** for positive identification. CMOS IC's with transistor output. • No direct connection necessary • Uses 9 volt battery • Adjustable trimmer for zero beating to WWV • Switch selects 100, 50, 25 KHz or OFF • 2-3/16 x 3-1/4 x 4 inches

$49.95

MFJ-1030BX Receiver Preselector

Clearly copy weak unreadable signals (increases signal 3 to 5 "S" units).

• More than 20 dB low noise gain • Separate input and output tuning controls give maximum gain and RF selectivity to significantly reject out-of-band signals and reduce image responses • Dual gate MOS FET for low noise, strong signal handling abilities • Completely stable • Optimized for 10 thru 30 MHz • 9 V battery • 2-1/8 x 3-5/8 x 5-9/16 inches

$29.95

MFJ-40T QRP Transmitter

Work the world with 5 watts on 40 Meter CW.

• No tuning • Matches 50 ohm load • Clean output with low harmonic content • Power amplifier transistor protected against burnout • Switch selects 3 crystals or VFO input • 12 VDC • 2-3/16 x 3-1/4 x 4 inches

MFJ-40V, Companion VFO $27.95

MFJ-12DC, IC Regulated Power Supply, 1 amp, 12 VDC $27.95

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by William I. Orr, W6SAI. A completely updated 20th edition of the famous communications handbook that is the electronics industry standard for engineers, technicians, and advanced amateurs. Explains in authoritative detail how to design and build all types of radiocommunications equipment. Contains greatly enlarged section on semiconductor and IC circuit design. Includes ssb design and equipment; rtty circuits; linear amplifiers, both solid-state and tube types; vhf and uhf transmitters and converters; as well as special-purpose and logic circuitry, plus completely revised chapter on electronics mathematics. 1080 pages; 6½ x 9¼; hardbound.
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HAM AND CB ANTENNA DIMENSION CHARTS

by Edward M. Noll, W3FQJ. Tabulates dimension information in feet and inches for all the popular antenna configurations. Gives data for dipole antennas, quarter-wave verticals, two-element beams, quads, triangles, inverted dipoles, and inverted vees. Includes information for cutting transmission lines to a preferred wavelength, dimensioning phasing lines, cutting a matching stub, and spacing antenna elements. 64 pages; 6 x 9; softbound.
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by Walter Jung. Provides an excellent introduction to the field of IC timers by presenting a collection of various circuit "recipes" useful in applying the devices. Arranged in three parts, the first part gives basic and generalized information. Part II, the applications section, is the "meat" of the book and includes over 100 different circuits for a wide range of uses. Part III contains reproductions of manufacturers data sheets, second-source manufacturers, and more. This book is a valuable reference for the hobbyist, the technical or engineering student, or professional. 288 pages; 5½ x 8½; softbound.
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by William Barden, Jr. Discusses these smaller computers and shows how they can be used in a variety of practical and recreational tasks in the home or business. Explains the basics of minicomputers and microcomputers, their hardware and software, peripheral devices available, and the various programming languages and techniques. Includes selection, buying, and programming your own system and gives detailed descriptions of currently available systems. 240 pages; 8½ x 11; softbound.
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MICROCOMPUTER PRIMER

by Mitchell Waite and Michael Pardee. Introduces the beginner to the basic principles of the microcomputers. Discusses the five main parts of a Computer—Central processing unit, memory, input/output interfaces, and programs. The important characteristics of several well-known microprocessors are given and a chapter is included on programming your own microcomputer. 224 pages; 5½ x 8½; softbound.
No. 21404 **$7.95**

THE 8080A BUGBOOK: MICROCOMPUTER INTERFACING AND PROGRAMMING

by Peter H. Rony, David G. Larsen, and Jonathan A. Titus. The principles, concepts, and applications of an 8-bit microcomputer based on the 8080 microprocessor IC chip. The emphasis is on the computer as a controller. Covers the four fundamental tasks of computer interfacing: (1) generation of strobe and device select pulses; (2) latching of accumulator output; (3) acquisition of input data by the accumulator; (4) generation of interrupt signals to the computer. Intended to help develop the skills needed to use an 8080-based breadboard microcomputer system. 5½ x 8½; softbound.
No. 21447 **$9.95**

New Products

from page 22

meter), and a laminated vswr chart. The price for this equipment is $298.

The test set is cushion-fit assembled in a durable, MIL-spec polyethylene case with space for seven plug-in elements, which determine power and frequency ranges. The carrying case and vswr chart are complimentary with the kit.

A customized luggage-style transit case has also been announced. Model 4300-070 has space for a Model 43 wattmeter, 15 plug-in elements, and additional accessories. Cushion inserts for other configurations can be designed for quantity requirements.

Price: 4300-064 test set $298, plug-in elements $36-75. Delivery: 4 weeks ARO from *Bird Electronic Corporation, 30303 Aurora Road, Cleveland (Solon) OH 44139.*

GARY MODEL 120 DMM CALIBRATOR IMPRESSIONS

"What good is my new, super accurate digital multimeter if I can't calibrate it?" you might ask, after purchasing such a device. Not a bad question, and considering the popularity of digital meters these days, it is a question that should be addressed.

DMMs are capable of extreme accuracy, which is of not much use when no method of initially calibrating the device is available. The Gary McClellan Company, a manufacturer of DMM kits, has provided the solution to the problem with their Model 120 DMM calibrator.

You may recall that last month I reviewed the Gary McClellan 103 DMM kit, the $29 special. I needed to calibrate that device, as well as my trusty analog meter. McClellan responded by providing the 120 calibrator to review.

The 120 calibrator uses an internal IC to provide voltage references of .1 volt at .2%, 1.0 volt at .2%, and 10.0 volts at .1%. Additionally, resistance references from 100 Ohms to 1 megohm are provided with similar accuracy. The calibrator is housed in a small plastic case with "banana" jacks for output connectors. A push-button enables the device when required, thus saving the internal 18-volt battery, consisting of two 9-volt transistor batteries.

As expected, operating the 120 calibrator is as easy as pushing the enable button. The meter or DMM to be calibrated is set to the appropriate range and adjusted while firing the calibrator. For the first time, I was really confident of the accuracy of my meter. The calibrator is so compact and easy to use that it can be used at a moment's notice — I keep mine directly behind my old VTVM for periodic checks. The decade voltage references also allow meters to be checked for linearity.

All things considered, the McClellan 120 DMM calibrator is a useful piece of test gear — usable by anyone with a DMM or VTVM, which includes just about everyone!

The Model 120 calibrator is priced at $34.95 factory built. *Gary McClellan and Company, Box 2085, 1001 W. Imperial Hiway, La Habra CA 90631.*

John Molnar WA3ETD
Executive Editor

THE SNOOP LOOP

Sencore, manufacturers of high quality test equipment, has made available a closed loop for signal pickup and frequency measurements, without connecting to the circuit. The Snoop Loop is simple in construction, as it connects directly to a 50 Ohm input cable for direct application to the new Sencore FC45 frequency counter or the PR47 UHF prescaler. The Snoop Loop works equally well on other 50 Ohm input frequency counters, as it enables the user to "hold back" from any of the high power sources, without actually connecting to the source, as it protects the frequency counter and the operator. Then, too, the PL207 Snoop Loop can be used to "snoop back" all along the signal path all the way back to low level circuits and be placed directly over oscillator coils, for example, without upsetting the operating frequency of the oscillator. The Snoop Loop model PL207, at $9.95, can be purchased from any Sencore distributor, or directly from the Sencore service department in Sioux Falls. *Sencore, 3200 Sencore Drive, Sioux Falls SD 57107, (605) 339-0100.*

POLICE RADAR DETECTOR IN KIT FORM

Now, for the first time, the proven "Bird Dog" police radar detector is offered in kit form. The Bird Dog has been proven by thousands of truckers and motorists over millions of miles. The Bird Dog was designed for long range, troublefree, hands off, reliable operation. Actual tests and reports from truckers and professional motorists show the Bird Dog to detect moving police radar as far away as 2½ to 3 miles. A unit with this type of sensitivity alerts the motorist of police radar long before the police radar has the motorist in sight. In actual comparative tests, the Bird Dog is equal in sensitivity to the top three radar detectors now on the market.

The Bird Dog is usually located on

Continued on page 189

C. Charles Roukas W2DNY
9 Tuxedo Pk
Rome NY 13440

-- this one's for the Wilson

Remote Speaker Mike for Your HT

I received my Wilson 1402SM HT a few weeks ago and immediately started having a ball mobiling, both on foot and in the car. In using it while in the car, I connected it to the rooftop 5/8 wave antenna. It was a bit awkward to use however, holding it up to my face and using it "a la a great big microphone." The microphone, located close to the bottom on the Wilson instead of the customary position about 3/4 of the way up, didn't help any. In using it while I was walking, I found it embarrassing seeing people driving by and turning to stare as I either held it to my ear in order to hear adequately, or positioning it next to my mouth for transmitting. I'm no youngster so I can't qualify as a kid playing Dick Tracy. I decided that a remote speaker/microphone was an absolute must. A quick check with the ads revealed that I'd have had to come up with $24.00 for a new one. It might as well have been $240.00 as far as my pocketbook was concerned. That left me no choice but to try to home brew one. With my huge junk box I didn't anticipate any parts problem. I live alone in a big house trailer. My friends say that I live in a huge junk box. My junk box served me well, as I had all of the necessary "junk." In my local area, you can duplicate my unit for about $1.50 if you have an old mike to start with. We have a fantastic electronics surplus outlet here for the necessary "junk." It is most unfortunate that he does not handle mail orders.

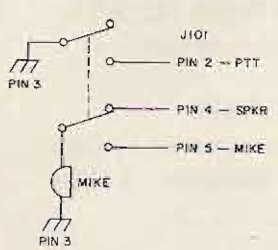


Fig. 1. Using mike as speaker.

At first I tried a dynamic microphone itself as both a speaker and as a microphone. See Fig. 1 for details. Actually, the element was a Shure Brothers controlled-magnetic transducer. It worked, but the "speaker" output was quite low. The output compared to a transistor radio earpiece. I next tried various true dynamic microphone elements of different shapes and sizes. I found one that had usable output, at least while in the trailer, but left much to be desired as a microphone. It made me sound as if I was talking with my head in a barrel. I added a high pass filter between the element and the speech amplifier input, to pre-emphasize the highs. See Fig. 2. The tone quality improved significantly, but the output suffered to the point of requiring my yelling into the mike. I changed the filter configuration to that as shown in Fig. 3, and it sounded normal. I did, however, vary the resistance value so that the deviation level was normal as well. This worked out reasonably well except that, needless to say, in a noisy environment, the "speaker" output was somewhat low and the unit had to be held up to one's ear as with an earphone. Another drawback was that the internal speaker would still "squawk," and consequently I could not operate in quiet environments, i.e., restaurants, libraries, hospitals, etc. Operating mobile on foot didn't work out too well either. I had the unit snapped to my belt and under my jacket, as it was cold out. This necessitated using the "mike" as an earphone continuously as I could not hear the internal speaker at all. Boy, does your arm ever get tired after awhile. Using it in the car wasn't acceptable either. The audio (from the internal speaker) was not loud enough to overcome the din of a noisy truck passing by and I couldn't continually hold the "mike" to my ear and still perform prerequisite driving functions. Oh well, back to the drafting board.

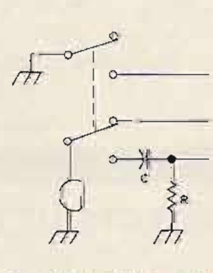


Fig. 2. Using mike with filter.

I then attempted using a small (1½") speaker both as a mike and speaker — the inverse of what I had tried previously. This worked out very satisfactorily as a speaker but not as a mike. Once again it sounded as if I was talking while I had my head in a barrel. The circuit was the same as that of Fig. 1, except that the element was a speaker. Since the deviation was low as well, I added a micro-miniature transistor output transformer to the mike input circuit for proper impedance matching. See Fig. 4. This increased the output to the point of overdeviating. The quality remained bassy. I added a high pass filter as with the dynamic element and got it sounding "hi-fi." The final circuit is shown in Fig. 5.

I can now drape the "mike" over my shoulder, either while using it in the car or while walking with it and it works fine. The audio level is more than adequate to override extraneous noises. The audio level control is now set so low that the raucous racket previously emanating from the internal speaker is now the equivalent of a stout whisper. I used a standard communication hand mike case for my unit. I held the speaker in place using silicone rubber (bathtub caulk). I replaced the push to

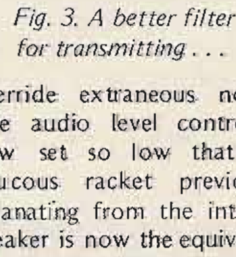


Fig. 3. A better filter for transmitting . . .

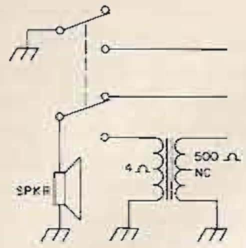


Fig. 4. This one hears well . . .

talk switch (it was only dpst) with a miniature push-button panel mount switch. My speaker/microphone works like a charm, and I've had nothing but compliments regarding how nice it sounds.

If you're wondering why I didn't try a separate miniature microphone, the answer is simply that my junk box did not produce one. I'm glad now that it did not. I did entertain the thought of a separate standard size microphone but could not squeeze one into the mike case along with the speaker.

This means of accentuating the highs (pre-emphasis) to make the microphone sound "human" applies to any microphone element. I even tried it with a carbon mike and now its quality can't be told from a communications type crystal, ceramic or dynamic microphone. Try it with a cheap (home tape recorder type) dynamic and make it sound "hi-fi." The values have to be altered to satisfy the characteristics of your speech amplifier and to compensate for the particular microphone element that you're using. ■

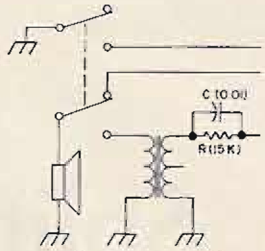
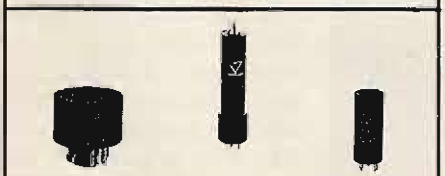
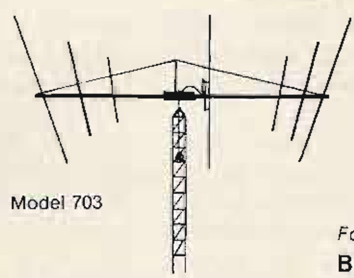


Fig. 5. Eureka! The finished unit.





Bob Tashjian WA6OMH
24100 Hamlin Street
Canoga Park CA 91307

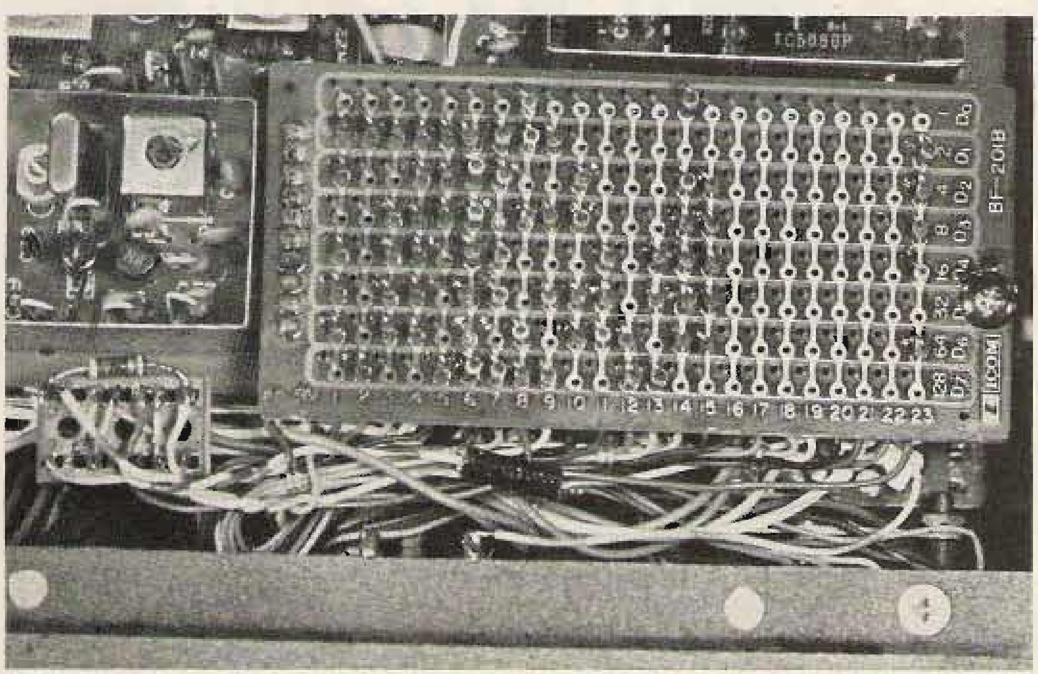
Split Your IC-22S

-- adding splinter frequencies

The IC-22S has brought the versatility of a synthesized 2 meter transceiver finally within the reach of those without unlimited funding, apparently by avoiding thumbwheel switches, digital displays, and the circuitry that these devices require. However, it has a limitation shared by most of the new synthesized rigs — it is restricted to operating on a 600 kHz split. In most localities this is no problem, but here in Los Angeles one of the most popular repeaters uses an odd split, receiving on 147.435 MHz and transmitting on 146.40 MHz. Numerous other communities also have this problem.

The IC-22S uses a diode matrix to program its frequency synthesizer for the lower of the two frequencies to be used. The selector switch selects a particular set of diodes. The output of the diode matrix goes to a digital adder circuit which adds 600 kHz (a binary 101000, where the least significant bit represents 15 kHz) when the higher frequency is called for. To modify this circuit would be a tedious job and, in all likelihood, would make it difficult to restore the circuit to its original state should in-warranty service be required. What must be done, then, is to use a different set of diodes for the second frequency.

When I first studied the circuit, I was disappointed to see that the voltage levels used were 0 and 9 volts, which eliminated the use of TTL devices. I was just about to settle for using a relay, but the thought of using a relay in a solid state device left me cold because of the threat of damage caused by transients from the coil. Nine volt relays aren't too easy to find, either. Then I noticed that the logic following the diode matrix was all CMOS, which operates on a supply voltage of anywhere from 3 to 15 volts. My problems were over.



IC-22S modification. Note pigtailed connection to existing wire to switch in center and new IC socket with sleeve removed at left.

In this circuit (Fig. 1), a CD4001 CMOS quad NOR gate chip provides all the gating necessary. The two inputs are the line from the selector switch and the "dp" line. The "dp," or duplex line, enables the adder circuit and here is used to enable the second set of diodes and disable the first. Both sets are disabled when the channel selector switch is not in the special position. The two outputs go to what I call the "normal" and the "abnormal" diodes. The normal diodes select the frequency to be used when the "dp" line is false (0 V), and the abnormal diodes select the frequency to be used when the "dp" line is true (9 V). In my particular case, because it is desirable to be able to receive on the repeater input for T-hunts or when there is interference on the output, I use the *duplex A* position. This position enables the adder logic ("dp" line true) in the receive mode. Therefore the diodes for receive (146.40 here) must be programmed for 600 kHz lower, or 145.80. Although this frequency is supposedly out of the range of the synthesizer, it doesn't really matter because the adder circuit intervenes before the 145.80 information ever reaches the synthesizer. There is plenty of range in the diode arrangement to program 600 kHz below even 146.01 MHz. Switching the function switch to the *simplex* position allows both receive and transmit on the *normal* frequency.

Construction is fairly simple. I wired everything on the back of a 14 pin IC socket, which fits very nicely between the volume control and the synthesizer board. I didn't fasten the IC socket to anything but just let it float on its wires. This allows removing the diode board and new circuitry as one unit for programming. To insulate the IC socket, I slipped over it a paper tube made from package sealing tape — that's the stuff you have to lick. It tasted dreadful but did the job. The normal diodes occupy the position corresponding to the switch position to be used. At the end of the diode board, adjacent to diode position 22, is an unused position just made to order for the abnormal diodes. To get to the lead coming from the selector switch, unsolder it from the diode board and replace it with the "normal" lead. The positions of the 9 volt and "dp" lines are marked on the board. The only thing missing on the diode board is a ground, and this is available on the meter.

The only problem encountered was rf occasionally getting into the new circuitry and causing loss of lock. Presumably some bypassing would have prevented this, but it was found that there was no trouble whenever the antenna was not actually mounted directly on the radio.

It's great that repeater splits are as standardized as they are, but for those which aren't, this is an easy, inexpensive solution. ■

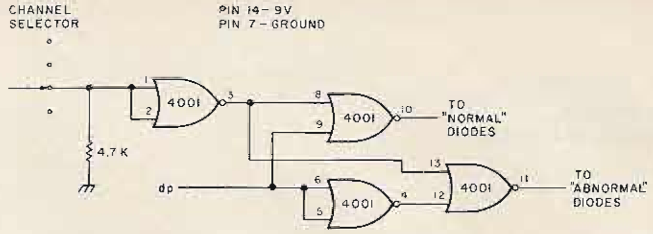


Fig. 1.

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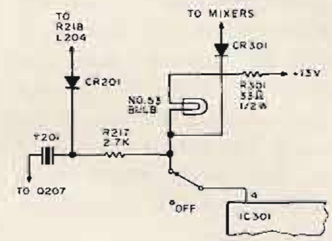

Fig. 1.

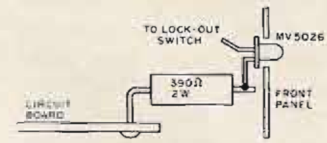

Fig. 2.

Remote Monitor for Your Scanner

--complete with lights

This article covers a circuit modification made to a Regency model TMR-8H/LM scanner monitor which replaces the channel indicator bulbs with light emitting diodes and includes the construction of a remote active channel indicator. Material cost for this project is quite reasonable and, depending upon the condition of the shack junk box, should amount to less than $5.00. Light emitting diodes are type MV5026, red, priced at 5/$1.00 just about everywhere. Other than the LEDs, the only parts needed are nine 390 Ohm 2 Watt resistors and a junk box speaker. The technique described should work equally well with other brands of scanners as the circuitry is simple and straightforward.

The scanner in question is (rather permanently) installed in the basement workshop shared by me and my retired fireman father. Most of the fireman's workshop time is spent in pursuit of his hobby at a power jigsaw. Obviously, when the scanner locks on a channel, far too much energy must be expended to turn around and look fifteen feet to see which channel is active. To eliminate this problem, an assembly containing a remote speaker and eight light emitting diode indicators was constructed and mounted on the wall in front of the saw. A labelmaker was used to affix the channel assignments adjacent to the proper LED indicators.

The remote indicators are wired in parallel with the indicators in the receiver. Fig. 1 shows the circuit diagram of the existing control circuitry for one channel.

IC301 is a power NAND gate which when activated by the scan decode circuitry functions such that its appropriate output (such as pin 4 in the figure) becomes a current sink effectively grounding pin 4. As well as activating the channel crystal Y201, the programming circuitry diode CR301 selects the appropriate high or low band mixer and at the same time must sink 120 mA just to light the channel indicator bulb. Not wishing to see if the additional 35 mA drawn by the remote LED in parallel with the No. 53 bulb would be the straw that broke the camel's back, it was decided to replace the bulbs with LEDs.

It is claimed by some scanner-owning visitors that with the LED indicators on the receiver, the locked channel is easier to determine at a quick glance because of the more point source light characteristics of the device.

To install the LEDs is as simple as replacing each light assembly. After removing the bulb assembly, it is necessary to use some method of supporting the diodes. This turned out to be mechanically simple though electrically redundant. As shown in Fig. 2, one end of a 390 Ohm 2 Watt resistor was connected to the +13 V B+ line on the circuit board.

The body of the resistor was positioned facing the opening in the front panel. The anode of the LED was then carefully soldered to the panel end of the resistor while the cathode was soldered to the appropriate contact on the channel lockout switch (same point as the removed bulb). The LED was aligned in the panel opening and that's all there is to it.

The remote installation is quite simple. A cable or wire bundle or whatever you choose to call it is required, and contains a pair of wires for the remote speaker. These may be connected directly to the remote speaker terminals on the rear of the receiver chassis. The cable which can be routed through an existing opening in the rear of the case must also contain an extension of the +13 V B+ line and a control wire for each channel indicator. These control wires are connected to the respective channel lockout switch previously described. Rather than be restricted by a hard-wired cable, I mounted a jack on the back of the chassis and a plug on the cable. (This would be up to individual

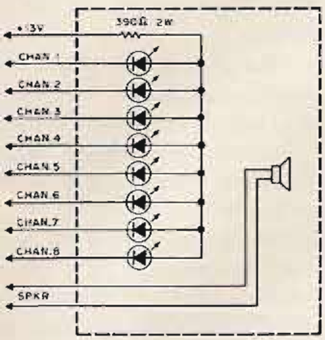

Fig. 3. All LEDs MV5026.

preference.) A circuit diagram of the remote unit is shown in Fig. 3.

Construction of the remote unit can take just about any form which is consistent with your abilities as a carpenter, cabinetmaker, sheetmetal worker or tin knocker. Mine is quite simple, being made out of some kind of fibrous pressboard material which makes friction fitting of the LEDs possible as a method of securing. A Dymo-maker was used to label the appropriate cities and towns beside each indicator using the "clever" scheme of red tape for fire departments and blue tape for police departments.

Having an installation such as this in the same area as the receiver might seem like overkill; however, it could be located upstairs in the kitchen, den or headboard of the bed. Mounted at the end of a hall, it could give one the feeling of being on final approach to an airport runway at night.

In conclusion, the intent here was to start the reader thinking of ideas for custom scanner installations. Putting the receiver on a good outside antenna usually pretty much dictates where the radio must be mounted and left. This restriction, however, should not dictate where you must be to listen to the local activity. ■

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Electronics Study Guide

-- remember when...?

There's no doubt about it. Some of the most delightful observations about electronic communication have been scrawled on tablet paper by grade school youngsters. Having taught in public schools for nineteen years, I'm sure of it. Take these historical explanations, for example.

Question: "When was the radio invented?" Answer: "On page 24."

"The radio was invented in the pre-me times."

"The Romans did not have radios. They used smoke signals in both the A.C. and D.C. times."

Kids have a knack for discarding everything but what they consider to be the most essential information. One boy brusquely wrapped up all of man's yearnings, struggles and triumphs in this eight word package: "Progress was from electricity to radios to now."

Here's a remark as charming as childhood itself: "I was thinking the radio was invented before the telegraph. When I learned different, all the thoughts I was going to say went in a swallow down my throat."

Another tiny historian concluded: "The Dark Ages lasted until the invention of electricity."

Through the years, the grade schooler's fund of knowledge has proved to be a glittering gold mine of wit and unconscious wisdom, often unhampered by hard facts. Each new subject seems to be a fertile new field for off-base interpretation and lopsided logic. Digging into facts about Marconi produced such notable nuggets as these:

"Marconi was born in 1874, supposably on his birthday."

"It took much hard work for Marconi to think out how to invent the radio. He had to keep thinking around the clock, twelve days a week."

"In just a few short years he became a sensation overnight."

"He expired in 1937 and later died from this."

Last year a bright-eyed little radio enthusiast came up with this endorsement: "Every time I think how the radio gives us so much fun, I have joy feels all over."

A skeptical classmate of hers absorbed all the statistics regarding the number of ham radio operators in America, but got his skepticism across in one crushing statement: "The total amount of ham operators in America today is more for saying than believing."

It must run in the family. Two years later his younger sister reported: "The number of ham operators we have today is an adsurbly large fact of a number."

The subject of hams has stumped many eager young scholars. Here are three more futile but imaginative explanations:

"Ham operators look something like people."

"They are one of the chief by-products of electricity."

"The meaning of them has a very short memory in my mind."

The elementary school youngster's mind seems to be a vast storehouse of miscellaneous misinformation — half true, half false and wholly delightful. His fund of knowledge about electricity includes such fascinating items as these:

"Electricity has been with us forever and maybe even longer."

"Would the average person be able to keep up with the news if it was not for electricity? The chances are 999 out of a hundred."

"In electricity, opposites attract and vice versa."

"If you see lightning, no you don't. You see electricity."

"From now on, I will put both gladness and wonder in my same thought about electricity."

Here's one I've been trying to figure out for five years: "You should always capitalize the word electricity unless it is not the first word in the sentence."

This next little girl seemed to be giving it all she had when she wrote: "Correct my being wrung, but tell me true or false. Do negative charges go through electrons or through protons? I wrecked my brain trying to think which."

But I'm afraid others are more nonchalant in their pursuit of knowledge: "Protons are bigger than electrons in case I ever want to know."

Psychologists tell us that half learning a fact incorrectly is often the first step to learning it right. So let's be philosophical as we buzz through these fractured facts about electrons and protons:

"100 electrons equal 1 radio program."

"When the switch is on, electrons are constantly bumping into each other inside the wire. There is really quite an overpopulation of electrons."

"Once I saw in an educational cartoon about how electrons move. Electrons are very interesting folks. All their ways are hurry ways."

"Electrons carry the negative charge while protons take the affirmative."

"Electrons are the same as protons only just the opposite."

"I think I admire the electron more than anything else about electricity because it weighs only about one over 2000th as much as a proton but can still hold its own."

Obviously, one of the fringe benefits of being an elementary school teacher is the possibility that the next paper I read will contain a wrong answer that is twice as witty or thought-provoking as the expected one. Sometimes they don't know and they know they don't know, but that doesn't keep their answers from being charming:

"Ideas about how radios work have advanced to the point where they are no longer understandable."

"Did I pass the test about how to get a ham radio operator's license and why not?"

"I have found radios to be easier to listen to than to tell how they work."

Take three small boys, mix

them up thoroughly with several pounds of strange facts, then shake them up with an examination and you have the perfect formula for instant confusion. Here's what I mean:

"The way vacuum tubes work, as I understand it, is not very well understood."

"Many questions have been aroused in my mind about vacuum tubes. As a mattery fact, the main trouble with vacuum tubes is that they give more questions than answers."

"In electricity, positives are attracted by negatives for the reason of search me."

Judging from the size of the handwriting, this next tyke was under the influence of John Hancock when he took time out to report (with the aid of a bright purple Crayola): "When they asked my brother if he would like to watch a ham operator, he rolled his eyes and flashed his teeth and said sure."

Often a grownup can only envy the simplicity of a child's way of expression, as is the case of the lass who remarked: "When I learned we were going to see a movie about ham operators all over the world, I told my feet to quiet down but they felt too Saturday to listen."

In their world of uncertainty, once they know a fact for certain, they hang on to it tenaciously, e.g.: "Another name for the radio is radiotelephony, but I think I will just stick with the first name and learn it good."

Children, like mountain climbers, must always make sure that their grasp on a fact is firm, even though they want to leap far beyond. Otherwise, they may find themselves trapped on a mental ledge called a boner. There is usually at least an element of truth in the most absurd answer. Sometimes they aren't wrong at all. It's just the way they put it that's so funny:

"Radio has a plural known as mass communication."

"Water scientists have figured out how to change river currents into electric currents."

"The best thing live wires are good for is running away from."

"Quite a bit of the world's supply of electricity goes into the making of ham radios."

"Many things about electronic communication that were once thought to be science fiction now actually are."

Members of the grade school set certainly have their own opinions, and few are hesitant to express them:

"All the stuff inside a ham radio is so twisted and complicated it is really not good for anything but being the stuff inside a ham radio."

"Electronics is the study of how to get electricity without lightning."

Then I don't suppose I'll ever forget this remark by another boy: "Last month I found out how a radio works by taking it apart. I both found out and got in trouble."

And you can't argue with the young fellow who reported: "When currents at 110 to 120 volts go through, them radios start making sounds. So would anybody."

When members of the grade school set turn their attention to the subject of vacuum tubes, youngsterisms come as thick as chalk dust. Just what is a vacuum? Here are five answers, fresh from the minds of nine-year-olds:

"Vacuums are made up mostly of nothings."

"A vacuum is an empty place with nothing in it."

"Vacuums are not anythings. We only mention them to let them know we know they're there."

"There is no air in vacuums. That means there is nothing. Try to think of it. It is easier to think of anything than nothing."

"A vacuum tube contains nothing. All of its parts are outside of itself."

Another lad wrote of this frustrating experience: "I figured out how a vacuum tube works twice but I forgot it three times."

One of his classmates reported: "When I learned how empty vacuum tubes are, I would have fainted if I knew how."

If you're at all hazy about other parts in a radio, hang on. These next thoughts will leave you only slightly worse off than before:

"An electron tube can be heated two different ways. Either Fahrenheit or Centipede."

"When you turn a radio on, the tubes get hot. The hotter anything gets, the faster the molecules in it move. Like if a person sits on something hot, his molecules tell him to get up quick."

"In finding out that radio tubes get hot, the fun is not in the fingers."

"Transistors are what cause many radios to play. Transistors are a small but important occupation."

"We now have radios that can run on either standard or daylight time."

One of my students last year had many tussles with his spelling book. When he finished writing one particular sentence, the battleground looked like this: "Termanuls do not agree with themselves spelingly and pruncingly."

With apologies to Mr. Webster, I would like to present a pocket-size dictionary of pint-size definitions, compiled from school children's reports. Should any of them prompt Webster to turn over in his grave, he would have to do so with a smile:

"Axually, a *choke coil* is not as dangerous as its name sounds."

"*Electromagnets* are what you get from mixing electricity and magnets together."

"Think of a *volt.* Then yippee, because now you have had the same thought as Voltaire, after who this thought was named."

Another lad had the right information, but the wrong answer: "There are some things about electricity we are still not sure of. These things are called *whats.*"

If the kids don't know all the answers, they can always do what their parents once did — try to slide by on a guess or two:

"A *radio telescope* is a thing you can hear programs by looking through it."

"*Current electricity* is electricity that is currently in use."

Kids are so full of questions, they can't possibly wait for someone to tell them all the answers. That's why they plunge recklessly ahead on their own, like so:

"Sound travels better in water than in air because in water the molecules are much closer apart."

"I have noticed that if a portable radio is turned in different directions, the station talks loudest behind its back."

"Although air is hollow it is not just for looking through. It is also for having radio waves running through it and trying to answer questions about."

"Radio waves would not be all that important to study if it were not for ears."

"Someone in here said that FM has shorter waves than shortwave radios. Is this so? I think it is because I think I was the one that said it." (If you can't believe yourself these days, who can you believe?)

An obviously more confident young man proclaimed: "Much has been said about how radio waves travel. Radio waves are both hearable and talkable."

Another moppet was going great, until the last word: "I believe the radio is one of the most important inventions of all time. Of course my father works at a radio station, so I may be a little pregnant."

That's one young writer who would have done fine if she had just stopped while she was ahead (which is good advice for grownup writers, too). ■

Low Cost Tone Decoder

-- for repeater control

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The usefulness of the Bell touchtone™ system for remote control, and especially for remote control of repeaters, is well known. The cost of touchtone decoders is quite low now, chiefly because of the Signetics 567 tone decoder

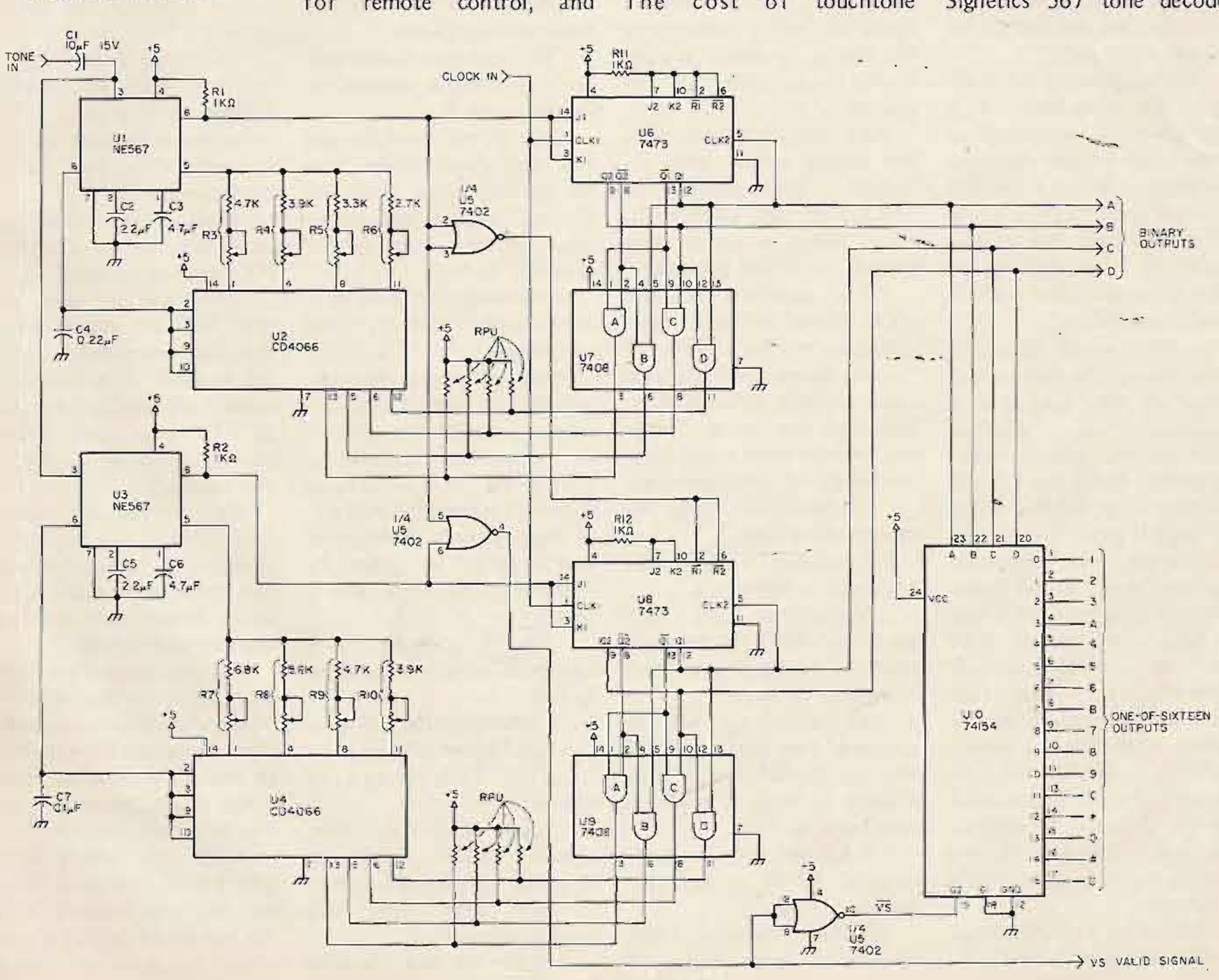

Fig. 1. Decoder circuit.

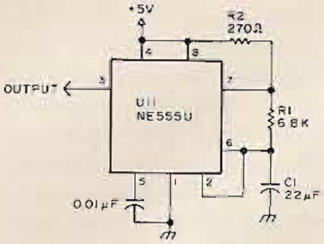

Fig. 2. Basic clock circuit.

IC. However, you still need eight of these ICs for a full 16 button system, if you use the standard method as described in *Signetics Databook*.[4]

A scanning decoder can get by with only two tone decoder ICs. It can become so complex, though, that any cost saving is wiped out. I decided that a scanning decoder would be simple enough to be worthwhile. My version is similar to the one described in reference 3. It uses a pair of 567s, a 555 timer, 2 CMOS quad switches, and 6 TTL ICs. All of these ICs are readily available from suppliers who advertise in *73*. The total cost of the ICs should be under 10 dollars. In addition, the decoder uses a handful of resistors and capacitors.

Circuit Operation

Fig. 1 shows a schematic diagram of the decoder. The eight tones used in the Bell system are divided into two groups. The low group tones – 697, 770, 852, and 941 Hz – are referred to as L1, L2, L3, and L4. H1, H2, H3, and H4 are the high group tones, respectively – 1209, 1336, 1477, and 1633 Hz.

U1 decodes tones in the low group. Its frequency of operation is determined by C4 and one of the resistors R3-R6. The resistors are connected in succession by U2, a CMOS quad switch. The state of U6, a dual flip-flop, is decoded by U7 into four control lines. One of the lines is always high, closing one of the individual switches in U2. The frequency of U3, the high group decoder, is switched the same way.

With no tone present, U8 is held reset while U6 is continuously clocked. When a pair of tones appears, as soon as U1 is switched to the proper frequency, U1-8 goes low. U6 is held in its current state, and U8 is allowed to clock. Then when U3 has decoded the high tone of the pair, its output goes low. U8 stops clocking and the valid signal line goes high. This indicates that the detection process is complete.

The flip-flop outputs are combined into a four-bit binary representation of the tone code. This four-bit word also goes to a 74154, which gives a low on the selected one-of-sixteen output. When the valid signal line is low, U10 is disabled – all outputs high.

Construction

There are no special problems in constructing the unit. Layout is not critical, and the wiring is not extremely complex, so a PC board is not essential. Follow the normal precautions in handling the CMOS ICs, and do not omit the eight pullup resistors (labeled RPU in Fig. 1). They protect the CMOS gates if the 7408s are removed for any reason. IC sockets make troubleshooting a lot easier, but are not necessary.

Some Notes on Design

The basic timer circuit (Fig. 2) is derived from reference 4. The values of R1 and C1 give a frequency in the neighborhood of 4 Hz. R2 is chosen for a duty cycle of 50%.

Fig. 3 shows some changes to the clock circuit, which make troubleshooting and alignment a lot less of a hassle. First, in order to set the frequency control resistors, it's best to defeat the cycling action and leave the proper CMOS switch permanently on. This is the purpose of S1. It converts the 555 from astable to monostable operation. Then, each time S2 is pressed, the 555

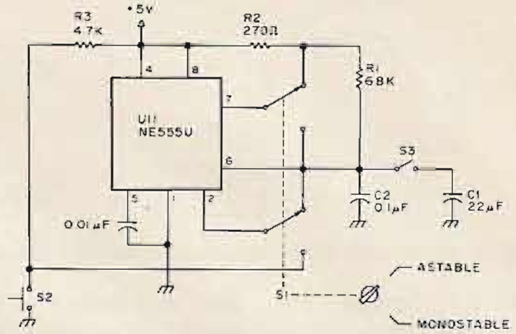

Fig. 3. Modified clock circuit.

produces a single pulse, and the state of the flip-flop advances by 1. To complete this revision, add a switch to ground pin 8 of U1. Some LED indicators driven from the four output lines are also handy. S3 simply lets the timer run fast enough so that the waveforms are easily viewed on a scope.

If, unlike me, you don't like to add a lot of extra hardware just to ease setup, you can get the same results with a couple of jumpers. The method is explained in the section on alignment.

The eight pullup resistors can be any convenient value between 10 kilohms and 1 megohm.

I used multi-turn pots to set the frequencies of U1 and U3. Assuming C4 and C7 are exactly 0.22 and 0.1 uF, you can calculate the resistance values from an equation in reference 4. These values are shown in Table 1. I used 5 kilohm pots in series with fixed 10% resistors. If you choose to set the frequencies with combinations of fixed resistors (more work but less strain on the budget), Table 1 gives you starting points. Note that the values given don't take into account the series resistance of the CMOS switches. There are two types of switches you can use: The CD4016 costs less, but I recommend the CD4066 because of its lower "on" resistance. You might also want to use more accurate capacitors for C4 and C7.

In a standard decoder as shown in reference 4, the ICs will lock up very quickly. Lockup times less than 0.1 second are easily achieved. With a scanning decoder, however, you cannot count on decoding a pair of tones in less than 8 clock periods. It takes this long for both counters to cycle through their four possible states. Each clock period must be long enough for the vco to settle down, then lock onto the tone. Because of this, there is little need to optimize the lockup time, and the design is simpler. You only need to be sure that the detection bands for the various tones do not overlap. Bandwidth is reduced by increasing the values of C2 and C5, and C3 and C6. I found that the values shown in Fig. 1 gave a narrow enough bandwidth. You may find that the high group bands overlap, especially H3 and H4. If so, change resistor values to move the bands apart. A high input level will increase bandwidth. Keep it as low as possible.

Alignment

A good audio generator – one with an output level control and an accurate frequency dial – is needed to align the decoder. You'll find that a scope and a frequency counter will be very useful.

I'm going to assume that you've built the circuit on "anyboard" without using IC sockets or any of the frills described in the section on design notes. I'll also assume that you used fixed resistors for R3-R10. If you use pots, the procedure is almost the same.

After checking for wiring errors, apply power and

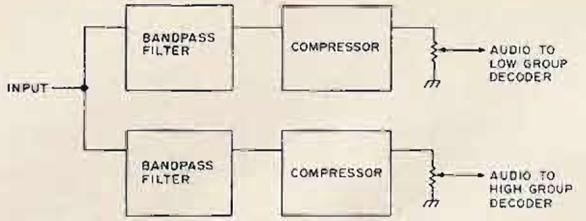

Fig. 4. Block diagram of input conditioning scheme.

measure the current. The decoder should draw about 250 mA. Be sure that U11 is producing a square wave at about 4 Hz. Then check that U6 is clocking normally and that pins 13, 5, 6, and 12 of U2 go high in succession. Now connect a jumper to U1-8, and touch the other end to ground. This will stop U6, leaving one switch of U2 closed. The trick is to get U2-13 high, closing the switch for the L1 resistor. This will take a few tries.

Once you have U2-13 high, leave U1-8 grounded and connect a decade box from U1-5 to U2-1. Set it to the value given in Table 1 for the L1 resistor. Connect an audio generator to the tone input. Set the frequency to 700 Hz and the level to 0.2 V rms. Remove the jumper. U1-8 should remain low. If it does not, adjust the decade box as necessary until it goes low. Remember to wait 1 second (four clock periods) between resistance changes. To fine tune the value, approach it from above and below and note the values where U1-8 just goes low. Set the decade box halfway between them. Now lower the audio level to about 50 mV rms. It's best to use the lowest level that will activate the decoder. Repeat the fine tuning process. This gives you the final value for R3. Select R4, R5, and R6 the same way, connecting the decade box in series with the proper switch each time. Now ground U1-8 permanently with the jumper. U4 should start switching. Use another jumper from U3-8 to ground to set the proper switch of U4 on, and select R7-R10. Wire the resistors into the circuit and remove the jumpers.

Check decoder operation by setting the generator to various low group frequencies. The circuit should hold in the proper state each time. Ground U1-8 and check the high group decoder.

If you have access to a frequency counter with a high input impedance, you can use an alternate method to set up the decoder. Connect the counter to pin 6 of U1 or U3. Select resistors so that the vco runs at the tone frequency in each case. This method saves some time and makes it easier to set single-turn pots.

This completes the alignment. Use a touchtone pad to check that the binary and one-of-sixteen outputs are corrrect as shown in Table 2. The decoder is now ready for operation. There are some pitfalls to avoid in making it work in your system, however.

Interfacing the Decoder

The ideal input signal is a pair of sine waves. Most touchtone pads use digital techniques to generate the tones and do not produce sine waves. With these signals, the decoder needs a higher level than it would with sine waves and does not respond quite as quickly. Due to line losses or receiver audio response, the tones of a pair may not be equal in amplitude. Also, noise and distortion can cause false outputs. The best prevention for these problems is to use bandpass filters followed by compressors for both the low group and high group tones. The block diagram of such a system is shown in Fig. 4. These problems are discussed in more detail in references 1 and 2. A delay circuit like that shown in reference 2 can help prevent falsing. Of course, if you want to drive loads drawing more than a few mA, you will need transistors and perhaps relays.

Finally, take a look at Table 2. As you can see, because of the way the touchtone keyboard is organized, my decoder cannot produce true BCD outputs. The keys are encoded and decoded in rows from top to bottom: 1, 2, 3, A, and so on. There are possibilities in using a touchtone pad to control a home computer, but it would take some code conversion hardware.

Conclusion

The scanning touchtone decoder I've described uses a small number of ICs and requires only a single 5-volt supply. While it is slower than the standard type of decoder, it is reliable and uses readily available parts. It compares favorably in price with the standard decoder. It has fairly good immunity to noise and distortion and is easily protected if these are a problem. Keep its limitations in mind and you will get good service out of it. ■

Tone frequency	Capacitance (chosen)	Resistance (calculated)
697 Hz	0.22 uF	7.174k Ohms
770 Hz	0.22 uF	6.494k Ohms
852 Hz	0.22 uF	5.869k Ohms
941 Hz	0.22 uF	5.313k Ohms
1209 Hz	0.1 uF	9.098k Ohms
1336 Hz	0.1 uF	8.234k Ohms
1477 Hz	0.1 uF	7.448k Ohms
1633 Hz	0.1 uF	6.736k Ohms

Table 1. Calculated values for resistors R3 to R10.

Touchtone Key	Tones Used	BCD Codes	Decoder Outputs Binary	Hexadecimal
1	L1, H1	0001	0000	0
2	L1, H2	0010	0001	1
3	L1, H3	0011	0010	2
4	L2, H1	0100	0100	4
5	L2, H2	0101	0101	5
6	L2, H3	0110	0110	6
7	L3, H1	0111	1000	8
8	L3, H2	1000	1001	9
9	L3, H3	1001	1010	A
0	L4, H2	0000	1101	D
*	L4, H1	none	1100	C
#	L4, H3	none	1110	E
A	L1, H4	none	0011	3
B	L2, H4	none	0111	7
C	L3, H4	none	1011	B
D	L4, H4	none	1111	F

Table 2. Comparison of BCD code and decoder output code.

References

1. "Autocall 76," C. W. Andreasen WA6JMM, *73 Magazine*, June 1976, pp. 52-54.
2. "Toward a More Perfect Touchtone Decoder," J. H. Everhart WA3VXH, *73 Magazine*, Nov. 1976, pp. 178-181.
3. "A Scanning Touchtone Digit and Word Decoder," Carl F. Buhrer W1GNP, *QST Magazine*, Jan. 1976, pp. 34-37.
4. *Signetics Databook,* 1972 or later edition.

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Hufco Counter Kit

-- report from a happy user

Fundamentally, basically, and first of all, I'm cheap. If there is a cheaper or less expensive way of doing something, I'll try it. Perhaps that's why the Hufco "Easy $25 Counter Kit" caught my eye (my eyes are located in my wallet).

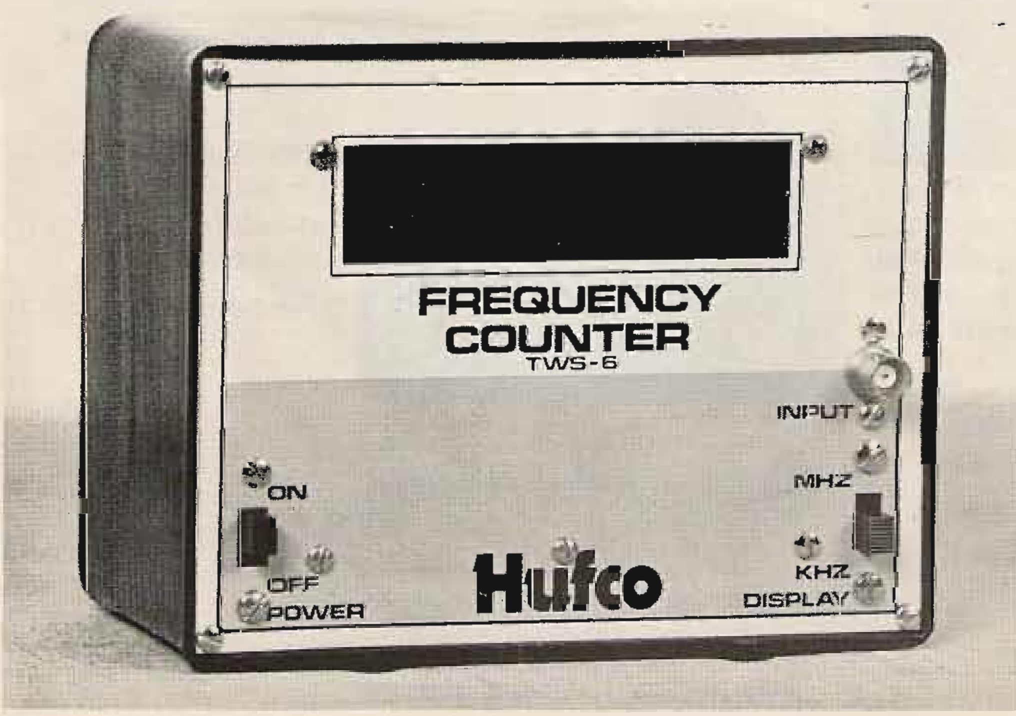
After painfully shelling out the coin and placing my order in the mail, I settled down for a long wait. Wonder of all wonders, within a week I received an acknowledgment of my order and a note that it would be six weeks for delivery (who *ever* acknowledges orders nowadays?). Included with the note was a list of the parts required for the kit so I could start "acquiring" the parts.

Perhaps this is the time to explain that this is a rather unique "kit" in that it does not include any parts . . . just the PC boards, a precut cabinet for the counter, and an instruction manual.

Through the abundance of an overstuffed junk box and the cultivation of friends, most of the parts were gradually collected. One traumatic experience was having to order the XAN362 readouts. The only readouts suitable were installed in a friend's clock, and he adamantly refused to part with them (cheap!).

After six weeks of waiting, the counter didn't come, but I did receive a nice letter explaining about the delay -- UPS strikes, delayed shipments from suppliers, etc. I also received a complimentary copy of their new publication *Channel 51*. This rather well done magazine is obviously aimed at CBers who wish to convert to ham radio. This gesture made the following weeks of waiting more palatable, just knowing that someone somewhere knew that I had an order coming.

Sure enough, one day a package arrived, and I was able to inspect my new TWS-006 counter kit. The cabinet was extremely well built with a nice silk screened front panel reminiscent in color of the old Heathkit



brown and beige.

The PC boards were the biggest surprise. I had expected rather rough boards at that price. Not so.

These were double-sided boards with plated-through holes. Clear sharp traces gave plenty of room for even the klutziest soldering iron mechanic. The component placement is clearly screened on the boards, and the one small mistake (a reversed index mark for one of the 7447s) is clearly called to your attention in the manual.

While the manual itself is not quite what I'd call Heathkit quality, it is adequate to insure correct assembly. It not only gives a step-by-step procedure for assembly and interconnections, it also gives a good presentation of the theory of operation and a method of troubleshooting in case of any malfunction. Various options are discussed, including adding a prescaler for VHF or UHF operation. I ended up purchasing their prescaler board ($4.00) for future addition.

The only drawbacks I ran into during construction are quite minor. The resistors used for the layout must have been 1/8 Watt units since my 1/4 Watt resistors were somewhat oversized. This resulted in a less than picture perfect board when finished, with leads wrapped back under components. Also, I'd like to know where they found 3/8" diameter 1000 uF capacitors on their silk screen layout. Mine are larger, but by extending leads, I was able to fit them in. These are all cosmetic complaints and don't affect the assembly of the unit.

The actual smoke testing of the unit was very disappointing . . . it worked. I couldn't believe it . . . I just plugged it in, and it worked . . . very anticlimactic. Other than adjusting the trimmer for exact frequency, there were no other adjustments or tuning required. Unless you've built a lot of kits before, you can't realize just how frustrating this can be. Half of the fun of kits is in troubleshooting the darn things after you've built them. I remember one clock kit that was over six months of fun . . . but that's another story.

The unit isn't the most sensitive I've ever seen, but it's not that bad either. I was able to trip it at less than full output from my Measurements Model 80 signal generator all the way up to 57 MHz. By picking and selecting 74LS90 ICs for the first three decades, I was able to bring the sensitivity down somewhat, but even as-is it is quite usable. I was able to read my 25 Watt CW transmitter on 21 MHz from across the room with just a clip lead as a probe.

Accuracy seems to be as good as six digits will allow. It counts the crystal output from my BC-221 as 2.00001 with the last digit varying from 1 to 2 to 0 on alternate counts. Warmup does not seem to affect it at all.

Options that I plan to add to my counter are nicads for portable operation and the prescaler as soon as I can scrounge up a 95H90 chip for it. The company also offers an optional input which features the ability to "withstand the full unloaded output from a transceiver on 28 MHz for 20 minutes." Since I already have a dummy load, and rarely load my transmitter into my counter, I don't plan on adding this option. Oh yes, it also increases the sensitivity to some extent or something like that.

In conclusion, I would recommend this counter to anyone who has a need for a *cheap* counter, or to anyone who is *cheap* and needs a counter. Seriously, it performs as well or better than commercial counters costing several times as much. If you have a well stocked junk box (or a friend who has one), you can bring the cost of this counter kit to well under $40 and still have the convenience of a well designed kit. ■

NEVER SAY DIE

. . . de W2NSD/1

EDITORIAL BY WAYNE GREEN

from page 6

pass along your experience through the pages of *73* . . . write.

One of the reasons ham equipment has been in such short supply has been the drain of sales to HF CBers. Many of the ham dealers are selling Yaesu and Kenwood transceivers to CB dealers (usually after converting the rig to work on the 27 MHz band). These dealers sell the rig to a CBer at the full list price (or more), often complete with an amplifier.

A few dealers make every effort to see that this ham gear does not end up in a CB shack — with Tufts Electronics being one of the leaders in this crusade. The manufacturers and importers of ham gear are unable to stop selling to the dealers who are abusing us, due to restraint-of-trade laws. There has been a move to get dealers to demand proof of a ham ticket before making a sale, but this won't cure anything, because the dealers who are selling ham gear for CB use know damned well what they are doing and are not about to stop as long as they can make an extra buck this way. If you can figure out any workable scheme to make it unprofitable to sell to CBers, then you'll have a good plan to stop this practice.

In the meanwhile, let's be vigilant and keep the CBers from twisting the dials of their transceivers to a ham band. What they do on the 27 MHz band is honestly none of our business at present — and we may be better off in the long run because they have established such a strong foothold there. What if the ITU (WARC) conference actually turns out as most of the knowledgeable hams of the world are predicting . . . with the loss of all HF ham bands? In that case, the 27 MHz HF CB band may be the *only* HF "ham" band we've got left.

THIRD ANNUAL INDUSTRY MEETING

The 1978 ham manufacturers and dealers conference will be held in Aspen, Colorado, from January 8th to 15th. In addition to the usual breakfast and dinner meetings which have made this yearly conference such a success, there will be three forum-workshops. Chuck Martin, the owner of Tufts Electronics, will conduct a workshop on things store managers should know, such as how to sell ham equipment, how to develop a comprehensive line of equipment to sell, and how to drum up a lot of local business using catalogs, newspaper advertising, radio, and television.

There will also be a workshop on how to write ads, catalogs, and other sales literature. This will also include a comprehensive workshop on media selection and planning: how to plan your advertising budget, how to select an ad agency, and how to save substantially on your advertising. This workshop could well pay for the entire conference.

Each of the workshops will probably take two evenings due to the comprehensiveness of the material. Even the old-timers will find a lot of value in these workshops.

There will be a forum devoted to crystal ball-gazing — second-guessing the future so you can take maximum advantage of what is going to happen next year.

The conference will be convening at the Continental in Aspen — it's a little tacky, but it does have a nice heated pool and a sauna, and it is right in the heart of town. Accommodations go early, so if you want to take advantage of this third annual ham industry workshop, better make your reservations with the hotel. There may even be snow this year.

SOME OPENINGS AT 73

It should be no news that *73* is growing — and so is *Kilobaud*. This means that we need more people to work on the magazines and the other plans afoot. We do have a need for some hams with experience in writing and construction to help test new equipment and write it up . . . to work on books . . . help with articles . . . etc. This is something that really has to be done right here in New Hampshire, which is one of the nicest places in the country to live.

We also need help in working on microcomputers . . . testing programs and selling them . . . checking out the newest equipment . . . things like that. A ham with a lot of experience in FORTRAN IV would find some interesting work. We also need help in support jobs such as management, marketing, sales, etc.

We're looking for people with intelligence, with some background, who don't smoke, and who are willing to go all out to become tops in their jobs. The pay is reasonable, and can be most rewarding if an outstanding job is done. Working for a small firm such as this gives you an excellent opportunity to grow and learn . . . something you just can't get in a larger business.

All you have to do is look at some of the *73* graduates . . . one is editor of a well-known magazine . . . another

Continued on page 185

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A Single Tone Can Do It

- - simple tone control system

In the process of putting together a repeater of my own, I found that I wanted to perform a simple ON/OFF auxiliary function via the repeater input. In my case, it happened to be turning an aural frequency indicator on or off, but the function could be almost anything. From previous experience with such a used control in another location, I decided on the use of two single tones – one to turn the function on and one to turn it back off. Armed with this idea, I dug into my data books, experimented a little, and arrived at the circuit described in this article.

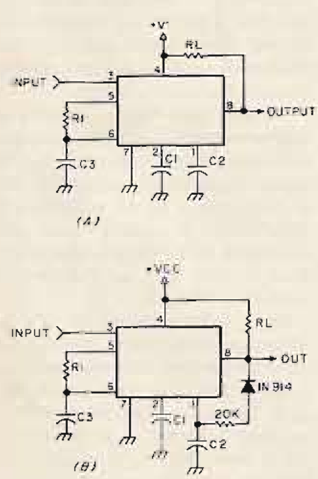


Fig. 1. (a) Basic 567 decoder circuit. Resistor R1 and capacitor C3 set the basic operating frequency or detection frequency. C1 and C2 are loop filters and their values affect response time and detection bandwidth. (b) Latching circuit, feeding the output (pin 8) back to the input of the final stage (pin 1). The latch can be released by pulling pin 1 to Vcc momentarily.

Circuit Operation

The basic 567 decoder circuit is shown in Fig. 1(a). By feeding the output back to the last stage at pin 1 (output filter), the output can be latched on. The circuit can then be unlatched simply by pulling pin 1 high momentarily. A general purpose PNP transistor can be hooked-up to do that task.

I then added another 567 decoder to get the unlatch signal. The output of this decoder turns on the PNP transistor just mentioned, thus unlatching the circuit.

The complete circuit is shown in Fig. 2. With the values shown, the decoders should tune over most of the normal single tone range. Depending on the length of tone burst available, the values of C3, 4, 6, and 7 might have to be adjusted slightly if the decoder does not respond fast enough.

Adjustment

When wiring is complete and checked, then power can be applied and the circuit checked out. A frequency counter or accurately calibrated scope is necessary to adjust the center frequency of the 567 decoders. Attach the counter or scope to pin 5 of U1 and then adjust R1 for the desired "ON" frequency. In my case, I used 1800 Hz. Now put the counter (scope) on pin 5 of U2 and adjust R4 for the desired "OFF" tone. Again, in my case, I used 1950 Hz.

Now connect whatever load you intend to use to pin 8. I have shown a relay since that is the most common usage. Connect an audio generator to the input and apply about 100 mV of 1800 Hz audio. The relay (load) should activate and should remain activated when the tone is removed. Now set the audio generator to the

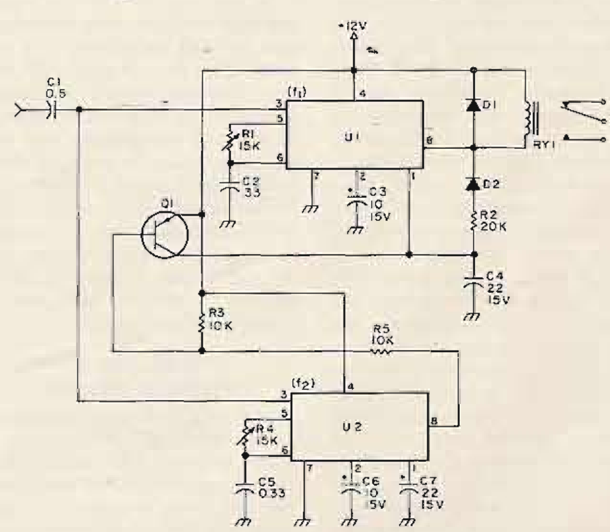
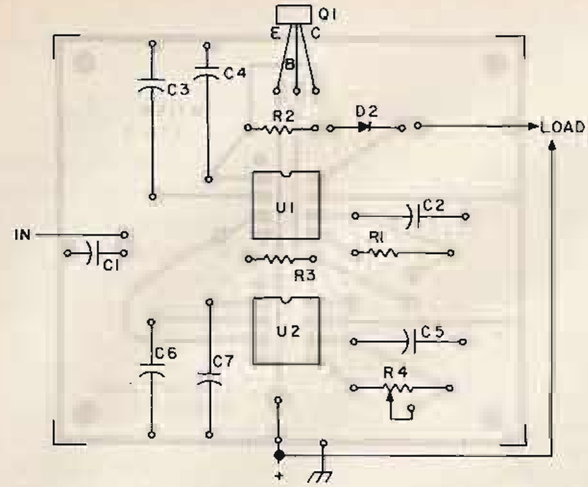


Fig. 2. Complete schematic of the two tone latching decoder.

A



B

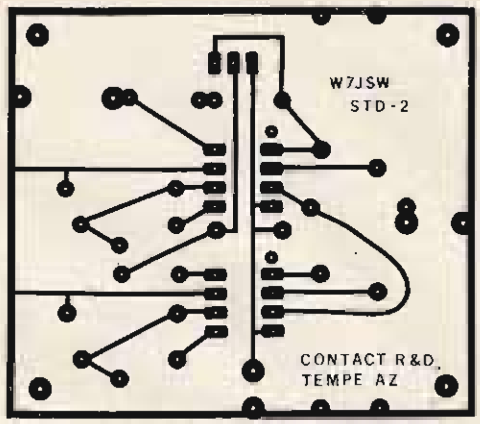


Fig. 3. (a) Parts layout for the prototype printed circuit board. This is the parts side of the board; the copper is on the other side. (b) Full size PC pattern for the prototype circuit board. Production boards, available from CONTACT, Inc., 35 W. Fairmont Dr., Tempe AZ 85281, will probably be slightly larger to make parts placement easier.

"OFF" frequency (1950) and apply that to the input. If all goes well, the load should de-activate.

Operation

I have my decoder operating from a 12 volt line and I am using a 24 volt relay as the load. The repeater receiver audio is fed to the audio input and I use the relay contacts to turn my tone frequency indicator on/off. The only thing you have to watch pretty closely is the input level to the 567s. The best operating point is about 150 mV. More will cause falsing and less won't operate too reliably.

Conclusion

A layout for a printed circuit board and the parts arrangement are shown in Fig. 3. The board is available from CONTACT, 35 W. Fairmont Dr., Tempe AZ 85281, for $5.00 ppd.

With cross-banding now approved, I may put one of these circuits on one of our local repeaters to provide a user accessible cross-link between 450 and 2 meters. Good luck and write if you have questions, but with today's postal rates, please enclose an SASE if you want a reply. ■

Parts List

C1 – 0.5 uF
C2, C5 – 0.33 uF
C3, C6 – 10 uF/15 V
C4, C7 – 22 uF/15 V
D1, D2 – 1N4001
R1, R4 – 15k PC trimmer
R2 – 20k ¼ W, 10%
R3 – 10k ¼ W, 10%
Q1 – 2N3905/3906/MPS6521/2N2222, etc.
U1, U2 – 567 decoder
RY1 – Relay to suit Vcc used

EDITORIAL BY WAYNE GREEN

from page 183

is the ad manager of a new magazine and is reportedly pulling down over $100,000 a year . . . another has his own magazine now, which is worth over $1 million . . . etc. The line forms to the left.

NEW IDEAS NEEDED

Despite the sudden growth of amateur radio as a result of the club programs to get in new licensees, attendance at hamfests seems to have been dropping off. How come, with more hams than ever before, we have fewer going to hamfests?

There are probably several reasons . . . such as the high cost of getting into hamfests . . . a lack of any real promotion of many of the prizes than anything else to draw attendance. The recent ARRL event at Hartford, home base for the League, is a case in point. The show was well-organized, and promoted in *QST* . . . yet the turnout was disappointing. The $6.50 entrance fee was cited by many as prohibitive for the youngsters . . . and, indeed, there were very few kids running around the show. Most of the fellows I saw were chaps I have known for thirty or forty years.

You really can't expect to get $6.50 from kids to see a dozen or so exhibits (mostly by dealers trying hard to sell gear) plus a talk by Dannals. Oh, add $20 if you want to take in the dinner.

We need ideas. If you have some ideas that have worked with a hamfest in your area, why not put them down on paper and send them along so the rest of us can benefit? We'll try to get all the good schemes published in *73*.

CB TO TEN

Owners of Standard Horizon 29 CB rigs can rejoice, for Standard has a dandy ten meter conversion for the set. If you have the 23-channel set, as I have, you can get a 40-channel switch from your local Standard dealer and get 40 channels on ten meters.

Standard has a conversion sheet available, "Procedure for 10 Meter Conversion of Horizon 29." This gives the details of where to cut the foil on the board and what parts to add and change. The changes are minimal.

The result is a rig which works on ten meters, starting at 28,965 and going up in the same increments as the CB channel spacing to 29,405 MHz. That's just two MHz above the 11 meter channel frequencies . . . and that change makes a lot of sense. If you start much lower, you run into the higher powered sideband stations in the lower 350 kHz of the phone band.

Give a call on 28,965 on Sundays at 1000 PDT and you'll probably get an answer from the bunch out in L.A. on the channel . . . if the band is open.

MORE ARTICLES

Perhaps you'd like to see more microcomputer articles in *73* . . . well, write 'em. In *Kilobaud*, I am exploring the advantages of getting into this new field and how to do it in my editorials . . . but you can't do much in microcomputing if you don't know anything about microcomputers. Let's see a lot more articles on microcomputing for *73* . . . and it doesn't hurt to bring ham applications into the act.

MARY PLEADS WITH YOU!

A few readers, despite every effort to make reader service simple, have been screwing things up. The worst complaint from Mary, the lovely gal who handles our reader service, is that there are dozens of readers who are *not* sending in their cards. Yes, I know this is difficult to believe, since you all know how much store advertisers put in getting requests for literature. They put even more store in your buying, of course, so don't let reading literature stop you from buying.

The other gripe is that a few readers are making a mess of the card with crosses and blotches. Mary says to circle the number, not obliterate it . . . puleeze! Mary also requests that you sign your name and address clearly . . . and if you're not sure, please ask someone.

THAT AUGUST QST!

If you are in the Maryland, D.C., Northern Virginia, Western Pennsylvania, or Western New York areas, be sure you don't miss getting your August subscription copy of *QST*. That's your August subscription copy, not one from a store . . . don't miss it.

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Eye On the Weather?

-- following weather satellites

Interest in the geosynchronous weather satellites is increasing rapidly. Many fine articles have appeared on the construction of receivers, converters and displays. Plotting charts are available for the low orbit satellites. But very little information is available on locating the geosynchronous satellites. This article presents a method of calculating the azimuth and elevation angles needed to point your antenna and, also, an alternate graphical technique.

To aim your antenna, you need the following information:

1. Your latitude and longitude.
2. The longitude of the satellite subpoint.

The result of the computations will be the desired elevation and azimuth. Elevation is the number of degrees the antenna must be tilted above the horizon. Azimuth is the bearing angle the antenna should be turned from true north.

Let us first calculate the azimuth angle. To do this, construct a great circle route which passes through your location and the satellite subpoint. The latitude of all geosynchronous satellites is zero degrees. This great circle is used to determine, first, the distance from the satellite subpoint to your location and, then, the desired azimuth angle. Fig. 1 shows the navigation triangle from which the distance to the subpoint, D, and the azimuth angle, A, is determined. From Bowditch[1] we find that:

$$\text{Hav D} = \text{Hav}(|\text{LO1}-\text{LO2}|)\cos(\text{L1})\cos(\text{L2}) + \text{Hav}(|\text{L1}-\text{L2}|)$$

Where:
Hav D is $\frac{1}{2}[1-\cos(D)]$;
L1 is your latitude;
L2 is the subpoint latitude (zero);
LO1 is your longitude, degrees west; and
LO2 is the subpoint longitude, degrees west.

This equation was developed for navigation using Napier's Laws for spherical triangles and, hence, is strange in appearance. However, making the necessary substitutions we find:

$$\cos(D) = \cos(\text{L1})\cos(\text{LO1}-\text{LO2})$$

From this, it is easy to find D. D is expressed in degrees. Having found D we can now determine A, the azimuth angle, by: Hav A = sec(L1) csc(D) [Hav(90° - L2) - Hav(|D - 90° + L1|)]. This equation can be simplified for geosynchronous satellites to:

$$\cos(A) = 1 - \frac{\sin(\text{L1}+D)}{\cos(\text{L1})\sin(D)}$$

If the subpoint longitude is less than your longitude, the azimuth angle is A. If the subpoint longitude is greater than your longitude, subtract A from 360° to obtain the azimuth angle.

If you are still with me, the elevation angle is calculated next. A drawing of the great circle path is laid out in Fig. 2. The desired elevation angle is labeled B. Here we have a triangle with two known sides, and the angle between them is known. One side is equal to the Earth's radius, 3,440 miles. The other side is equal to the sum of the Earth's radius and the satellite's altitude, 22,300 miles. Using the law of cosines:

$$B = 90° - D - \arctan\left(\frac{3440\sin(D)}{25740 - 3440\cos(D)}\right)$$

Let's examine some hypothetical cases of a station at 37° N. latitude and 76° W. longitude, desiring to receive ATS-1 at 149° W. longitude and ATS-3 at 70° W. longitude.

ATS-1:

$\cos(D) = \cos(37°)\cos(-73°) = .798 \times .292 = .233$

$D = 76.5°$

$\cos(A) = 1 - \frac{\sin(113.5°)}{\cos(37°)\sin(D)} = 1 - \frac{.917}{.798 \times .972} = -.182$

$A = 100.5°$

But ATS-1's longitude is larger than the station's longitude, so:

Azimuth angle = 360° - 100.5° = 259.5°

$B = 90° - 76.5° - \arctan\left(\frac{3440\sin(76.5°)}{25740 - 3440\cos(76.5°)}\right)$

$B = 90° - 76.5° -$

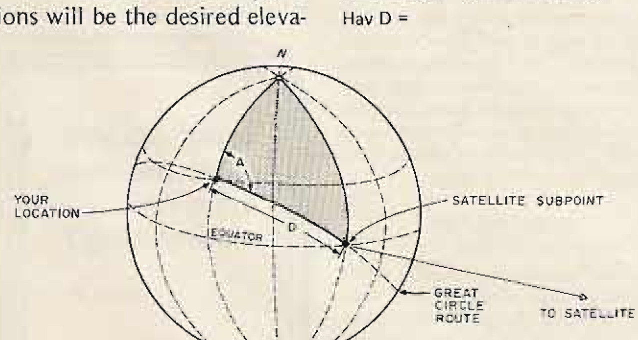

Fig. 1. Navigation triangle formed by your location, the North Pole, and the satellite subpoint.

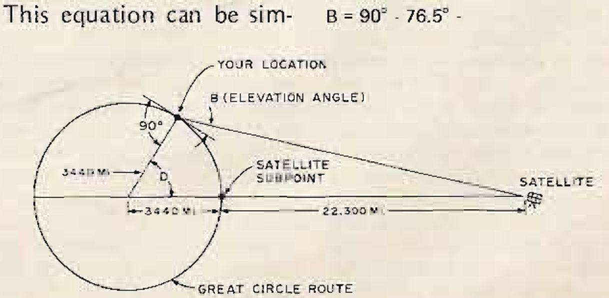

Fig. 2. Geometry used for calculating the elevation angle.

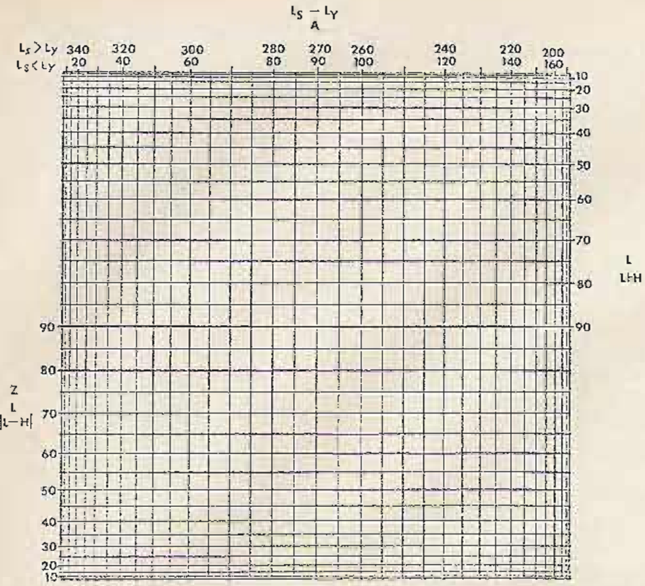

Fig. 3. Simplified d'Ocagne chart. All scales are expressed in degrees. L_S = satellite subpoint longitude; L_Y = your longitude; A = azimuth angle; Z = zenith angle; L = your latitude; and H = 90° - Z.

$$\arctan\left(\frac{3440 \times .972}{25740 - 3440 \times .233}\right) =$$

$90° - 76.5° - 7.6°$

Elevation angle = 5.9°

ATS-3:

$\cos(D) =$

$\cos(37°)\cos(6°) =$

$.798 \times .994 =$

$.793$

$D = 37.5°$

$\cos(A) =$

$$1 - \frac{\sin(74.5°)}{\cos(37°)\sin(37.5°)} =$$

$$1 - \frac{.963}{.798 \times .609} = -.982$$

Azimuth angle = 168°

$B = 90° - 37.5° -$

$$\arctan\left(\frac{3440\sin(37.5°)}{25740 - 3440\cos(37.5°)}\right)$$

$B = 90° - 37.5° -$

$$\arctan\left(\frac{3440 \times .609}{25740 - 3440 \times .793}\right) =$$

$90° - 37.5° - 5.2°$

Elevation angle = 47.3°

While the mathematical approach is precise and accurate, a much simpler graphical technique can be used with little loss in accuracy. Fig. 3 is a simplified d'Ocagne diagram from Bowditch, which can be used to solve spherical triangle problems by drawing straight lines and doing simple subtraction and addition. Each axis has been divided according to the haversine of the angles. The scales in Fig. 3 are simplified to reduce confusion. The graph applies only to stations in the Northern Hemisphere.

The use of the graph is best explained with examples. Taking the same examples as before, ATS-1 and ATS-3, let us proceed.

Step 1: Mark your latitude on both the left and right vertical scales. Connect the two marks with a straight line.

Step 2: Subtract your longitude from the satellite subpoint longitude, $L_S - L_Y$. If the result is positive, proceed to step 3. If the result is negative, add 360° to the result to get a positive angle between 0° and 360°. If $|L_S - L_Y|$ is greater than 90°, the satellite is below your horizon and cannot be received.

Step 3: Take the result of step 2 and make a mark on the top axis. Drop a vertical line from this point to the line drawn in step 1. From where the two lines cross, draw a horizontal line to the left scale and note the reading, Z. This value of Z can be converted to the elevation angle B by Table 1. If Z is greater than 80°, the satellite is below your horizon and cannot be received.

Step 4: Subtract the value Z from 90°. The result is labeled H for convenience.

Step 5: Subtract H from your latitude. Ignore the sign of the result. Mark the result on the left vertical scale. Similarly, add H to your latitude, and mark the right scale accordingly. Connect the two marks with a straight line.

Step 6: Where the line from step 5 crosses the 90° horizontal line, extend a line vertically to the top scale. If the satellite subpoint longitude is greater than your longitude, use the upper scale. If not, read the lower scale. The reading is the desired azimuth angle. The elevation angle was obtained from Table 1 in step 3.

The worksheets for ATS-1 and ATS-3 (see Figs. 4 and 5) demonstrate that the errors are typically less than one degree. I find this graphical method to be much faster and easier on the brain than the exact mathematical method, and the errors are much less than the beamwidth of practical antennas.

Aligning the actual antenna mount, in order to use this data, can be difficult. There are two methods I find useful to calibrate the azimuth scale. The elevation scale is easily aligned using a spirit level.

The first, and simplest, method is to use the North Star, Polaris. Rigging a sight on the mount and bore sighting the mount with Polaris at night will bring the mount to an azimuth angle of 0° ± ½°. However, every time I have attempted to use this method I have found a tree, house, or even a mountain between me and Polaris.

The alternate technique requires a copy of the *Nautical Almanac* and the ability to see the noon position of the sun. A *Nautical Almanac* can be purchased at most marine outlets, or a copy is usually available at a local library. When you open the almanac, it appears to be a vast array of tables. Each page pair covers three days. The column we are interested in is labeled "Sun." Under this heading are two subheadings, "Dec." and "GHA". "Dec." is an abbreviation for declination, which

Z	B Elevation Angle (degrees)
0	90.0
2	87.7
4	85.4
6	83.0
8	80.8
10	78.5
12	76.2
14	73.9
16	71.6
18	69.3
20	67.0
22	64.7
24	62.5
26	60.2
28	57.9
30	55.7
32	53.4
34	51.2
36	49.0
38	46.7
40	44.5
42	42.3
44	40.1
46	38.0
48	35.8
50	33.6
52	31.5
54	29.3
56	27.2
58	25.0
60	22.9
62	20.8
64	18.7
66	16.6
68	14.6
70	12.5
72	10.4
74	8.4
76	6.4
78	4.3
80	2.3

Table 1. Antenna elevation angles for Z values from 0° to 80°.

is not of importance for our work. GHA is an abbreviation for Greenwich Hour Angle. GHA is the longitude of the solar subpoint. "Dec." is the latitude of the solar subpoint.

Assuming you are in the continental United States, when the sun's GHA is equal to your latitude, the sun is directly south, or at your 180° azimuth position. To the right of the GHA column is a GMT column. To use the almanac, look down the GHA column for the date of interest until you find a GHA near or equal to your longitude. If the GHA matches your longitude, the corresponding GMT is the time when the sun is directly south of your location. If not, you must interpolate. Note that a difference of one hour in GMT corresponds to a change

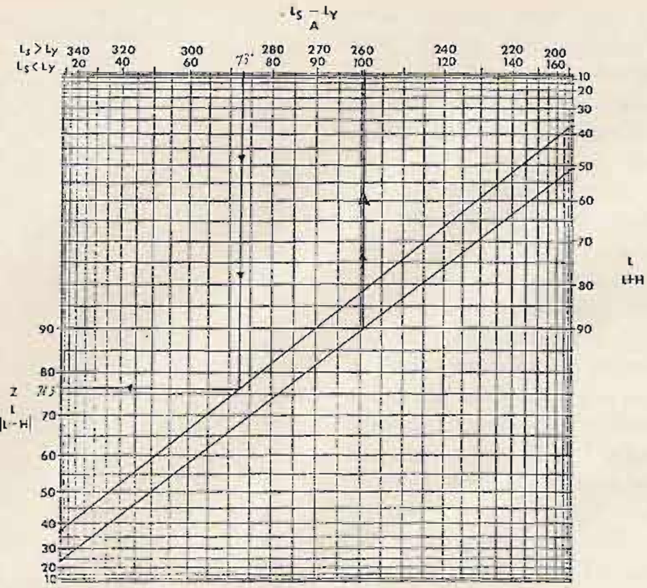

Fig. 4. ATS-1 worksheet. QTH is 37° N., 76° W. Satellite is 0° N., 149° W. $L = 37°$; $L_S - L_Y = 149° - 76° = 73°$; $Z \approx 76.5°$; $H = 90° - Z = 13.5°$; $|L - H| = 24°$; $L + H = 51°$; $A \approx 259°$ (259.5° calculated); B (from table) = 5.9° (5.9° calculated).

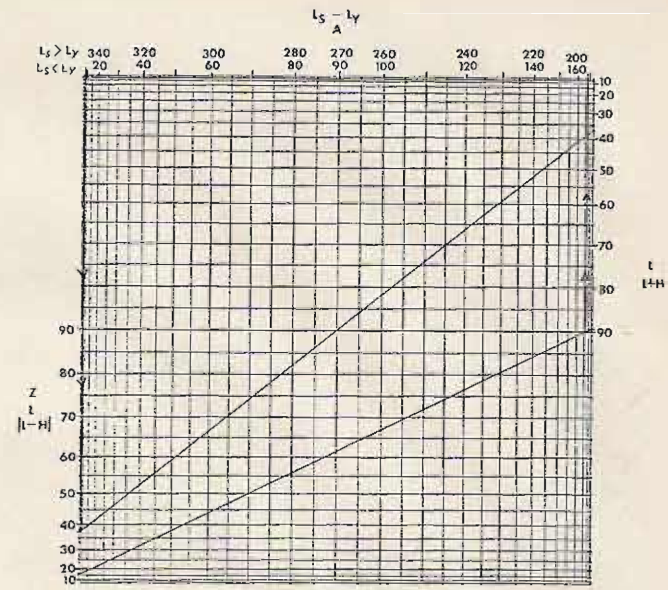

Fig. 5. ATS-3 worksheet. QTH is 37° N., 76° W. Satellite is 0° N., 70° W. $L = 37°$; $L_S - L_Y = 70° - 76° = -6° = 354°$; $Z \approx 37.5°$; $H = 90° - Z = 52.5°$; $|L - H| = 15.5°$; $L + H = 89.5°$; $A \approx 167°$ (168° calculated); B (from table) = 47.5° (47.4° calculated).

of 15° in GHA. Taking the largest GHA less than your longitude, note the GMT. Subtract the GHA from your longitude. Divide this difference by 15°, and multiply the result by 60 minutes (time, not angle). This product is the number of minutes which must be added to the noted GMT to obtain the exact time when the sun will be due south. Fasten a stick on your antenna mount parallel to the antenna axis. When the calculated time arrives, point the stick at the sun by watching the stick's shadow (never look directly at the sun). Your azimuth scale can now be set to 180°. By the way, an error of one minute in time is an error of only ¼° in azimuth. ■

Reference

[1] Bowditch, Nathaniel, *American Practical Navigator,* H.O. Publication Number 9, US Government Printing Office, Washington, 1966.

Social Events

CLEARWATER BEACH FL
NOV 19-20

The Florida Gulf Coast Amateur Radio Council is holding its 2nd annual convention on November 19 and 20, 1977 at the Sheraton Sand Key Hotel on Clearwater Beach FL. Official attendance at our last affair was placed in excess of 2200, and this year we expect to double that number as we increase the number of activities and size of the convention. For more information contact: Florida Gulf Coast Amateur Radio Council Inc., PO Box 157, Clearwater FL 33517.

MASSILLON OH
NOV 20

The Massillon ARC 16th Annual Hamfest and Auction will be held Sunday, November 20, 1977, at a new location: Towne Plaza Shopping Center in downtown Massillon, Ohio. Unlimited parking. Major prizes given away. Starts 9 am – admission $1.50 at door. Mobile check-in 146.52 simplex. For brochure and map write to MARC, PO Box 73, Massillon OH 44646.

ELLICOTT CITY MD
NOV 27

The Columbia Amateur Radio Association (CARA) will hold its CARA Hamfest on November 27, 1977, at the Ellicott City Armory in Ellicott City, Maryland. Program includes exhibits, flea market, prizes, and refreshments. All indoors. No tailgating. Talk-in on 147.99/39, 146.16/76, 146.52/52. For more info contact CARA, PO Box 850, Columbia MD 21044.

OAK PARK MI
NOV 27

The Oak Park High School Electronics Club is presenting a Swap and Shop on Thanksgiving Sunday, November 27, 1977, at Oak Park High School, Oak Park, Michigan 48237. Refreshments and door prizes. Donation, $1.00. Table, $1.00.

FORT WAYNE IN
JAN 22

The annual Fort Wayne Winter Hamfest will be held on January 22 at Shiloh Hall, north of Fort Wayne, from 8 am until 4 pm local time. Early parking is available and 28/88 and 52/52 will be monitored. This yearly event is sponsored by the Allen County Amateur Radio Technical Society (AC/ARTS). Admission is $2.00 at the door. Table space is available at $1.50 per half table (about 4 feet).

New Products

from page 168

the vehicle dash panel with the microwave horn "peeping" through the windshield. The power plug simply plugs into the cigarette lighter. It is designed to operate from the 12 volt battery with either positive or negative ground with low power consumption. The electronics is housed in a handsome 5-1/4" x 4" x 3-1/8" high steel cabinet with a black textured finish.

The operator controls are intentionally limited to a single three-position switch with the following functions: 1) system test; 2) radar detection, visual indication only; 3) radar detection, simultaneous audio and visual alarm. The Bird Dog has thus been designed to eliminate the troublesome, and usually unsatisfactory, gain adjustment control knob found on competitive units. The elimination of this gain adjustment also enhances the unit for out-of-sight mounting if the user so desires, such as under the hood with the microwave horn "peeping" through the grille opening.

The unit features a high gain, die-cast, aluminum microwave horn and rf cavity tuned to 10.525 GHz. A pair of microwave diodes are located in the cavity, one for modulation of the continuous rf carrier and the other for detection of the low-level radar signal.

The detector diode drives a low noise, low level, metal package, linear integrated circuit amplifier. The low noise and metal package along with other appropriate filtering and shielding virtually eliminate false triggering from spurious sources. The output circuit consists of a phase locked loop integrated circuit package whose bandwidth is controlled to ±5% of the local oscillator to virtually eliminate any unwanted frequencies beyond the range of the phase locked loop's local oscillator. The output driver drives both an audible buzzer and a red jeweled indicator light.

The kit assembly is simple and no special training is required. The kit can be completely assembled in one evening.

The Bird Dog kit, including a set of detailed plans for construction, sells for $49.95, or, if you prefer, $74.95 for a preassembled and fully tested unit, plus $2.00 for postage and handling. A set of detailed construction plans can be purchased separately for $5.95 and is discounted from your purchase price when you purchase a Bird Dog kit.

The Bird Dog is available through *Micro Electronics, 1921 I-85 South, Charlotte NC 28208, telephone (704) 392-1705.*

The Bird Dog.

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For more information about Model HK-5A, write *Ham Radio Center, Inc., 8340-42 Olive Boulevard, P.O. Box 28271, St. Louis MO 63132,* or call (toll free) 1-800-325-3636.

The Model HK-5A keyer.

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Skytec of Ukiah, California, is offering a loudspeaker unit designed expressly for CW. Employing a unique acoustic chamber resonator, the Skytec CW-1 combines good "single frequency" selectivity with a nice tone shaping characteristic.

By filtering right at the audio output to the room, the unit suppresses hum, hiss, ringing, and miscellaneous noises left in the audio by most receivers. The CW-1 adds a remarkable degree of selectivity to receivers without a sharp electronic filter, and it gives the best of receivers the most pleasant, "just right" tone output and bandpass for long QSOs, net operating, and band scanning, Skytec says.

Priced at $19.95, the 3½" by 6½", 2-pound unit is shipped with a connecting cable. A front switch provides for bypassing the audio to the regular station speaker for other than CW reception. *Skytec, Box 535, Talmage CA 95481.*

The Skytech CW-1.

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Supply voltage 4.5V ~ 9V D.C
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Take advantage of this new state-of-the-art counter featuring the many benefits of custom LSI circuitry. This new technology approach to instrumentation yields enhanced performance, smaller physical size, drastically reduced power consumption (portable battery operation is now practical), dependability, easy assembly and revolutionary lower pricing!
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Includes all parts, PC Board and Transformer
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* 0.5" red LED 6 digits display
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ALL BRAND NEW UNITS
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Supply voltage 9 ~ 15V D.C.
Sensitivity: 100Mv for full output
Total harmonic distortion 1% @ 1 KHz @ 1.5 watt
Output is short circuit protected
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Ideal for Alarm or Tone Indicator
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Built in X'TAL controlled time base. Protected against automotive volt transients. Automatic brightness control with 0.3" green color display. Display turnoff with ignition "OFF".
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Features:

- Frequency Range—100Hz to 30Hz min., resolution 100 Hz
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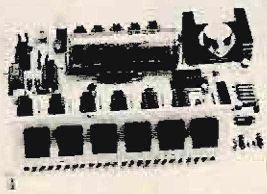

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$54.95

KIT # T-250-30A

KIT INCLUDES: Detailed Instructions (22 pages). All parts including transformer (case not available).

PUT YOUR HAM GEAR OR CB IN YOUR HOUSE WITH THIS SPECIALLY DESIGNED POWER SUPPLY KIT!

A lot of companies offered you this kind of power supply with very poor quality. Either the ripple is too high or the output voltage is not stable. Some of them even made their power supply with a zener diode and a resistor! Nobody has ever considered the safety of your equipment. With our kit, you can be sure of high quality and your equipment is protected against any failure of your power supply by a built in OVP circuit.

KIT INCLUDES: Transformer, PC Board, Large heat sink, Large filtering capacitor and all the parts with detailed instruction.

ONLY $16.95 KIT # T-700

WOW! LOOK AT THIS!

5V 10A Power Supply Kit for your TTL Circuits!

Kit Includes: Extra Large Heat Sink, Power Tr., IC Regulator, P.C. Board, with OVP Circuitry. KIT # T-500 **$11.95**

With Optional ~~Xformer~~, Rectifiers and Filtering Capacitor. **$14.95** (X'former not available)

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6-DIGIT AUTO CLOCK KIT WITH ALARM

Features:

A. Fairchild 0.5" FND 500 Series Display
B. Display Board may be remote
C. X'tal time base
D. P.C. Boards, speaker, IC's and all parts.
E. Detailed Instructions

$19.95 KIT # T-1302

0.8" 4 Digit Jumbo Display Alarm Clock Kit

Features:

A. Fairchild 0.8" FSC8000 Display Array
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C. P.C. Board, Transformer, Speaker and all parts included (less case)
D. Detailed Instructions

THIS IS A BIG ONE!

$19.50

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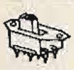

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PUSH BUTTON SWITCH

Red, White, green and yellow 30¢ ea. 4/$1.00

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2¼" X 2¼"

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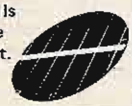

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NPN-General Purpose 30V	10/$1.00
PNP-General Purpose 30V	10/$1.00
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2N3055-150W Power	10/$6.75
2N6059-Darlington Power,	$3.25 ea.

20A HFE 1k Typical

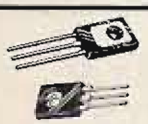
WIRE-WRAP TOOLS from OK

Hobby Wrap - 30 $5.45
Hobby Wrap—Model BW-630 Battery Op. (less batt.) $30.95

OPEN FRAME POWER SUPPLY

5V @ 3A with OVP 115V AC input $17.50

POWER TRANSISTORS



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MOTOROLA MJE2955 PNP
MJE3055 NPN
10 AMP 60 VOLT 90 WATTS
$2.25 PER PAIR

PLASTIC PUSH BUTTON SWITCH

J-188-1	Push On — Push Off
J-188-3	Normally Closed
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0.20"	Red	25¢	10 for $1.75
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Red—Green Colors in one LED with Plastic Housing
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DPDT	On-Off	$1.50 ea.
3PDT	On-Off	$1.75 ea.

Mini-Size Rocker Type also available at the same price

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Fully assembled.
Works on 9~15V D.C.
2 speakers make it work.
With Schematic
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1μ 10V	.15
3.3μ 35V	.20
10μ 50V	.35
22μ 35V	.25

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MM5375AA $4.25 MM5375AE $4.25

60 Hz Time Base IC MM5369 $1.95

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Commercial Single Turn 2K 3305P
$1.25 ea. 10/$10.00
Cermet Mil. Spec. Multi-Turn 1K & 2K RJ24CX
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10-40p Mini Capacitance Trimmer
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AN214-4.5W Power IC with spec. Supply voltage = 13V	$2.95 ea.
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Features:

Custom computer grade commercial components, capacitors, and tube sockets manufactured especially for high power use—heavy duty 10Kw silver plated ceramic band switches • Silver plated copper tubing tank coil • Huge 4" easy to read meters—measure plate current, high voltage, grid current, and relative RF output • Continuous duty power supply built in • State of the art zener diode standby and operating bias provides reduced idling current and greater output efficiency • Built in hum free DC heavy duty antenna change-over relays • AC input 110V or 220V AC, 50-60Hz • Tuned input circuits • ALC-rear panel connections for ALC output to exciter and for relay control • Double internal shielding of all RF enclosures • Heavy duty chassis and cabinet construction and much, much more.

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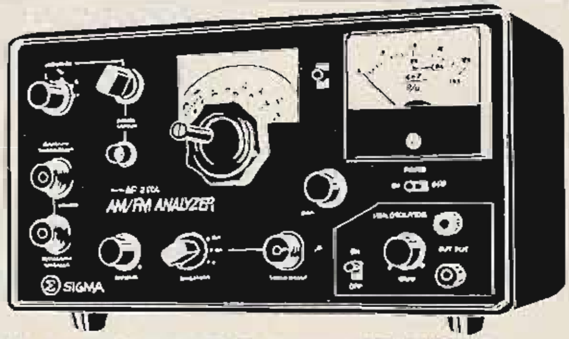
- Heavy duty commercial grade quality and construction second to no other unit at any price!
- Weight: 90 lbs. Size: 9½" (h) x 16" (w) x 15¾" (d).

HOLIDAY INTRODUCTORY SPECIAL!

New! Sigma Model AF250L Deviation/Modulation Meter



Introductory Price

$169

Features:

Extremely stable local oscillator for easy measurement of HF, VHF, and UHF bands employing negative feedback, to insure extremely high stability • Easy to read, accurate linear scale • Direct off the air signal measurement capability.

Specifications:

Frequency: 1.8MHZ-520MHZ/3 range select (A, B, C, EXT), A range: 26.5 MHZ-40MHZ, B range: 48MHZ-60MHZ, C range: 140MHZ-156MHZ, EXT. range: 1.8MHZ-520MHZ (Need Signal Generator) • Generous overranges • Input level: (1) Through type input level: IW-200W (RF Input Terminal), (2) Direct input level: More than 80db/50ohm impedance • Amplitude modulation degree: 0-100% • Frequency deviation: 0-20KHZ • Accuracy: +/-3% of full scale • Intermediate frequency: 10.7MHZ • Local input frequency (EXT Range) • Measuring frequency +/-10.7MHZ • RF Attenuator: 0-60db variable • Audio signal oscillator: (1) Audio Frequency—1,000HZ (1 KHZ), (2) Output level—More than 1V RMS • Power Source: AC117V • Dimensions: H-5½" (140mm), W-10¼" (260mm), D-7¼" (184mm) • Weight: 7 lbs.

$29

Introductory Price

Sigma RF-2000 SWR & Power Meter

NEW CDE HAM III ROTATORS— Reg. $159.95—$125

Cal PWR Scales 200W-2000W Freq Range 3.5-150 MHz Please do not confuse the RF2000 with similar appearing lower priced units. RF2000 is an individually calibrated professional quality instrument. Unequaled at many times the price. Size 7" (w) x 2½" (h) x 2⅓" (d).

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FMPS-4B	Regulated AC PS	$49
FMTP-1	Touch Tone Pad	$59
FMTP-2	Touch Tone Pad with 80 Number Programmable Memory	$99
FMMC-1	Microphone with Built-in Touch Tone Pad	$69
FMTC-1	Private Call Decoder for use with and Programmed by Any Touch Tone Pad	$75
SC-32A	Audible Tone Encoder Decoder	$55
FMSC-1	Scanner—Random, Any Range	$99
FMSC-2	Scanner—Programmable 14 Channels	$65
MARS CAP	Option Kit—Any Frequency, Any Split	$1?
FMOF-1	Offset Option Kit—2 Extra Positions, Crystals Required	$10
FMOF-2	±1 MHz Offset Option Kit (No Crystals To Buy)	$10
FMTE-1	Sub Audible Tone (100 Hz-Adjustable 67-203 Hz)	$15
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Standard New 2 Meter FM Transceivers Model SRC 146A Special Sale

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NEW!!! Touch Tone pad completely wired and ready to plug in-$69.00

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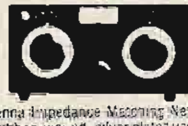
New! Nye Viking Model MB-11 3,000 Watts



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Antenna Impedance Matching Network. Copper ribbon-wound, silver plated variable inductor. Heavy duty 7000 volt variable output capacitor. 10,000 volt fixed capacitors. Silver plated RF conductors. Large precision, easy-to-read dials. 360° readout. Overload protection for SWR meter.

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12" Video Monitor

This solid state monitor will display 80 characters x 16 lines for a total of 1,280 characters. These are ready to attach to your computer or CCTV. Operates on 115VAC, video input to 75 ohm, SO-239 co-ax connector. Qty. Ltd. Used and guarenteed. Sh. Wt. 35 Lbs.
7HU70398 . . . . $68.88 each

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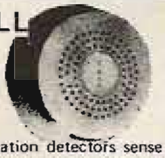

Dual chamber ionization detectors sense tiny air-borne particles of combustion in a fire's earliest stage - even before there's smoke. Operates on 115VAC, UL listed.
Sh. Wt. 3 Lbs. . . 7MI70349 . . . $24.88

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Large 2-3/8" square see-thru plastic covered meters. External resistor req. Super!
Sh. Wt. 8 oz. . . 7W70343 . . . $2.00 ea.

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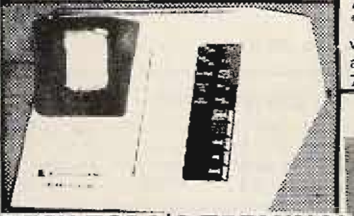
Converts any standard TV into a computer monitor. This self-contained RF oscillator & modulator allows easy interface of any video output device to a standard TV set. This kit was part of a video game, and contains its own power supply. With instructions & data.
Sh. Wt. 3 Lbs. . . .7ZU70213 . . . $7.88
7 for $48.00. . . 7ZU70213 . . $48.00/7



DESK-TOP I/O TERMINAL

At one time these data terminals were used by stock brokers for keeping track of stock quotations. They tied in to a central system which has now been updated, leaving these surplus units behind.

Use this unit as a basis for building your own computer input/output station or to build a compact scope . . . or simply take it apart for the components within.

Sold complete or in parts, prices and descriptions listed below:

† 3" CRT, with Hi-volt. supply (+3315 vdc; −1730 vdc), and low-volt. supply +440V; +225V; +125V; +28V; +1.2V; +0.6V; 6.3VDC; 6.3VAC. Also - ramp generator card & some drive circuits (15 Lbs.) $17.50
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† COMPLETE UNIT Sh. Wt. 35 Lbs.
6NB60336 . . . . $29.95
† Also available is a complete tech. manual covering operating procedure, theory disassembly (& reassembly), trouble-shooting techniques and schematics.
With complete unit - $1.00 or sold separately for $3.50 each. Sh. Wt. 8 oz.
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Specify part, use order no. 6NB60336

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SUPER SURPLUS SAVINGS!

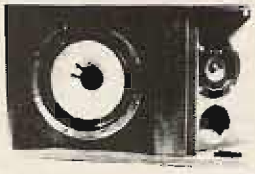
Build your own and save! These kits are made up of quality components intended for use by a big-name mfr. (who we can't mention). Over $2-million in inventories were closed out! His loss your gain! Kits are 1st quality, all U.S. made. Cabinets are vinyl-clad with pre-cut holes, grill cloth is included. Perfect for those do-it-yourself-ers! Two types of kits available:

SPEAKER SYSTEMS KIT No. 1 Our deluxe model . . .

Super cabinets, size 21x12x8". Includes 8" woofers w/whizzer; 4" dome tweeters; crossovers; damping; hardware & instructions. Systems sells for $198 if bought ready-to-go, B&F kit price only $69.95 per pair. Quality need not be costly!
7ZU70283 . . . .(45 Lbs.) . . . $69.95/pr.
Kit No. 1/CABINETS Only (45 Lbs.)
7OB70197 . . . .$25.00/pair

SPEAKER SYSTEMS KIT No. 2

Fantastic cabinets designed for direct dispersion of high frequency sounds and wide dispersion of bass tones. Size: 17x 10½x9½". Sold with 8" woofers, 4" dome tweeters, crossovers & instructions.
7ZU70242 . . . (35 Lbs.) . . . $49.50/pair
Kit No. 2/CABINETS Only (25 Lbs.)
7OB70200 . . . . $25.00/pair



More SPEAKERS & COMPONENTS . . . are available through our catalog!

Line Printer

Computer surplus close-out on Singer-Friden Md. 52 line printer. 100 lines per minute with 132 characters per line max. The printer is connected to a system computer through an input/output channel and may be located up to 2,000 wire-feet from computer using a 2-wire line. Uses standard continuous paper forms, with up to 5 copies and 1 original. Power: 115V, 60 Hz; 6 amps. Size: 30"W x 27"Dp x 38"H.

These units were working & going units when taken out of service. Shipped only on an "AS IS" basis. You should be able to put these on line with a minimum of work, and then you have a $3,600 line printer working for you at less than 1/5 the cost. Shipped via truck freight collect to you, F.O.B. Peabody, Ma. 01960.
7SF70298 . . . . $650.00
DATA MANUALS, while they last . . .
7SF70298-M $45.00
**Also available are a few damaged units, which have broken glass covers. Damage appears to be cosmetics only. Save $100.
7SF70299 . . . . $550.00

Singer-Friden Md. 52 Line Printer

Key-to-Tape Recorder

Singer/Pertec systems with display station, keyboard, 7 track magnetic data recorder, controller, etc. Singer closes out its computer products division and these unit become surplus! Their loss ($460x10⁶) is your gain . . . you can buy this super recorder for pennies on a dollar. They are late design models of recent mfg., and are still being serviced with backup. Unit has internal memory/buffer for 80 or 200 character storage. Units show character, character no., and record no. Read back circuits allows search on record key, editing, duplicating, etc. Units were working when taken out of service and are complete & ready-to-go, but may require minor adjustments. Sold on an "AS IS" basis only. Manuals not supplied with unit, available separately. Size: 19"H x 21¼"W x 19½"D. Tape not supplied.

We have 2 types available:

Md. 4301-7 7-track Data Recorder, our catalog no. 7SF70296 . . . . $218.88
Complete Manual .7SF70296-M .$28.50
Md. 4311-7 7-track Data Recorder with remote data communication channel, our catalog no. 7SF70297 . . . . $248.88
Complete Manual .7SF70297-M .$28.50
(Manuals weigh 3 Lbs.)

All Magnetic Tape Data Recorders are shipped via truck, freight collect to you. Customer pays shipping.

PLASTIC CABLE CLIPS

Unique 12" strip, self-stick backing, ¼" high. Use whole or cut into smaller parts to give up to 24 - ½" cable clips. Handy!
Sh. Wt. 8 oz. . 7K70354 . $1.25/2 strips

OTHER SINGER/FRIDEN MACHINES ARE AVAILABLE SEND FOR CATALOG

POSTAGE: Please add sufficient funds for postage and insurance. Shipping weight for merchandise is listed at the end of each product description. All shipping is from Peabody, Ma. 01960.

Mass. Residents Add 5% Sales Tax.

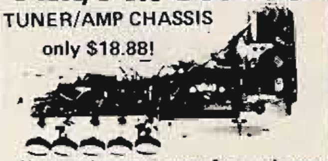
SEND FOR OUR FREE CATALOG!
Or, receive our catalog in an order and insure yourself of a place on our mailing list

PHONE ORDERS WELCOME!
Bank Americard, Master Charge and American Express Accepted.
Phone: (617) 531-5774 / 532-2323
$10.00 Minimum on Charge Orders

B&F ENTERPRISES
Dept. "S"
119 FOSTER STREET
PEABODY, MASS. 01960
(617) 531-5774/532-2323

B&F

AM/FM stereo TUNER/AMP CHASSIS only $18.88!



New surplus stereo tuner & amp, 4 watts RMS per channel. Super-slim unit measures only 2¼"H x 12½"L x 8"D. Controls include bal., tone, vol.-on/off, AM/FM/FM stereo AFC/Aux. selector and tuning. Dial has red needle and black face with no markings. Sh. Wt. 6 Lbs.
7HU70397. . . . . $18.88 each

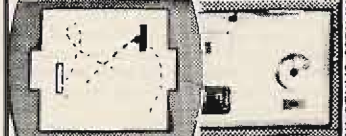
LOGIC & OP AMP POWER SUPPLY

Surplus from a computer phone. Power supply is regulated, input of 115V 60Hz., outputs of ±12V @ .125A, +5V @ .75A. Uses (3) 723 voltage regulator IC's for regulation. Open frame type. Qty. Ltd. Size: 7.2"L x 5.6"W x 2"H. New.
Sh. Wt. 5 Lbs. . . 7MI70353 . . . $13.50
3 for $38.88. . . 7MI70353 . . $38.88/3

10 to 24 VDC, 2 Amp POWER SUPPLY KIT GREAT FOR CB's!

A complete kit which puts out 10 to 24 VDC at 2 amps, regulated, 115 VAC in. Can be wired for contant 13.8VDC, ideal & compact for C.B. Kit includes PC card, components and instructions . . just add your own case. Super as a bench supply!
Sh. Wt. 6 Lbs. . . .6C60498. . . . $14.88

4 in 1 TV GAME With JOYSTICK CONTROLS



Hockey-Soccer/Novice-Expert. Features a hockey mode in which players skate up, down and accross the ice using the joystick, with the ability to "catch" the puck and "shoot" for goals with another control. A real challenge for all players. LED readouts show score, operates on 115V 60Hz. Never at this low price!
Sh. Wt. 5 Lbs. . . 7HU70284 . . . $22.50
5 for $100.00. . 7HU70284 . $100.00/5

JOYSTICKS Two 10K POT'S

Super for X-Y functions: audio, computer, remote control, graphics, etc. Sh. Wt. 8 oz.
7J70163 . . . . . . $4.95

Joystick: Four 100K Pot's; by ALPS
The best controls on the market. . . 8 oz.
7J70293 . . . . $5.95 ea

RADIOSONDE with SENSORS

This radiosonde is used by meteorologists for upper atmosphere studies of pressure, temperature & humidity. Package has temp. sensor, hygistor, barograph, etc. Tinkerer's delight - lots of gadgets!
Sh. Wt. 1 Lb . . . 7F70364. . . . $5.00

SEISMIC SENSOR/XMITTER

A what?! This unique looking & operational intruder detector/xmitter was used by the U.S. army to detect troop movements. It looks like a rock or glob of mud, but contains: a trasmitter with a range of 300 meters that sends out coded pulses on 150 MHz; a built-in dipole antenna; seismic sensor; & 3 mercury cells. Weighs about 1 ounce, measures less than 2" across. Fantastic! Sh. Wt. 3 oz.
7MI70365 . . . $4.00 ea . . . $10.00 for 3

TELEPHONE ORDERS WELCOME! CREDIT CARDS ACCEPTED - MASTER CHARGE, BANK AMERICARD AND AMERICAN EXPRESS CARDS WELCOME: CALL US (617) 531-5774 / 532-2323 CIRCLE THE READER SERVICE CARD FOR OUR CATALOG!

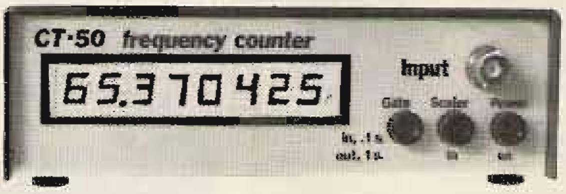
PHONE ORDERS WELCOME! — (617) 531-5774/532-2323 — BANKAMERICARD / MASTER CHARGE / AMERICAN EXPRESS CARDS ACCEPTED

B4

NEW

Frequency Counter

$79.95 kit



UTILIZES NEW MOS-LSI CIRCUITRY

You've requested it, and now it's here! The CT-50 frequency counter kit has more features than counters selling for twice the price. Measuring frequency is now as easy as pushing a button, the CT-50 will automatically place the decimal point in all modes, giving you quick, reliable readings. Want to use the CT-50 mobile? No problem, it runs equally as well on 12 V dc as it does on 110 V ac. Want super accuracy? The CT-50 uses the popular TV color burst freq. of 3.579545 MHz for time base. Tap off a color TV with our adapter and get ultra accuracy — .001 ppm! The CT-50 offers professional quality at the unheard of price of $79.95. Order yours today!

CT-50, 60 MHz counter kit $79.95
CT-50 WT, 60 MHz counter, wired and tested 159.95
CT-600, 600 MHz prescaler option for CT-50, add 29.95

SPECIFICATIONS

Sensitivity: less than 25 mv.
Frequency range: 5 Hz to 60 MHz, typically 65 MHz
Gatetime: 1 second, 1/10 second, with automatic decimal point positioning on both direct and prescale
Display: 8 digit red LED .4" height
Accuracy: 10 ppm, .001 ppm with TV time base!
Input: BNC, 1 megohm direct, 50 Ohm with prescale option
Power: 110 V ac 5 Watts or 12 V dc @ 1 Amp
Size: Approx. 6" x 4" x 2", high quality aluminum case

Color burst adapter for .001 ppm accuracy
CB-1, kit $14.95

CLOCK KIT
6 digit 12/24 hour

Want a clock that looks good enough for your living room? Forget the competitor's kludges and try one of ours! Features: jumbo .4" digits, Polaroid lens filter, extruded aluminum case available in 5 colors, quality PC boards and super instructions. All parts are included, no extras to buy. Fully guaranteed. One to two hour assembly time. Colors: silver, gold, black, bronze, blue (specify).

Clock kit, DC-5 . . . . $22.95
Alarm clock, DC-8, 12 hr only 24.95
Mobile clock, DC-7 . . . . 25.95
Clock kit with 10 min ID timer, DC-10 . . . 25.95
Assembled and tested clocks available, add $10.00

VIDEO TERMINAL KIT $149.95

A compact 8 x 10 inch PC card that requires only an ASCII keyboard and a TV set to become a complete interactive terminal for connection to your microprocessor asynchronous interface. Its many features are single 5-volt supply, crystal controlled sync and baud rates (up to 9600 baud), 2 pages of 32 characters by 16 lines, read to and from memory, computer and keyboard operated cursor and page control, parity error display and control, power-on initialization, full 64-character ASCII display, block type see-thru cursor. Keyboard/computer control backspaces, forward spaces, line feeds, rev. line feeds, home, returns cursor. Also clears page, clears to end of line, selects page 1 or 2, reads from or to memory. The card requires 5 volts at approx. 900 ma and outputs standard 75 ohm composite video.

TH3216 Kit . . . $149.95
TH3216, Assembled and Tested . . . 239.95
VD 1, Video to RF Modulator Kit . . . 6.95

CAR CLOCK KIT $27.95

12/24 Hour 12 Volt AC or DC
- High Accuracy (1 minute/month)
- 6 jumbo .4" LED readouts
- Easy, no polarity hookup
- Display blanks with ignition
- Case, mounting bracket included
- Super instructions

Complete Kit, DC 11 . . . $27.95

AUTO-DIMMER $2.50

Automatically adjusts display brightness according to ambient light level For DC 11 Car Clock.

MINI-KITS

TONE DECODER KIT

A complete tone decoder on a single PC Board. Features: 400-5000 Hz adjustable frequency range, voltage regulation, 567 IC. Useful for touch-tone decoding, tone burst detection, FSK demod, signaling, and many other uses. Use 7 for 12 button touchtone decoding. Runs on 5 to 12 volts.
Complete Kit, TD-1 . . . . $4.95

SUPER-SNOOP AMPLIFIER

A super-sensitive amplifier which will pick up a pin drop at 15 feet! Great for monitoring baby's room or as a general purpose test amplifier. Full 2 watts of output, runs on 6 to 12 volts, uses any type of mike. Requires 8-45 ohm speaker.
Complete Kit, BN-9 . . . . $4.95

FM WIRELESS MIKE KIT

Transmit up to 300' to any FM broadcast radio, uses any type of mike. Runs on 3 to 9 V. Type FM-2 has added super sensitive mike preamp.
FM-1 . . . . . . $2.95 FM-2 . . . . . . $4.95

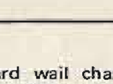
COLOR ORGAN/MUSIC LIGHTS

See music come alive! 3 different lights flicker with music or voice. One light for lows, one for the mid-range and one for the highs. Each channel individually adjustable, and drives up to 300 watts. Great for parties, band music, nite clubs and more.
Complete Kit, ML-1 . . . . $7.95

LED BLINKY KIT

A great attention getter which alternately flashes 2 Jumbo LEDs. Use for name badges, buttons, or warning type panel lights. Runs on 3 to 9 volts.
Complete Kit $2.95

POWER SUPPLY KIT



Complete triple regulated power supply provides variable ±15 volts at 200 mA and +5 volts at 1 Amp. 50 mV load regulation good filtering and small size. Kit less transformers. Requires 6-8 V at 1 Amp and 18 to 30 VCT.
Complete Kit, PS-3LT $6.95

SIREN KIT

Produces upward and downward wail characteristic of police siren. 5 watts audio output, runs on 3-9 volts, uses 8-45 ohm speaker.
Complete Kit, SM-3 . . . . $2.95

DECADE COUNTER PARTS

Includes: 7490A, 7475, 7447, LED readout, current limit resistors, and instructions on an easy to build low cost frequency counter.
Kit of parts, DCU-1 . . . . $3.50

CHEAP CLOCK KIT $8.95

DC-4 Features:	Does not	PC Board
• 6 digit .4" LED	include board	$2.95
• 12 or 24 format	or transformer	Transformer $1.49

600 MHz PRESCALER

Extend the range of your counter to 600 MHz. Works with all counters. Less than 150 mv sensitivity. Specify ÷10 or ÷100
Wired, tested, PS-1B $59.95
Kit, PS-1B $44.95

30 watt 2 meter Power Amp

The famous RE class C power amp now available mail order! Four Watts in for 30 Watts out, 2 in for 15 out, 1 in for 8 out, incredible value, complete with all parts, instructions and details on T-R relay. Case not included.
Complete Kit, PA-1 . . . . $22.95

CALENDAR ALARM CLOCK

Has every feature one could ever ask for. Kit includes everything except case, build it into wall, station or even car!
FEATURES:
- 6 Digits, .5" High LED
- 12/24 Hour Format
- Calendar shows mo./day
- Snooze button
- True 24 Hour Alarm
- 7001 chip does all!!
- Battery back up with built in on chip time base

Complete Kit, less case, DC-9 . . . . $34.95

		LINEAR		REGULATOR		TRANSISTORS	
5314 Clock	$2.95	555	$ .50	78MG	$1.49	MRF-238 30W VHF	$11.95
74S00	.35	556	.75	309k	.89	NPN 2N3904 type	10/$1.00
74S112	.75	566	1.49	309H	.99	PNP 2N3906 type	10/$1.00
7447	.79	567	1.49	340K 12	.99	NPN Power Tab 40W	3/$1.00
7473	.35	1458	.50	7805	.89	PNP Power Tab 40W	3/$1.00
7475	.50	LED DRIVER		7812	.89	FET MPF-102 type	3/$2.00
7490A	.55	75491	.50	7815	.89	UJT 2N2646 type	3/$2.00
74143	3.50	75492	.50	7818	.89	2N3055 NPN Power	.75

SPECIAL

DIODES: 1KV,2.5A . . . . 5/$1.00 100V,1A . . . . 10/$1.00 1N914A type . . . . 50/$2.00

LED DISPLAYS

FND 359 75
FND 510 . . . . . . 1.25
DL 707 . . . . . . 1.25
HP 7730 . . . . . . 1.25
Red Polaroid Filter . . . 4.25" X 1.125" 59

741 OP-AMP SPECIAL
Factory prime mini dip with both Xerox and 741 part numbers
10 for $2.00

SOCKETS

14 PIN	5/$1.00
16 PIN	5/$1.00
24 PIN	2/$1.00
40 PIN	3/$2.00

FERRITE BEADS
with info and specs
15/$1.00
6 hole Balun Beads
5/$1.00

ramsey electronics
P.O. Box 4072 Rochester NY 14610
(716) 271-6487

TELEPHONE ORDERS WELCOME

master charge BANKAMERICARD

Satisfaction guaranteed or money refunded. COD, add $1.00. Orders under $10.00 add $.75. NY residents add 7% tax.

BULLET ELECTRONICS

P. O. BOX 19442E
DALLAS, TEXAS 75219
(214) 823-3240

PHONE ORDERS ON MASTERCHARGE OR VISA CARDS

B8

New! PS-14 HIGH CURRENT REGULATED POWER SUPPLY KIT

A low cost, no frills, heavy duty power supply. Designed for use and abuse!

12V @ 15A

Less Case, meters & jacks

- Better than 200MV load & line regulation
- Foldback Current Limiting
- Short Circuit Protected
- Thermal Shutdown
- Adjustable Current Limiting
- Less than 1% ripple.
- 15 amps 11.5 to 14.5V
- All parts supplied including heavy duty transformer.
- Quality plated fiberglass PC board.

$39.95
UPS SHIPPING PAID!

PS–12: SAME AS ABOVE BUT VARIABLE OVER 3–30 VDC IN 2 RANGES. $49.95
(without thermal shutdown)

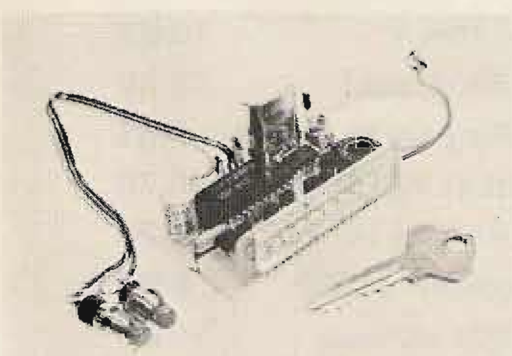
A COMPLETE CAPACITOR DISCHARGE IGNITION KIT for **$9.95**

You get all the electronics less the case and heat-sinks.

SPECIAL SALE! The response to our anniversary sale on CDI's was fantastic so here goes again...WHILE THEY LAST...Buy two CDI kits for $9.95 each, get the third CDI kit for $1.00!

MK-05 MINI MOBILE CLOCK

The smallest and best priced mobile clock kit on the market. Designed to be a mobile clock from the ground up. There has been no compromise on quality.



FEATURES:
* Quartz crystal timebase
* Toroid & zener noise & overvoltage protection.
* Magnified .15", 6 digit LED readout.
* Complete with presettable 24 hr. alarm.
* 9–14 VDC @ 40 to 50 ma.
* Readouts can be suppressed
* EASY, QUICK ASSEMBLY
* All components required included (you supply the speaker).
* Top quality drilled and plated PC boards.
  Clock board: 2.6" x 2"
  Readout board: 2 3/8" x .75"

$12.95

With punched front aluminum case – $15.95

Small enough to mount in the instrument panel!

SPECIAL! METERS

LARGE, QUALITY 3½ RECTANGULAR METERS AVAILABLE FOR USE WITH OUR POWER SUPPLIES. DIAL CAN BE BACK LIGHTED. INDIVIDUALLY PACKAGED WITH MOUNTING HARDWARE. NEW DESIGN REQUIRES MUCH SMALLER CUTOUT THAN STANDARD METERS.

0–15V DC 7.16	0–15 ADC 7.16
0–25V DC 7.05	0–25 ADC 7.05

DEDUCT 10% IF ORDERED WITH PS 14 OR PS 12 POWER SUPPLY.

OVERVOLTAGE PROTECTION KIT

Provides cheap insurance for your expensive equipment. Trip voltage is adjustable from 3 to 30 volts. Overvoltage instantly fires a 25A SCR and shorts the output to protect equipment. Should be used on units that are fused. Directly compatible with the PS-12 and PS-14. All electronics supplied. Drilled and plated PC board. (Order OVP-1)

$6.95

2N6283 MOTOROLA HOUSE # DEVICE

$1.00

20amp NPN Darlington with Hfe of over 5,000! VCE of 80V. Outperforms MJ3001 and MJ1000 devices.-TO-3. Limited Qty.!

Free Money $$ Free Money

Starting October 1, 1977, each Bullet catalog will be stamped with a different special code number that will be placed in a monthly drawing. The monthly prize will be **$100.00 in cash!** The winning number will be announced each month in this ad and the winner will have until the 20th of the month to claim the money. *No purchase necessary. Catalogs are available free upon request. All orders receive a catalog.* **Watch for your Lucky Number!**

Ribbon Cable

Multi Colored Standard

26 conductors of no. 28 standard wire with a woven binder for easy separation. Super flexibility. For computers, and other projects.
10' ROLL 2.95
50' ROLL 9.95

No. 30 gauge silver plated wire wrap wire with Kynar® jacket. 500ft. 5.95

MINI ELECTRONIC GRANDFATHER CLOCK KIT

Complete Electronics!
* Chimes the hour (ie: 3 times for 3 O'clock)
* Unique "swinging" LED pendulum
* Tick tock sound matches pendulum swing.
* Large 4 digit .5" LED readout
* All CMOS construction
* Complete electronics including transformer & speaker; drilled and plated PC boards measure 4.5" x 6.5"

$39.95

BEAUTIFUL SOLID WALNUT

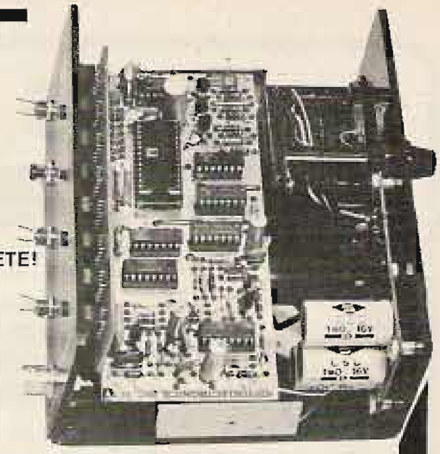
Custom case for above kit. Over 9¾" tall. **$19.95**

* No COD'S.
* Send check or MO
* MasterCharge or VISA accepted.
* Texas Residents add 5% sales tax.
* Foreign orders add 10% (20% airmail)
* Catalog included with each order
* Orders over $50. take 10% discount.

SPECIAL — All phone orders over $10. from this ad will receive a FREE Warble Alarm Kit ($2.50 value). PHONE ORDERS ONLY!

NEW LSI TECHNOLOGY

FREQUENCY COUNTER



TAKE ADVANTAGE OF THIS NEW STATE-OF-THE-ART COUNTER FEATURING THE MANY BENEFITS OF CUSTOM LSI CIRCUITRY. THIS NEW TECHNOLOGY APPROACH TO INSTRUMENTATION YIELDS ENHANCED PERFORMANCE, SMALLER PHYSICAL SIZE, DRASTICALLY REDUCED POWER CONSUMPTION [PORTABLE BATTERY OPERATION IS NOW PRACTICAL], DEPENDABILITY, EASY ASSEMBLY AND REVOLUTIONARY LOWER PRICING!

KIT #FC-50C	60 MHZ	COUNTER WITH CABINET & P.S.	$119.95 COMPLETE!
KIT #PSL-650	650 MHZ	PRESCALER [NOT SHOWN]	29.95
MODEL #FC-50WT	60 MHZ	COUNTER WIRED, TESTED & CAL.	165.95
MODEL #FC-50/600 WT	600 MHZ	COUNTER WIRED, TESTED & CAL.	199.95

SIZE:
3" High
6" Wide
5½" Deep

FEATURES AND SPECIFICATIONS:

DISPLAY: 8 RED LED DIGITS .4" CHARACTER HEIGHT
GATE TIMES: 1 SECOND AND 1/10 SECOND
PRESCALER WILL FIT INSIDE COUNTER CABINET
RESOLUTION: 1 HZ AT 1 SECOND, 10 HZ AT 1/10 SECOND.
FREQUENCY RANGE: 10 HZ TO 60 MHZ. [65 MHZ TYPICAL].
SENSITIVITY: 10 MV RMS TO 50 MHZ, 20 MV RMS TO 60 MHZ TYP.
INPUT IMPEDANCE: 1 MEGOHM AND 20 PF.
[DIODE PROTECTED INPUT FOR OVER VOLTAGE PROTECTION.]
ACCURACY: ± 1 PPM [± .0001%]; AFTER CALIBRATION TYPICAL.
STABILITY: WITHIN 1 PPM PER HOUR AFTER WARM UP [.001% XTAL]
IC PACKAGE COUNT: 8 [ALL SOCKETED]
INTERNAL POWER SUPPLY: 5 V DC REGULATED.
INPUT POWER REQUIRED: 8-12 VDC OR 115 VAC AT 50/60 HZ.
POWER CONSUMPTION: 4 WATTS

KIT #FC-50C IS COMPLETE WITH PREDRILLED CHASSIS ALL HARDWARE AND STEP-BY-STEP INSTRUCTIONS. WIRED & TESTED UNITS ARE CALIBRATED AND GUARANTEED.

PLEXIGLAS CABINETS

Great for Clocks or any LED Digital project. Clear-Red Chassis serves as Bezel to increase contrast of digital displays.

CABINET I 3"H, 6¼"W, 5½"D

CABINET II 2½"H, 5"W, 4"D

Black, White or Clear Cover

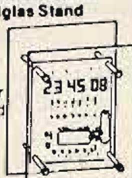
$6.50 ea.

RED OR GREY PLEXIGLAS FOR DIGITAL BEZELS 3"x6"x1/8" 95¢ ea. 4/$3

SEE THE WORKS Clock Kit

Clear Plexiglas Stand

- 6 Big .4" digits
- 12 or 24 hr. time
- 3 set switches
- Plug transformer
- all parts included



Plexiglas is Pre-cut & drilled

Kit #850-4CP

Size: 6"H, 4⅓"W, 3"D

$23.50 ea. 2/$45. Assembled $29.95

60 HZ. XTAL TIME BASE

Will enable Digital Clock Kits or Clock-Calendar Kits to operate from 12V DC. 1"x2" PC Board Power Req.: 5-15V (2.5 MA. TYP.) Easy 3 wire hookup Accuracy: ± 2PPM

#TB-1 (Adjustable)

Complete Kit $4.95

Wir & Cal $9.95

SPECIAL PRICING!

PRIME - HIGH SPEED RAM

21L02-3 400 NS

LOW POWER - FACTORY FRESH

1-24	$1.75 ea.	100-199	$1.45 ea.
25-99	1.60 ea.	200-999	1.39 ea.

1000 AND OVER $1.29 ea.

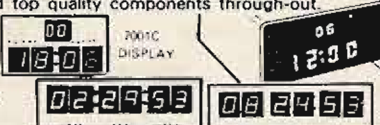
6-DIGIT LED CLOCK CALENDAR KIT

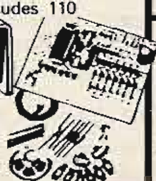
DATE-TIME-SNOOZE ALARM & MORE... KIT 7001

FOR THE BUILDER THAT WANTS THE BEST. FEATURING 12 OR 24 HOUR TIME — 29-30-31 DAY CALENDAR. ALARM. SNOOZE AND AUX. TIMER CIRCUITS

Will alternate time (8 seconds) and date (2 seconds) or may be wired for time or date display only, with other functions on demand. Has built-in oscillator for battery back-up. A loud 24 hour alarm with a repeatable 10 minute snooze alarm, alarm set & timer set indicators. Includes 110 VAC/60Hz power pack with cord and top quality components through-out.

KIT-7001B WITH 6-.5" DIGITS $39.95
KIT-7001C WITH 4-.6" DIGITS & 2-.3" DIGITS FOR SECONDS $42.95
KIT-7001X WITH 6-.6" DIGITS $45.95





KITS ARE COMPLETE (LESS CABINET)

ALL 7001 KITS FIT CABINET I AND ACCEPT QUARTZ CRYSTAL TIME BASE KIT #TB-1

JUMBO DIGIT CLOCK

A complete Kit (less Cabinet) featuring: six .5" digits, MM5314 IC 12/24 Hr. time, PC Boards, Transformer, Line Cord, Switches and all Parts. Ideal Fit in Cabinet II

Kit #5314-5 $19.95 2/$38.

JUMBO DIGIT CONVERSTION KIT $9.95 ea.

Convert small digit LED clock to large .5" displays. Kit includes 6 - LED's, Multiplex PC Board & Hook up info.

Kit #JD-1CC For Common Cathode
Kit #JD-1CA For Common Anode

PRINTED CIRCUIT BOARDS for CT-7001 Kits sold separately with assembly info PC Boards are drilled Fiberglass, solder plated and screened with component layout

Specify for 7001 B, C or X - $7.95

MOBILE LED CLOCK

12/24 HR .4" DIGITS!

MODEL #2001

12 VOLT AC or DC POWERED

- 6 JUMBO .4" RED LED'S BEHIND RED FILTER LENS WITH CHROME RIM
- SET TIME FROM FRONT VIA HIDDEN SWITCHES • 12/24-Hr. TIME FORMAT
- STYLISH CHARCOAL GRAY CASE OF MOLDED HIGH TEMP. PLASTIC
- BRIDGE POWER INPUT CIRCUITRY — TWO WIRE NO POLARITY HOOK-UP
- OPTIONAL CONNECTION TO BLANK DISPLAY [Use When Key Off in Car, Etc.]
- TOP QUALITY PC BOARDS & COMPONENTS - INSTRUCTIONS.
- MOUNTING BRACKET INCLUDED

KIT #2001 COMPLETE KIT $27.95 EA. 3 OR MORE $25.95 ea.

115 VAC Power Pack #AC-1 $2.50 EA.

ASSEMBLED UNITS WIRED & TESTED ORDER #2001 WT [LESS 9V. BATTERY] Wired for 12-Hr. Op. if not otherwise specified. $37.95 EA. 3 OR MORE $35.95 ea.

AUTO BURGLAR ALARM KIT

AN EASY TO ASSEMBLE AND EASY TO INSTALL ALARM PROVIDING MANY FEATURES NOT NORMALLY FOUND. KEYLESS ALARM HAS PROVISION FOR POS & GROUNDING SWITCHES OR SENSORS. WILL PULSE HORN RELAY AT 1HZ RATE OR DRIVE SIREN. KIT PROVIDES PROGRAMMABLE TIME DELAYS FOR EXIT, ENTRY & ALARM PERIOD. UNIT MOUNTS UNDER DASH - REMOTE SWITCH CAN BE MOUNTED WHERE DESIRED. CMOS RELIABILITY RESISTS FALSE ALARMS & PROVIDES FOR ULTRA DEPENDABLE ALARM. DO NOT BE FOOLED BY LOW PRICES! THIS IS A TOP QUALITY COMPLETE KIT WITH ALL PARTS INCLUDING DETAILED DRAWINGS AND INSTRUCTIONS. OR AVAILABLE WIRED AND TESTED

KIT #ALR-1 $9.95

#ALR-1WT WIRED & TESTED $19.95

VARIABLE REGULATED 1 AMP POWER SUPPLY KIT

- VARIABLE FROM 4 to 14V
- SHORT CIRCUIT PROOF
- 723 IC REGULATOR
- 2N3055 PASS TRANSISTOR
- CURRENT LIMITING AT 1 Amp

KIT IS COMPLETE INCLUDING DRILLED & SOLDER PLATED FIBERGLASS PC BOARD AND ALL PARTS (Less TRANSFORMER) KIT #PS-01 $8.95

TRANSFORMER 24V CT will provide 300MA at 12V and 1 Amp at 5V. $3.50

OPTOELECTRONICS, INC.

BOX 219 HOLLYWOOD, FLA. 33022
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O3

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master charge
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D.R.C. ELECTRONICS

1 AMP RECTIFIERS
House Numbered. Factory marked units. All meet 200 PIV minimum. Many up to 1,000 PIV.
30 FOR $1
Full Leads.

RCA HOUSE #2N3772
NPN Power Transistor. 30 AMP. 150 W. VCEO-60. TO-3. Vastly out performs 2N3055. Reg. List $3.04
2 FOR $1

OPCOA LED READOUT
SLA-1 Common Anode. .33 In. character size. The original high efficiency LED display.
$.75 each 4 FOR $2.50

PRECISION RESISTORS
1K OHM 1%
10K OHM 1%
Your Choice:
6 FOR $1

MOTOROLA CD 4040
CMOS 12 Stage Binary Ripple Through Counter.
$ .99 ea.

CALCULATOR DISPLAYS
Brand New Units
By BOWMAR.
Common Cathode.
.11 INCH CHARACTER.
9 DIGIT - $ .99
6 DIGIT - $ .69

MYLAR CAPACITOR
1 MFD. 400 VDC. 5%
2 FOR $1

THERMISTOR
1 K OHM at Room Temp.
Very Sensitive.
4 FOR $1

741C OP AMPS
MINI DIP. Prime New Units. Has computer MFG's house number.
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100 FOR $15

DISC CAPACITORS
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P.C. Leads. By Sprague.
20 FOR $1

HEAVY DUTY Full Wave Bridge
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.5 OHM 50 WATT.
Adjustable · 5%
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3 FOR $1

.25 OHM
3 WATT. 1% IRC
4 FOR $1

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IN3998A 10 W. 6.2 V.
2 FOR $1 W/HDWR

16 PIN 1C SOCKETS
Low profile. Solder Tail.
5 FOR $1

ZENERS
1 W. 15 V.
House Number.
Motorola.
5 FOR $1

TANTALUM CAPACITOR
1 MFD. 35 V. Kemet.
Axial Lead. Best Value.
10 FOR $1

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709C	Op Amp. ITT 14 Pin Dip	$ .29
IN4004	1A. 400 PIV. I. R.	12/$1
2N2646	Mot. Unijunction	2/$1
2N4871	Mot. TO-92-Unij.	3/$1
2N3819	T. I. House #N-FET.	4/$1
EN3906	PNP Driver XSTR	10/$1
LM565	Phase Locked Loop	$ .99
LM723C	V. R. 14 Pin Dip	$ .79
4136	Quad Op Amp	$ .99
2N5777	Photo Transistor	5/$1
1N4748	1 W. 22V Zener	10/$1
2N2925	Pre-amp NPN XSTR	8/$1
2N1307	PNP Germanium	5/$1
EN2222	House # XSTR	10/$1
2N2219	TO-5 NPN Power	4/$1
1N5384	5W 150V Zener	5/$1
TIS92	NPN Driver	10/$1

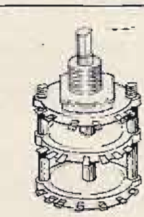
TRANSFORMER
12 Vac. 600 MA.
PRI—115 VAC 60 HZ.
Perfect for clocks or power supplies.
Small Size.
$1.95

JUMBO LED READOUT ARRAY

By Bowmar. .5 in. char. common cathode. Designed for use with multiplexed clock chips. Four digits in one pack.
LIMITED STOCK
$1.95

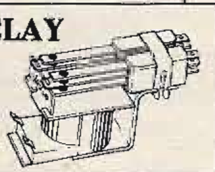
CABLE TIES
Most popular size. 3¾" overall for a ¾" bundle. Ty-wrap style. Nylon self-locking.
100 FOR $1 $8 FOR 1,000

FILTER CAP 4 FOR $1
Mini Size. Axial. 1,000 MFD 16 WVDC



ROTARY SWITCH
Instrument Grade.
3 Pole.
6 Position.
Centralab.
99¢

HEAVY DUTY 115 VAC RELAY



By Guardian. Coil is 115 VAC 60 HZ. DPDT 10 AMP Contacts.
$1.95 each

RED LED READOUT FILTER
Very handy. Can be used with our Calculator Displays.
2¼ x ½ In. **6 FOR $1**

TRANSISTORS

2N3566 - TO - 5 plastic. NPN.
VCEO-40 HFE 150 TO 600
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MPS-6566 - TO - 92 plastic. NPN.
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10 FOR $1

CINCH-JONES TERMINAL BLOCKS
#5-140 5-Terminal — **3 FOR $1**
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5-140 is 2.5 In. 9-140 is 4 In.

TERMS: ORDERS UNDER $15 ADD $ .75. NO C.O.D. WE ACCEPT VISA, MASTER CHARGE AND AMERICAN EXPRESS CARDS. MONEY BACK GUARANTEE ON ALL ITEMS. TEXAS RESIDENTS ADD 5% SALES TAX.

WE PAY POSTAGE!

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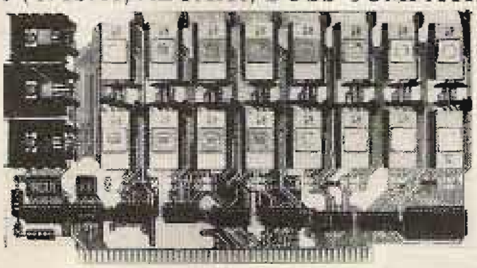
D20

D.R.C. ELECTRONICS

16K E-PROM CARD

$69.95 (KIT)

S-100 (IMSAI/ALTAIR) BUSS COMPATIBLE



IMAGINE HAVING 16K OF SOFTWARE ON LINE AT ALL TIME!

KIT FEATURES:

1. Double sided PC Board with solder mask and silk screen and Gold plated contact fingers.
2. Selectable wait states.
3. **All** address lines and data lines buffered!
4. All sockets included.
5. On card regulators.

USES 2708's!

KIT INCLUDES ALL PARTS AND SOCKETS! (EXCEPT 2708's)

DEALER INQUIRES INVITED

ADD $25 FOR ASSEMBLED AND TESTED

SPECIAL OFFER: Our 2708's (650 NS) are **$12.95** when purchased with above kit.

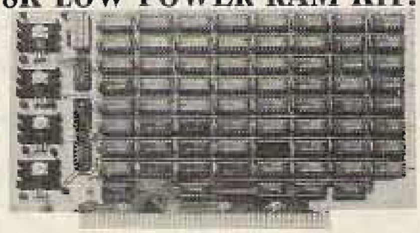
$149.00 KIT

8K LOW POWER RAM KIT!

ADD $30 FOR ASSEMBLED AND TESTED. KIT FEATURES:

1. Double sided PC Board with solder mask and silk screen layout. Gold plated contact fingers.
2. All sockets included!
3. **Fully** buffered on all address and data lines.
4. **Phantom** is jumper selectable to pin 67.
5. **FOUR** 7805 regulators are provided on card.

S-100 (IMSAI/ALTAIR) BUSS COMPATIBLE



USES 21L02-1 RAM'S.

$24.95 with connector

S-100 REVERSING EXTENDER BOARD

Turns the board under test around so that the foil side is facing you. Makes trouble shooting and debugging a SNAP! P.C. Layout designed to minimize noise and stray capacitance.

COMPUTER GRADE CAP.
48,000 MFD 25 WVDC Mallory
$3.95 **NEW!**

IC SOCKETS
For the newer RAM chips.
18 PIN — **4 FOR $1**
22 PIN — **3 FOR $1**

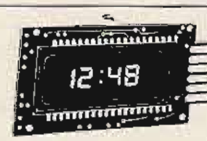
RCA HOUSE #2N3772
NPN Power Transistor. 30 AMP. 150 W. VCEO-60. TO-3. Vastly out performs 2N3055. Reg. List $3.04
2 FOR $1

T. I. ASCII CHARACTER GENERATOR
TMS 4103 JC. 28 PIN CER DIP. Has seven bit COLUMN Output for use with Matrix hard copy devices. With specs.
$3.50

NEW! **4K STATIC RAM'S** NEW!
2114. The industry standard. 18 PIN DIP. Arranged as 1K X 4. Equivalent to FOUR 21L02's in ONE package! TWO chips give 1K X 8, with data.
2 FOR $24 **450 N.S.!**

MOTOROLA 7805R VOLTAGE REGULATOR
Same as standard 7805 except 750 MA OUTPUT. TO-220. 5VDC OUTPUT.
$ .44 each **10 FOR $3.95**

NATIONAL SEMI. MA1003 CAR CLOCK
Not a kit. Complete tested module. Works on 12 VDC, has on board time base. Sold by others at $24.95. Big .30" Bright Green Digits. Same as used by Detroit in new cards.



$19.95

EDGE CONNECTOR -- $1.50

Z - 80 PROGRAMMING MANUAL
By MOSTEK, the major Z - 80 second source. The most detailed explanation ever on the workings of the Z - 80 CPU CHIPS. At least one full page on **each** of the 158 Z - 80 instructions. A **MUST** reference manual for any user of the Z - 80. 300 pages. Just off the press! A D.R.C. exclusive! **$12.95**

2708 1KX8 EPROMS 2708
Prime new units from a major U.S. mfg. 650 N.S. access time. Equivalent to four 1702A's in one package!
$15.75 each

TERMS: ORDERS UNDER $15 ADD $ .75. NO C.O.D. WE ACCEPT VISA, MASTER CHARGE AND AMERICAN EXPRESS CARDS. MONEY BACK GUARANTEE ON ALL ITEMS. TEXAS RESIDENTS ADD 5% SALES TAX.

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CLOCK SPECIAL GOOD THROUGH DEC. 31st.

SPECIAL

Grandson of a cheap clock

SPECIAL

CLOCK SPECIAL GOOD THROUGH DEC. 31st.

$10.95 plus 1lb. post

Several years ago, we introduced our "Cheap Clock", a simple, unpretentious clock kit that has spawned numerous imitations. Later, we upgraded our kit with bigger readouts, brighter digits, and a bigger board; that was our "Son of a Cheap Clock". Our current clock is the "Grandson of a Cheap Clock"---and this time we have upped the digit size to .4", while retaining all the features that made the original clocks such big successes...like 6 digit operation, separate driver and segment transistors, 12/24 hour operation, 60 or 50 Hz capability, industrial quality PC board, IC socket to eliminate heat damage, and so on.

This is a complete clock kit...less only case. Unlike many of our imitators who charge extra for the PC board and transformer, we include both items---as well as time setting switches---in the package price. Our data sheet tells how to remote the readouts, how to use with a time base for battery or automotive operation, and assembly procedure.

MORE SPECIALS

computer grade filter capacitors!

21,000 uF 25V **$4.95**

33,000 uF 25V **$5.95**

CAVE grafx

$3.95 JOYSTICK!

4-100K pots

CMOS

4000	$0.25	4037	0.50
4001	0.29	4040	1.50
4002	0.34	4041	0.85
4007	0.29	4042	0.85
4008	1.28	4043	0.60
4009	0.53	4044	0.60
4010	0.53	4047	1.63
4011	0.29	4049	0.50
4012	0.29	4050	0.50
4013	0.50	4051	1.03
4014	1.23	4052	1.03
4015	0.90	4053	1.03
4016	0.45	4060	1.48
4017	1.23	4066	0.58
4019	0.55	4069B/	
4020	1.50	74C04	0.33
4021	1.23	4070	0.60
4022	1.20	4071	0.33
4023	0.29	4073	0.33
4024	1.03	4075	0.33
4025	0.29	4076B/	
4027	0.75	74C173	1.63
4028	1.00	4081	0.33
4029	1.73	4116	0.50
4030	0.53	14511	2.00
4033	1.50		

New from VECTOR..

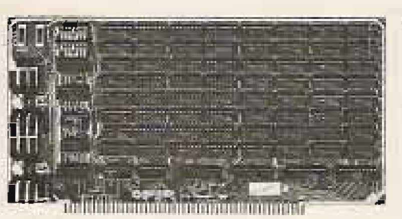
VP2 ASSEMBLED MICROCOMPUTER CASE...an adjustable packaging system for S-100 buss microcomputers. Card guides and hardware for 12 cards, with provision for 21 cards total on .75" centers. Instantly accessible interiors with slip out covers; sturdy chassis plate for power supply. And...it's really beautiful....................$134.30

Personal to Frank Tinius: watch this space, it's happening!

8Kx8 Econoram II™

single kit $163.84

3 kits-24K!-$450



Those who know memory recognize the Godbout board as not just an exceptional value (it's no secret we know how to keep costs down), but as an example of how to pack extra options into a basic memory board. Extras like a vector interrupt provision if you try to write into protected memory. Configuration as two independent 4K blocks (both protectable separately). A selectable write strobe for either PWR or MWRITE. An all static design. The ability to handle DMA devices. Guaranteed speed under 450 ns (with on-board wait state logic for use with 4 MHz Z-80) and guaranteed current under 1.5A (1250 mA typ). And of course...sockets for all ICs, legended board with solder mask, one year warranty on parts...we've got it all.

ALSO AVAILABLE: 8K ASSEMBLED, TESTED, WARRANTED 1 YEAR...$188.50; 4K KIT...$100.

Low power Schottky

74LS00	$0.30	74LS151	$0.95
74LS01	0.30	74LS155	1.38
74LS02	0.30	74LS157	0.95
74LS04	0.33	74LS160	1.40
74LS08	0.36	74LS161	1.40
74LS10	0.30	74LS162	1.40
74LS11	0.36	74LS163	1.40
74LS12	0.33	74LS168	1.87
74LS14	1.38	74LS169	1.87
74LS15	0.30	74LS173	1.65
74LS20	0.30	74LS174	1.25
74LS21	0.33	74LS175	1.15
74LS22	0.33	74LS195	1.30
74LS26	0.43	74LS240	1.88
74LS27	0.36	74LS257	1.25
74LS30	0.30	74LS258	1.25
74LS32	0.38	74LS266	0.53
74LS37	0.45	74LS283	1.20
74LS38	0.45	74LS365/	
74LS42	0.98	80LS95	0.75
74LS47	1.00	74LS366/	
74LS48	0.98	80LS96	0.75
74LS74	0.50	74LS367/	
74LS75	0.68	80LS97	0.75
74LS76	0.50	74LS368/	
74LS86	0.50	80LS98	0.75
74LS109	0.50	74LS386	0.55
74LS125	0.63	81LS95	1.13
74LS126	0.63	81LS96	1.13
74LS132	1.25	81LS97	1.13
74LS138	1.10	81LS98	1.13
74LS139	1.15		

10 Slot Motherboard $90

18 Slot Motherboard $124

Both have edge connectors, active terminations

CPU POWER SUPPLY $50

5V @ 4A, +12V @ ½A, -12V @ ½A. With crowbar.

TERMS: Please allow up to 5% for shipping, more for supply & VP2; excess refunded. Prices good through end of magazine cover month. Californians add tax. CODs accepted with street address. For BankAmericard®/VISA®/Mastercharge® orders ($15 min) call 415-562-0636, 24 hours.

GODBOUT

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SEVERAL GOOD REASONS WHY YOU SHOULD HAVE OUR FLYER: 1) CMOS 2) LINEARS 3) MICROPROCESSORS 4) POWER SUPPLIES 5) RESISTORS 6) CAPACITORS 7) DISPLAYS 8) SOCKETS 9) VECTOR PRODUCTS 10) ENCLOSURES 11) ALL THE OTHER THINGS WE CAN'T FIT INTO THIS SPACE.

G4

7400N TTL

SN7400N	.16	SN7472N	.39	SN74160N	1.25
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SN7408N	.20	SN7483N	.70	SN74170N	2.10
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SN7413N	.59	SN7490N	.45	SN74176N	.79
SN7414N	.70	SN7491N	.75	SN74177N	.79
SN7416N	.35	SN7492N	.49	SN74179N	2.49
SN7417N	.35	SN7493N	.49	SN74180N	.99
SN7420N	.20	SN7494N	.79	SN74181N	2.49
SN7421N	.39	SN7495N	.79	SN74182N	.95
SN7422N	.49	SN7496N	.79	SN74184N	1.95
SN7423N	.37	SN7497N	3.00	SN74185N	1.95
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SN7426N	.29	SN74107N	.39	SN74187N	6.00
SN7427N	.37	SN74109N	.95	SN74188N	3.95
SN7429N	.42	SN74116N	1.95	SN74190N	1.79
SN7430N	.25	SN74121N	.39	SN74191N	1.25
SN7432N	.25	SN74122N	.39	SN74192N	.89
SN7437N	.35	SN74123N	.50	SN74193N	.89
SN7438N	.35	SN74125N	.60	SN74194N	1.25
SN7439N	.25	SN74126N	.60	SN74195N	.75
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SN7442N	.59	SN74141N	1.15	SN74198N	1.75
SN7443N	.75	SN74142N	2.95	SN74199N	1.75
SN7444N	.75	SN74143N	3.25	SN74200N	5.59
SN7445N	.75	SN74144N	3.00	SN74251N	1.79
SN7446N	.89	SN74145N	1.15	SN74279N	.90
SN7447N	.69	SN74147N	2.35	SN74282N	2.25
SN7448N	.89	SN74148N	2.00	SN74284N	6.00
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SN7451N	.25	SN74151N	.79	SN74365N	.75
SN7453N	.25	SN74153N	.89	SN74366N	.75
SN7454N	.25	SN74154N	1.25	SN74367N	.75
SN7459A	.25	SN74155N	.89	SN74368N	.75
SN7460N	.25	SN74156N	.89	SN74390N	2.25
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20% Discount for 100 Combined 7400's

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CD4000	.23			MC14562	14.50
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CD4010	.49	CD4049	.49	74C02	.55
CD4011	.23	CD4050	.49	74C04	.75
CD4012	.25	CD4051	1.19	74C10	.65
CD4013	.39	CD4053	1.19	74C14	3.00
CD4014	1.39	CD4056	1.49	74C20	.65
CD4015	1.19	CD4059	9.95	74C30	.65
CD4016	.49	CD4060	1.49	74C42	2.15
CD4017	1.19	CD4066	.79	74C73	1.50
CD4018	.99	CD4068	.39	74C74	1.15
CD4019	.49	CD4069	.45	74C89	4.00
CD4020	1.19	CD4070	.55	74C90	3.00
CD4021	1.39	CD4071	.23	74C93	2.00
CD4022	1.19	CD4076	1.39	74C95	2.00
CD4023	.23	CD4081	.23	74C107	1.25
CD4024	.79	CD4082	.23	74C151	2.90
CD4025	.23	MC14409	14.95	74C154	3.00
CD4026	2.25	MC14410	14.95	74C157	2.15
CD4027	.69	MC14419	4.95	74C160	3.25
CD4028	.89	MC14506	.75	74C161	3.25
CD4029	1.19	MC14507	.99	74C163	3.00
CD4030	.49	CD4508	3.95	74C164	3.25
CD4035	.99	CD4510	1.39	74C173	2.60
CD4040	1.19	CD4511	1.29	74C193	2.75
CD4041	1.25	CD4515	2.95	74C195	2.75
CD4042	.99	CD4518	1.29	80C95	1.50
CD4043	.89	CD4520	1.29	80C97	1.50

LINEAR

LM300H	.80			LM723N	.55
LM301H	.35			LM733N	1.00
LM301CN	.35			LM739N	1.19
LM302H	.75	LM340T-5	1.25	LM741CH	.35
LM304H	1.00	LM340T-12	1.25	LM741CN	.35
LM305H	.60	LM340T-15	1.25	LM741-14N	.39
LM307CN	.35	LM340T-18	1.25	LM747H	.79
LM308H	1.00	LM340T-24	1.25	LM747N	.79
LM308CN	1.00	LM350N	1.00	LM748H	.39
LM309H	1.10	LM351CN	.65	LM748N	.39
LM309K	1.25	LM370	1.75	LM1303N	.90
LM310CN	1.15	LM370N	1.15	LM1304N	1.19
LM311H	.90	LM373N	3.25	LM1305N	1.40
LM311N	.90	LM377N	4.00	LM1307N	.85
LM317K	6.50	LM380N	1.25	LM1310N	2.95
LM318CN	1.50	LM380CN	.99	LM1351N	1.65
LM319N	1.30	LM381N	1.79	LM1414N	1.75
LM320K-5	1.35	LM382N	1.79	LM1458CN	.59
LM320K-5.2	1.35	NE501K	8.00	LM1496N	.95
LM320K-12	1.35	NE510A	6.00	LM1556V	1.75
LM320K-15	1.35	NE529A	4.95	LM2111N	1.95
LM320T-5	1.25	NE531H	3.00	LM2901N	2.95
LM320T-5.2	1.25	NE536T	6.00	LM3053	1.50
LM320T-8	1.25	NE540L	6.00	LM3065N	.69
LM320T-12	1.25	NE550N	1.30	LM3900N(3401)	.49
LM320T-15	1.25	NE555V	.39	LM3905N	.89
LM320T-18	1.25	NE556B	5.00	LM3909	1.25
LM320T-24	1.25	NE561B	5.00	LM5558V	1.85
LM323K-5	5.95	NE562B	5.00	MC5558V	1.00
LM324N	1.80	NE565H	1.75	LM7525N	.90
LM339N	.99	NE565N	1.25	LM7534N	.75
LM340K-5	1.35	NE566CN	1.75	8038B	4.95
LM340K-8	1.35	NE567V	1.95	LM75450	.49
LM340K-12	1.35	NE567V	1.49	75451CN	.39
LM340K-15	1.35	LM703CN	.45	75452CN	.39
LM340K-18	1.35	LM709H	.29	75454CN	.39
LM340K-24	1.35	LM709N	.29	75491CN	.79
LM340T-5	1.25	LM710N	.79	75492CN	.89
LM340T-6	1.25	LM711N	.39	75494CN	.89
		LM723H	.55		

74LS00 TTL

74LS00	.29			74LS153	1.25
74LS02	.29			74LS155	1.25
74LS03	.29			74LS157	1.50
74LS04	.35			74LS160	1.95
74LS05	.35			74LS161	1.95
74LS08	.29	74LS76	.49	74LS162	1.95
74LS09	.29	74LS83	1.75	74LS163	1.95
74LS10	.29	74LS85	2.45	74LS164	1.95
74LS13	.69	74LS86	.49	74LS175	1.65
74LS14	1.75	74LS90	.89	74LS181	3.69
74LS20	.29	74LS92	.89	74LS190	2.49
74LS21	.29	74LS93	.89	74LS191	2.49
74LS22	.29	74LS95	1.50	74LS192	2.49
74LS26	.39	74LS96	1.89	74LS193	2.49
74LS27	.39	74LS107	.59	74LS194	1.39
74LS28	.39	74LS109	.59	74LS195	1.89
74LS30	.29	74LS112	.59	74LS253	1.75
74LS32	.39	74LS123	1.25	74LS257	1.75
74LS40	.39	74LS132	1.25	74LS260	.55
74LS42	1.25	74LS136	.59	74LS279	.79
74LS47	1.25	74LS138	1.25	74LS367	.99
74LS51	.29	74LS139	1.25	74LS368	1.99
74LS55	.29	74LS151	1.25	74LS670	3.95
74LS73	.49				
74LS74	.49				
74LS75	.69				

Grab Bag Specials

CAPACITORS

GB100	100 ea. Ceramic Disc	$2.00/lot
GB101	60 ea. Mylar	4.00/lot
GB102	60 ea. Electrolytics	4.00/lot
GB103	40 ea. Tantalum (tubular)	4.00/lot
GB104	20 ea. Ceramic Trimmers (marked)	5.00/lot
GB105	20 ea. Ceramic Trimmers (house # or unmarked)	3.00/lot

DIODES

GB106	100 ea. Germanium	2.00/lot
GB107	100 ea. Silicon	2.00/lot

INTEGRATED CIRCUITS

GB108	50 ea. Marked TTL Series	4.00/lot
GB109	30 ea. Marked Linear	4.00/lot

LEDS LAMPS - Readouts

GB110	100 ea. ASST LEDS	6.00/lot
GB111	40 ea. NE2 Type Lamps	3.00/lot
GB112	20 ea. Multiple Readouts, Calculators, Watches, Timers, Leds to Panaplex New — Used — Rejects	6.00/lot

RESISTORS

GB116	200 ea. ¼ watt Assortment	$2.00
GB117	200 ea. ½ watt Assortment	2.00
GB118	40 ea. Wirewound 3-10 watt 1-100 ohm	5.50
GB119	40 ea. Wirewound 3-10 watt 100Ω-25K	5.00

SWITCHES

GB120	25 ea. Miniature Slide	3.00
GB121	12 ea. Rocker	3.00
GB122	20 ea. Reed-Coil & Magnetic	5.00

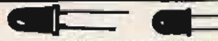
MISC.

GB123	30 ea. Heat Sinks Asst. Sizes	2.50
GB124	6 ea. Calculator Type Keyboards	5.00
GB125	300 ea. Molex Pins (8,9,14 sections)	3.00
GB126	50 ea. Opto Isolators IL-1 Series (untested)	2.00
GB127	100 ea. Transistors Plastic & Power	3.00
GB128	30 ea. Toroids Cores Iron & Tape	4.00
GB129	50 ea. Photo Transistors	4.00
GB130	1 ea. Tape Drive - 6 volt Motor with Erase Head & 2 Cassette Tapes (no amplifier)	5.00
GB131	30 ea. 6" Shrinktubing Asst. Sizes & Colors	4.00
GB132	Wire Asst. Sizes & Colors — 1lb.	2.95

POTENTIOMETERS

GB113	30 ea. Minature Trimmers 100Ω-1meg	4.00
GB114	10 ea. 10 Turn P.C. Mount (rectangular marked)	4.00
GB115	10 ea. 10 Turn P.C. Mount (rectangular mismarked)	2.00
GB133	15 ea. ⅜" sqaure Single Turn P.C. Mount (mismarked)	3.00

DISCRETE LEDS



.125" dia.			.200" dia.			.185" dia.			.200" dia.			.190" dia.		
XC209	Red	10/$1	XC22	Red	10/$1	XC526	Red	5/$1	XC556	Red	5/$1	XC111	Red	10/$1
XC209	Green	4/$1	XC22	Green	4/$1	XC526	Green	4/$1	XC556	Green	4/$1	XC111	Green	4/$1
XC209	Orange	4/$1	XC22	Yellow	4/$1	XC526	Yellow	4/$1	XC556	Yellow	4/$1	XC111	Yellow	4/$1
XC209	Yellow	4/$1	XC22	Orange	4/$1	XC526	Orange	4/$1	XC556	Orange	4/$1	XC111	Orange	4/$1
			SSL-22	RT	4/$1	XC526	Clear	4/$1	XC556	Clear	7/$1			

.085" dia. MV50 - Red - 5/$1

INFRA-RED LED ¼" x ¼" x 1/16" Flat 5/$1.00

DISPLAY LEDS

TYPE	POLARITY	HT	PRICE
MAN 1	Common Anode	.270	2.95
MAN 2	5 x 7 Dot Matrix	.300	4.95
MAN 3	Common Cathode	.125	.39
MAN 4	Common Cathode	.187	1.95
MAN 7	Common Anode	.270	1.25
MAN 7G	Common Anode-green	.270	1.95
MAN 7Y	Common Anode-yellow	.270	1.95
MAN 52	Common Anode-green	.300	1.00
MAN 71	Common Anode	.300	1.25
MAN 72	Common Anode	.300	1.25
MAN 74	Common Cathode	.300	1.50
MAN 81	Common Anode-yellow	.300	1.00
MAN 82	Common Anode-yellow	.300	1.00
MAN 84	Common Cathode-yellow	.300	1.00
MAN 3620	Commmon Anode-orange	.300	1.00
MAN 3640	Common Cathode-orange	.300	1.75
MAN 4610	Common Anode-orange	.300	1.00
MAN 4640	Common Cathode-orange	.400	1.00
MAN 4710	Common Anode-red	.400	1.00
MAN 4730	Common Anode-red	.400	1.00
MAN 4740	Common Cathode-red	.400	1.00
MAN 4830	Common Anode-yellow	.400	1.00
MAN 6610	Common Anode-Double Digit-orange	.560	1.25
MAN 6630	Common Anode-orange	.560	1.25
MAN 6640	Common Cathode-Double Digit-orange	.560	1.25
MAN 6650	Common Cathode	.560	1.25
MAN 6660	Common Anode	.560	1.25
MAN 6680	Common Cathode	.560	1.25
MAN 6710	Common Anode-Double Digit-red	.560	1.25
MAN 6730	Common Anode-Double Digit-red	.560	1.25
MAN 6740	Common Cathode-Double Digit-red	.560	1.25
MAN 6750	Common Cathode	.560	1.25
MAN 6760	Common Anode-red	.560	1.25
MAN 6780	Common Cathode-red	.560	1.25
DL701	Common Anode-red±1	.300	1.00
DL702	Common Cathode-red	.300	1.25
DL704	Common Cathode	.300	1.50
DL707	Common Anode	.300	1.50
DL728	Common Cathode	.500	2.95
DL741	Common Anode	.600	1.95
DL746	Common Anode	.630	1.95
DL747	Common Anode	.600	2.25
DL749	Common Cathode	.630	1.95
DL750	Common Cathode	.600	2.49
DL338	Common Cathode	.110	.69
FND70	Common Cathode (FND359)	.250	.75
FND503	Common Cathode (FND500)	.500	1.29
FND507	Common Anode (FND510)	.500	1.29

RCA LINEAR

		CA3083	1.60
CA3013	2.15	CA3086	.85
CA3023	2.56	CA3089	3.75
CA3035	2.48	CA3091	10.20
CA3039	1.35	CA3102	2.95
CA3046	1.30	CA3123	2.15
CA3052	1.50	CA3130	1.39
CA3059	3.25	CA3140	1.25
CA3060	3.25	CA3401	.49
CA3080	.85	CA3600	1.75
CA3081	2.00	RC4194	5.95
CA3082	2.00	RC4195	3.25

HP 5082-7400 Series — Multi-Digit

- ⅛" ht. • Common Cathode Red
- 3-5 volts @ 5 mils/second
- 7 segment Monolithic
- Dip Package

		10 or more
2 Digit	$ .79	.69
3 Digit	.89	.79
4 Digit	.99	.89
5 Digit	1.19	.99

TV GAME CHIP SET — $9.95

Includes AY-3-8500-1 Chip and 2.010 mhz crystal (2.010 crystal — $1.95 ea/AY-3-8500-1 chip — $8.95 ea.)

IC SOLDERTAIL — LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100		1-24	25-49	50-100
8 pin	$.17	.16	.15	24 pin	$.38	.37	.36
14 pin	.20	.19	.18	28 pin	.45	.44	.43
16 pin	.22	.21	.20	36 pin	.60	.59	.58
18 pin	.29	.28	.27	40 pin	.63	.62	.61
22 pin	.37	.36	.35				

SOLDERTAIL STANDARD (TIN)

	1-24	25-49	50-100		1-24	25-49	50-100
14 pin	$.27	.25	.24	28 pin	$.99	.90	.81
16 pin	.30	.27	.25	36 pin	1.39	1.26	1.15
18 pin	.35	.32	.30	40 pin	1.59	1.45	1.30
24 pin	.49	.45	.42				

SOLDERTAIL STANDARD (GOLD)

	1-24	25-49	50-100		1-24	25-49	50-100
8 pin	$.30	.27	.24	24 pin	$.70	.63	.57
14 pin	.35	.32	.29	28 pin	1.10	1.00	.90
16 pin	.38	.35	.32	36 pin	1.75	1.40	1.26
18 pin	.52	.47	.43	40 pin	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

	1-24	25-49	50-100		1-24	25-49	50-100
10 pin	$.45	.41	.37	24 pin	$1.05	.95	.85
14 pin	.39	.38	.37	28 pin	1.40	1.25	1.10
16 pin	.43	.42	.41	36 pin	1.59	1.45	1.30
18 pin	.75	.68	.62	40 pin	1.75	1.55	1.40
22 pin	.95	.85	.75				

50 PCS. RESISTOR ASSORTMENTS $1.75 PER ASST.

ASST. 1	5 ea.	10 OHM / 27 OHM	12 OHM / 33 OHM	15 OHM / 39 OHM	18 OHM / 47 OHM	22 OHM / 56 OHM	1/4 WATT 5% = 50 PCS.
ASST. 2	5 ea.	68 OHM / 180 OHM	82 OHM / 220 OHM	100 OHM / 270 OHM	120 OHM / 330 OHM	150 OHM / 390 OHM	1/4 WATT 5% = 50 PCS.
ASST. 3	5 ea.	470 OHM / 1.2K	560 OHM / 1.5K	680 OHM / 1.8K	820 OHM / 2.2K	1K / 2.7K	1/4 WATT 5% = 50 PCS.
ASST. 4	5 ea.	3.3K / 8.2K	3.9K / 10K	4.7K / 12K	5.6K / 15K	6.8K / 18K	1/4 WATT 5% = 50 PCS.
ASST. 5	5 ea.	22K / 56K	27K / 68K	33K / 82K	39K / 100K	47K / 120K	1/4 WATT 5% = 50 PCS.
ASST. 6	5 ea.	150K / 390K	180K / 470K	220K / 560K	270K / 680K	330K / 820K	1/4 WATT 5% = 50 PCS.
ASST. 7	5 ea.	1M / 2.7M	1.2M / 3.3M	1.5M / 3.9M	1.8M / 4.7M	2.2M / 5.6M	1/4 WATT 5% = 50 PCS.

ASST. 8R Includes Resistor Assortments 1-7 (350 PCS.) **$10.95 ea.**

$5.00 Minimum Order — U.S. Funds Only
California Residents — Add 6% Sales Tax

Spec Sheets - 25¢ — Send 35¢ Stamp for 1978 Catalog
Dealer Information Available

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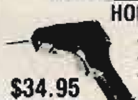
All Advertised Prices Good Thru November

J1

WIRE WRAP CENTER

HOBBY-WRAP TOOL-BW-630



- Battery Operated (Size C)
- Weighs ONLY 11 Ounces
- Wraps 30 AWG Wire onto Standard DIP Sockets (.025 inch)
- Complete with built-in bit and sleeve

$34.95 (batteries not included)

WIRE-WRAP KIT — WK-2-W

WRAP • STRIP • UNWRAP

- Tool for 30 AWG Wire
- Roll of 50 Ft. White or Blue 30 AWG Wire
- 50 pcs. each 1", 2", 3" & 4" lengths — pre-stripped wire.

$11.95

WIRE WRAP TOOL WSU-30

WRAP • STRIP • UNWRAP - $5.95

WIRE WRAP WIRE — 30 AWG

25 ft. min. $1.25 50 ft. $1.95 100 ft. $2.95 1000 ft. $15.00
SPECIFY COLOR — White - Yellow - Red - Green - Blue - Black

WIRE DISPENSER — WD-30

- 50 ft. roll 30 AWG KYNAR wire wrap wire **$3.45 ea.**
- Cuts wire to desired length
- Strips 1" of insulation **Specify** — Blue-Yellow-White-Red

B&K PRECISION **New**

3½-Digit Portable DMM

- Overload Protected • .3" high LED Display
- Battery or AC operation • Auto Zeroing
- 1mv, 1Va, 0.1 ohm resolution • Overange reading.
- 10 meg input impendence
- DC Accuracy 1% typical

Ranges: DC Voltage: ±0-1000V/AC Voltage: 0-1000V
Freq. Response: 50-400 HZ/DC-AC Current: 0-1000mA
Resistance: 0-10 meg ohm
Size: 6.4" x 4.4" x 2"

Comes with test leads, operating manual and spare fuse.

Model 2800	**$99.95**
AC Adapter BC-28	**8.00**
Rechargeable Batteries BP-28	**20.00**
Carrying Case LC-28	**6.00**

DATAHANDBOOKS

7400	Pin-out & Description of 5400/7400 ICS	$2.95
CMOS	Pin-out & Description of 4000 Series ICS	$2.95
Linear	Pin-out & Functional Description	$2.95

ALL THREE HANDBOOKS $6.95

ZENERS — DIODES — RECTIFIERS

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
1N746	3.3	400mm	4/1.00	1N4005	600 PIV	1 AMP	10/1.00
1N751A	5.1	400m	4/1.00	1N4006	800 PIV	1 AMP	10/1.00
1N752	5.6	400m	4/1.00	1N4007	1000 PIV	1 AMP	10/1.00
1N753	6.2	400m	4/1.00	1N3600	50	200m	6/1.00
1N754	6.8	400m	4/1.00	1N4148	75	10m	15/1.00
1N959	8.2	400m	8/1.00	1N4154	35	10m	12/1.00
1N965B	15	400m	4/1.00	1N4305	75	25m	20/1.00
1N5232	5.6	500m	28	1N4734	5.6	1w	28
1N5234	6.2	500m	28	1N4735	6.2	1w	28
1N5235	6.8	500m	28	1N4736	6.8	1w	28
1N5236	7.5	500m	28	1N4738	8.2	1w	28
1N456	25	40m	6/1.00	1N4742	12	1w	28
1N458	150	7m	6/1.00	1N4744	15	1w	28
1N485A	180	10m	6/1.00	1N1183	50 PIV	35 AMP	1.60
1N4001	50 PIV	1 AMP	12/1.00	1N1184	100 PIV	35 AMP	1.70
1N4002	100 PIV	1 AMP	12/1.00	1N1185	150 PIV	35 AMP	1.50
1N4003	200 PIV	1 AMP	12/1.00	1N1186	200 PIV	35 AMP	1.80
1N4004	400 PIV	1 AMP	12/1.00	1N1188	400 PIV	35 AMP	3.00

SCR AND FW BRIDGE RECTIFIERS

C36D	15A @ 400V	SCR	$1.95
C38M	35A @ 200V	SCR	1.95
2N2328	1.6A @ 300V	SCR	.50
MDA 980-1	12A @ 50V	FW BRIDGE REC.	1.95
MDA 980-3	12A @ 200V	FW BRIDGE REC.	1.95

TRANSISTORS

MPS A05	5/$1.00	PN3567	3/$1.00	PN4249	4/$1.00
MPS A06	5/$1.00	PN3568	4/$1.00	PN4250	4/$1.00
2N2219A	3/$1.00	PN3569	4/$1.00	2N4400	4/$1.00
2N2221	4/$1.00	2N3704	5/$1.00	2N4401	4/$1.00
2N2222A	5/$1.00	2N3705	5/$1.00	2N4402	4/$1.00
2N2369	5/$1.00	2N3706	5/$1.00	2N4403	4/$1.00
2N2484	4/$1.00	2N3707	5/$1.00	2N4409	5/$1.00
2N2904	4/$1.00	2N3711	5/$1.00	2N5086	4/$1.00
2N2906A	4/$1.00	2N3724	$.65	2N5087	4/$1.00
2N2907A	5/$1.00	2N3725	$1.00	2N5088	4/$1.00
2N3005	5/$1.00	2N3903	5/$1.00	2N5089	4/$1.00
2N3053	2/$1.00	2N3904	4/$1.00	2N5129	5/$1.00
2N3055	$.89	2N3905	4/$1.00	2N5138	5/$1.00
MJE3055	$1.00	2N3906	4/$1.00	2N5139	5/$1.00
MJE2955	$1.25	2N4013	3/$1.00	2N5209	5/$1.00
2N3392	5/$1.00	2N4014	3/$1.00	2N5951	5/$1.00
2N3398	5/$1.00	2N4123	10/$1.00	C106B1SCR	2/$1.00
				2N5432	$2.00

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

	1-9	10-49	50-100		1-9	10-49	50-100
10 pf	.05	.04	.03	.001μF	.05	.04	.035
22 pf	.05	.04	.03	.0047μF	.05	.04	.035
47 pf	.05	.04	.03	.01μF	.05	.04	.035
100 pf	.05	.04	.03	.022μF	.06	.05	.04
220 pf	.05	.04	.03	.047μF	.06	.05	.04
470 pf	.05	.04	.035	.1μF	.12	.09	.075

100 VOLT MYLAR FILM CAPACITORS

.001mf	.12	.10	.07	.022mf	.13	.11	.09
.0022	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22

+20% DIPPED TANTALUMS (SOLID) CAPACITORS

.1/35V	.28	.23	.17	1.5/35V	.30	.26	.21
.15/35V	.28	.23	.17	2.2/25V	.31	.27	.22
.22/35V	.28	.23	.17	3.3/25V	.31	.27	.22
.33/35V	.28	.23	.17	4.7/25V	.32	.28	.23
.47/35V	.28	.23	.17	6.8/25V	.36	.31	.25
.68/35V	.28	.23	.17	10/25V	.40	.35	.29
1.0/35V	.28	.23	.17	15/25V	.63	.50	.40

MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS

Axial Lead				Radial Lead			
.47/50V	.15	.13	.10	.47/25V	.15	.13	.10
1.0/50V	.16	.14	.11	.47/50V	.16	.14	.11
3.3/50V	.15	.13	.10	1.0/16V	.15	.12	.10
4.7/25V	.16	.14	.12	1.0/25V	.16	.14	.12
10/25V	.15	.13	.10	1.0/50V	.16	.14	.11
10/50V	.16	.14	.12	4.7/16V	.15	.13	.10
22/25V	.17	.15	.12	4.7/25V	.15	.13	.10
22/50V	.24	.20	.18	4.7/50V	.16	.14	.11
47/25V	.19	.17	.15	10/16V	.14	.12	.09
47/50V	.25	.21	.19	10/25V	.15	.13	.10
100/25V	.24	.20	.18	10/50V	.16	.14	.12
100/50V	.35	.30	.28	47/50V	.24	.21	.19
220/25V	.32	.28	.25	100/16V	.19	.15	.14
220/50V	.45	.41	.38	100/25V	.24	.20	.18
470/25V	.33	.29	.27	100/50V	.35	.30	.28
1000/16V	.55	.50	.45	220/16V	.23	.17	.16
2200/16V	.70	.62	.55	470/25V	.31	.28	.26

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Kits, Books, Boards, Magazines. Special 2102LI 8 for $17.50. 8080A CPU Chip $19.95. We stock OK Battery Operated Wire Tool $34.95, OK Hand Wire Wrapped Tool $5.95. 7400 ICs CMOS, Timers PLL's IC Sockets. All kinds of transistors, rectifiers and diodes. Plus other electronic parts.

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Actual Size – 1.75" x 3.05"

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7812	7915
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LM723 14 pin 55

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A natural for cars, campers and mobile homes. Use on 12 volt dc with optional crystal time base (not including cabinet)

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12 or 24 hour **DIGITAL CLOCK KIT** uses .5 display LED. 5314 clock chip fits our standard cabinet. Freeze feature $18.95

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PC board, 555 & all parts works on 9 volts – $2.50. Morse button – $1.00.

NOW!

2 Dual Digital 12-24 hour clock kits

MODEL ALD5:
Six big .5 display LEDs in an attractive black plastic cabinet with a red front filter. Great for a ham or broadcast station. Set one clock to GMT the other to local time. Or have a 24 hour format on one clock and 12 hour on the other. Freeze feature lets the clock be set to the second. Each clock is controlled separately. Cabinet measures 2¾" x 4¾" x 9¾". Complete Kit $44.95.

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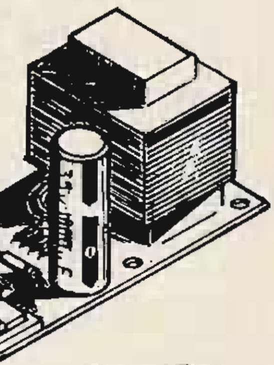
Four bright .3 nixie tube display. Cabinet is an attractive deep blue including front filter. Will display seconds at the push of a button. An asset to any station. Cabinet size is 2¾" x 3" x 9¾". Complete Kit $34.95.

Variable Power Supply Kit



500 mA regulators feature current limiting and thermal protection.

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Frequency counter typical 100 Hz to 40 MHz accuracy .0001%

Switchable from counter to clock. Clock maintains time while frequency counter is in use. Can be wired for either 4 or 6 digit clock. Small size makes attractive unit for auto or boat. Operates on 12 volt DC. Plug in power supply is available for 110 volt AC use. Comes complete with instructions. Cabinet and all parts assembled unit $139.95. Optional 110 volt AC supply $5.95
Kit only $99.95

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8K, 16K, 24K, 32K USING MOSTEK MK4115 WITH 8K BOUNDARIES & PROTECTION. Utilizes DIP switches. PC board comes with sockets for 32K operation THE ABOVE NOW AVAILABLE

AVAILABLE THE 1st QUARTER OF 1978: 16K, 32K, 48K, 64K USING MOSTEK 4116 WITH 16K BOUNDARIES & PROTECTION.

BUY AN S100 COMPATIBLE 8K RAM BOARD AND UPGRADE THE SAME BOARD TO A MAXIMUM OF 32K* IN STEPS OF 8K AT YOUR OPTION BY MERELY PURCHASING MORE RAM CHIPS FROM S.D. SALES! AT A GUARANTEED PRICE— LOOK AT THE FEATURES WE HAVE BUILT INTO THE BOARD.

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Board fully assembled and tested for $50.00 extra.

8K FOR $139.

Interface Capability

CONTROL, DATA AND ADDRESS INPUTS UTILIZE LOW POWER SCHOTTKY DEVICES.

Power Requirements

+8VDC 400 MA DC
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−18VDC 30MA DC
on board regulation is provided.

ON BOARD (INVISIBLE) REFRESH IS PROVIDED WITH NO WAIT STATES OR CYCLE STEALING REQUIRED.
MEMORY ACCESS TIME IS 375ns.
Memory Cycle Time is 500ns.

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Z-80 CPU BOARD KIT

Complete Kit $139. NEW PRICE! NEW PRICE!

CHECK THE ADVANCED FEATURES OF OUR Z-80 CPU BOARD: Expanded set of 158 instructions, 8080A software capability, operation from a single 5VDC power supply, always stops on an M1 state, true sync generated on card (a real Plus feature), dynamic refresh and NMI available, either 2MHZ or 4MHZ operation, quality double sided plated through PC board, standard kit shipped with Z-80 technical manual and all parts plus sockets provided for all IC's. Z-80 Chip & Manual Sep. — 39.95
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FEATURES: Litronix dual 1/2" displays, Mostek 50250 super clock chip, single I.C. segment driver, SCR digit drivers. Greatly simplified construction. More reliable and easier to build. Kit cincludes all necessary parts (except case). P.C. Board and Xfmr optional. Eliminate the hassle — avoid the 5314! Do not confuse with Non-Alarm kits sold by our competition!

P.C.B. — $3.00; AC XFMR — $1.50 **$9.95 KIT**

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ONE TUNE SUPPLIED WITH EACH KIT. ADDITIONAL TUNES — $6.95 EACH. SPECIAL TUNES AVAILABLE — YOU SUPPLY THE SHEET MUSIC WE SUPPLY PROGRAMMED PROM TO YOU.
STANDARD TUNES NOW AVAILABLE:
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E. Perfect for cars, boars, vans, etc.
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ITT DUAL SENSE AMPLIFIER. 75234 AND 75235. 49c each

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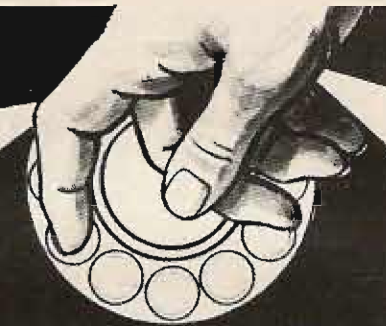

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- Use with HK-5 or any electronic keyer
- Heavy base with non-slip rubber feet
- Paddles reversible for wide- or close-finger spacing

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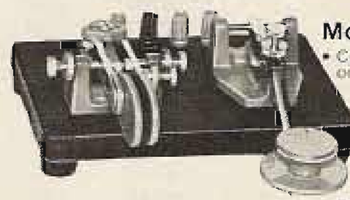

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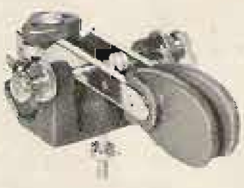

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Electronic Keyer
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1N4007	1000v	1A	.15
1N4148	75v	10mA	.05
1N753A	6.2v	z	.25
1N758A	10v	z	.25
1N759A	12v	z	.25
1N4733	5.1v	z	.25
1N5243	13v	z	.25
1N5244B	14v	z	.25
1N5245B	15v	z	.25

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8-pin	pcb	.25	ww	.45
14-pin	pcb	.25	ww	.40
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18-pin	pcb	.25	ww	.75
22-pin	pcb	.45	ww	1.25
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2 Amp Bridge 100-prv 1.20

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4012	.20
4013	.40
4014	1.10
4015	.95
4016	.35
4017	1.10
4018	1.10
4019	.60
4020	.85
4021	1.35
4022	.95
4023	.25
4024	.75
4025	.35
4026	1.95
4027	.50
4028	.95
4030	.35
4033	1.50
4034	2.45
4035	1.25
4040	1.35
4041	.69
4042	.95
4043	.95
4044	.95
4046	1.75
4049	.70
4050	.50
4066	.95
4069	.40
4071	.35
4081	.70
4082	.45

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7400	.15
7401	.15
7402	.20
7403	.20
7404	.15
7405	.25
7406	.35
7407	.55
7408	.25
7409	.15
7410	.10
7411	.25
7412	.30
7413	.45
7414	1.10
7416	.25
7417	.40
7420	.15
7426	.30
7427	.45
7430	.15
7432	.30
7437	.35
7438	.35
7440	.25
7441	1.15
7442	.45
7443	.85
7444	.45
7445	.65
7446	.95
7447	.95
7448	.70
7450	.25
7451	.25
7453	.20
7454	.25
7460	.40
7470	.45
7472	.40

7473	.25
7474	.35
7475	.35
7476	.30
7480	.55
7481	.75
7483	.95
7485	.95
7486	.30
7489	1.35
7490	.55
7491	.95
7492	.95
7493	.40
7494	1.25
7495	.60
7496	.80
74100	1.85
74107	.35
74121	.35
74122	.55
74123	.55
74125	.45
74126	.35
74132	1.35
74141	1.00
74150	.85
74151	.75
74153	.95
74154	1.05
74156	.95
74157	.65
74161	.85
74163	.95
74164	.60
74165	1.50
74166	1.35
74175	.80

74176	1.25
74180	.85
74181	2.25
74182	.95
74190	1.75
74191	1.35
74192	1.65
74193	.85
74194	1.25
74195	.95
74196	1.25
74197	1.25
74198	2.35
74221	1.00
74367	.85
75108A	.35
75110	.35
75491	.50
75492	.50
74H00	.25
74H01	.25
74H04	.25
74H05	.25
74H08	.35
74H10	.35
74H11	.25
74H15	.30
74H20	.30
74H21	.25
74H22	.40
74H30	.25
74H40	.25
74H50	.25
74H51	.25
74H52	.15
74H53J	.25
74H55	.25

74H72	.55
74H101	.75
74H103	.75
74H106	.95
74L00	.35
74L02	.35
74L03	.30
74L04	.35
74L10	.35
74L20	.35
74L30	.45
74L47	1.95
74L51	.45
74L55	.65
74L72	.45
74L73	.40
74L74	.45
74L75	.55
74L93	.55
74L123	.55
74S00	.55
74S02	.55
74S03	.30
74S04	.35
74S05	.35
74S08	.35
74S10	.35
74S11	.35
74S20	.35
74S40	.25
74S50	.25
74S51	.45
74S64	.25
74S74	.40
74S112	.90
74S114	1.30

74S133	.45
74S140	.75
74S151	.35
74S153	.35
74S157	.80
74S158	.35
74S194	1.05
74S257 (8123)	.25
74LS00	.35
74LS01	.35
74LS02	.35
74LS04	.35
74LS05	.45
74LS08	.35
74LS09	.35
74LS10	.35
74LS11	.35
74LS20	.35
74LS21	.25
74LS22	.25
74LS32	.40
74LS37	.35
74LS40	.45
74LS42	1.10
74LS51	.50
74LS74	.65
74LS86	.65
74LS90	.95
74LS93	.95
74LS107	.85
74LS123	1.00
74LS151	.95
74LS153	1.20
74LS157	.85
74LS164	1.90
74LS367	.85
74LS368	.85

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LM309H	.65
LM309K (340K-5)	.85
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LM311D (Mini)	.75
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LM320K12	1.65
LM320T5	1.65
LM320T12	1.65
LM320T15	1.65
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7805 (340T5)	.95
LM340T12	1.00
LM340T15	1.00
LM340T18	1.00

LM340T24	.95
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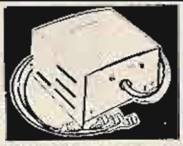

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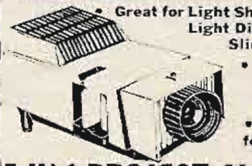

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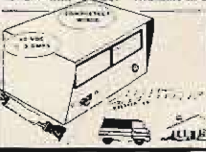

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The supply of these back issues is very limited . . . and when these are gone, that will be it. Don't miss out by procrastinating. Treat yourself (or a ham friend) to a fantastic bargain.

JUNE 63. Surplus issue. DMQ 2 Beacon Tx on 220, increasing ARC-2 transceiver selectivity, PE-97A pwr supply conversion, BC-348 band spread, inductance tester, converting BC-230 tx, beginner's rx using BC-453, recvr motor tuning, transistor cw monitor, BC-442 ant relay conversion, mobile loading coils, increasing Two-er selectivity, TV with the ART-26 tx, TRC-8 rx on 220, ARC-5 hf rx & tx, ARC-3 tx on 2M.

AUG 63. Battery-op 6M stn, diode noise gen, video modulation, magic T-R switch, ant gain, halo mods, cw breakin, VEE beam design, coax losses, RF wattmeter, TX Tube Guide, diode pwr supply, "Lunchbox" squelch, SWR explanation, vertical ant info, info on Windom ant.

OCT 63. WBFM transceiver ideas, HF propagation, cheap fone patch, remote-tuned Yagi, construction hints, ant coupler, $5 Vertical, filament xfermer construction, 2M nuvistor converter, Lafayette HE-35 mods, Buyer's Guide to Rx & Tx, product detector, novel Hi-C VFO, radio astronomy, panadaptor "if" converter, compact mise amp.

FEB 64. 2M multichannel exciter, rx design ideas, majic t/r switch, loudspeaker enclosures, 40M 2W tx, look at test equipment, radio grounds, 40M ZL Special ant, neutralization.

MAY 67. Quad Issue: 432 Quad quad-quad, expanded HF quad, Two el quad, miniquad, 40M quad, quad experiments, half quad, three el quad, 20M quad, tiltover quad, easy to erect quad, Quad Bibliography, FET vfo, tube troubleshooting, HF dummy load, understanding "HS," HF SSB/cw rx, geometric circuit design, GSB-201 transceive, FET converter for 10-20M, hi pass rx filters.

JULY 67. VE ham radio, VE0 hams, dsb adaptor, home brew tower, transistor design, '39 World's Fair, gnd plane ant, G4ZU beam, SSTV monitor, UHF FET preamps, IC "if" strip, vertical ant, VHF/UHF dipper, tower hints, scope monitoring, operating desk, S Line crossband, hi-school ham club, Heath HR-10 mods.

OCT 67. HF solid state rx, rugged rotator, designing slug-tuned coils, FET converter, SSTV pix gen, VHF log-periodics, rotatable dipole, gamma-match cap, old-time dxing, modern dxing.

JUNE 68. Surplus Issue: Transformer tricks, BC-1206 rx, APS-13 ATV tx, low voltage dc supply, surplus scopes, FM rig commercial xtal types, Wilcox F-3 rx, restoring old equipment, 7A1 rx mods, TRA-18 on 432, freq counter uses, transceiver pwr supply, uses for cheap tape recorders, Surplus Conversion Bibliography, RT 209 walkie on 2M, ARC 1 guard rx, RTTY tx TU.

JULY 68. Wooden tower construction, tiltover towers, erecting a telephone pole, IC AF osc, "dB" explained, ham club tips (Part 1).

SEPT 68. Mobile vhf, 432 FET preamps, converting TV Tuners, xtal osc stability, parallel-Tee design, moonbounce, rhombic, 6M xciter (corrections Jan 69), 6M transceiver (corrections Jan 69), 2M dsb amp, ham club tips (Part 3).

NOV 68. SSB xtal filters, solid state trouble shooting, IC freq counter (many errors & omissions), "cv" transformers, space comm odyssey, pulsar info, thin-wire ants, 40M transistor cw tx/rx, BC-348M double conversion, multifunction tester, copper wire specs, thermistor applications, hi voltage transistor list, ham club tips (Part 5).

JAN 69. Suppresser compressor, HW-12 on 160, beam tuning, AC voltage control, 2M transistor tx, LC power reducer, spectrum analysis info, 6M transistor rx, operating console, RTTY autostart, calculating osc stability, lo-pwr 40 cw tx, sequential relay switching, sightless operator's bridge, ham club tips (Part 7).

FEB 69. SSTV camera mod for fast-scan, tri-band linear, selective af filter, unijunction transistor info, Nikola Tesla biography, mobile installation hints, extra class license study (Part 1).

MAR 69. Surplus issue: TCS tx mods, cheap compressor-amp, RXZ calculations, transistor keyer, better balanced modulator, transistor oscillators, using blowers, halfwave feedline info, Surplus Conversion Bibliography, extra license study (Part 2).

APR 69. 2 channel scope amp, rx preamp, Two-er RTT, variable DC load, SWR bridge, 100 kHz marker gen, some transistor specs, SB-100 monitorscope mods, portable 6M AM tx, 2M converter, extra license study (Part 3).

MAY 69. 2M Turnstile, 2M Slot, rx attenuator, generator filter, short VEE, quad tuning, using antennascope, measuring ant gain, phone patch regs, SWR indicator, 160M short verticals, 15M antenna, HF propagation angles, FSK exciter, KW dummy load, hi-power linear, extra license study (part 4), all-band curtain array.

JUNE 69. Microwave pwr generation, 6M ssb tx, 432 er tx/rx, 6M converter, 2M 5/8 wave whip, UHF tv tuners, ATV video modulator, UHF FET preamps, RTTY monitorscope, extra license study (part 5), building uhf cavities, mini-VEE for 10-20M, vhf vfo.

JULY 69. AM modulator, SSTV sig gen, 6M kw linear, 432 KW amp, 432 er tx/rx, 6M IC converter, radio controlled models, RTTY IC TU, audio notch filter, VRC 19 conversion, tube substitution, 2M transistor xciter, extra license study (part 6), hf FET vfo.

AUG 69. FET regen for 3.5 MHz up, FM crystal switching, 5/8 wave vertical, introduction to ICs, RTTY tone gen, good/bad transistor checker, 2M AM tx, measure transistor Ft, 160M propagation, triac applications, simple IF sweep gen, transistor keyer, SB-100 on 6M, xtal freq measurement, extra license study (part 7), FM deviation meter, grp am 6M tx, circular quads, FM noise figure, transistor parameter tracer.

SEPT 69. Tunnel diode theory, majic tee, soldering techniques, wave travel theory, cable shielding, transistor theory, AM noise limiter, AFSK gen, transistor amp debugging, measure meter resistance, diode stack pwr supply, transistor testing, 2½W 6M tx, HX-10 neutralizing, capacitor useage, radio propagation, AM mod percentage, extra class license study (part 8), 3-400Z linear, ATV vidicon camera, 2 transistor testers, FET compressor, rf plate choke.

OCT 69. Super gain 40M ant, FET chirper, telephone info, scope calibrator, thyrector surge protector, slower tuning rates, identify calibrator harmonics, FM adaptor for AM tx, CB sets on 6M, proportional control xtal oven, xtal filter installation, Q-multiplier, transceiver pwr supply, extra class study (part 9).

NOV 69. NCX-3 on 6M, IF notch filters, dial calibration, HW32A external VFO, 6M converter, feedline info, rf z bridge, fm mobile hints, umbrella ant, 432-er tx (part 1), pwr supply tricks with diodes, transistor keyer, transistor bias design, xtal vhf sign gen, electronic variac, SB33 mods, extra class study (part 10), SB34 linear improvements.

DEC 69. Transistor-diode checker, dummy load/attenuator, tuned filter chokes, band switching Swan 250 & TV-2, SBmm selectivity, match exercizes, rtl xtal calibrator, transistor ps design, hv mobile p.s., 1-10 gHz freqmeter, CB rig on 6M, extra license study (part 11), 1970 buyer's guide.

JAN 70. Transceiver accessory unit, bench power supply, SSTV color method, base-tuned center loaded ant, 6M bandpass filter, extra license study (part 12, rectifier diode useage, facsimile info.

FEB 70. 18 inch 15M dipole, 6M converter, high-density pc board, camper mobile hints, 2M freq synthesizer, encoding/decoding for repeaters, DX-35 mods, panoramic vhf rx, variable-Z HF mobile mount, extra license study (part 13), linear IC info, qrp 40M tx, IC Q-multiplier.

MAR 70. Gdo applications, charger for drycells, FM freq meter, pc board construction, ham fm standards, cheap rf wattmeter, multifreq fm osc, "IF" system modules (part 1), Six-er mods, gdo dip lite, Motorola 41V conversion, tv monitor, buying surplus logic, SSC-23A sono buoy conversion, GRC-9 rx/tx conversion, extra class study (part 14), intro to vhf fm.

APR 70. Noise blanker, 2M nuvistor diode converter, repeater controller, understanding COR repeater, 7/8 wave 2M ant, extra class study (part 15), inexpensive semiconductors, renovating surplus meters, linear amp bias regulator, hi performance if amp & agc system, SSB bfo for shortwave radio, vacuum tube load box, general fm class & transfer guide, rugged-ing your ant.

MAY 70. Comments on "hardware" = 1.2830, future of cw, dream rx adapter, 5/8 wave verticals using 2M intelligently, auto burglar alarms, pwr supplies from surplus components, "IF" system modules (part 2), vhf FET preamps, educated "idiot" lites, postage stamp 6M tx, extra class study (part 16), Bishop 1E%L, low-band police monitor, mobile cw tx, Wichita auto-patch.

JUNE 70. DBRR ant, vfo circuit, remote SWR indicator, indoor hf vertical, two tx on one antenna, environment & coax loss, 2 el triap vertically, buying surplus, 400M amp tx, 32 el 2M beam, extra class study (part 17).

DEC 70. Solid state vhf exciter, delta freq control for SSB, 2M transistor FM tx, HW100 offset tuning, "little gate" dipole, 3-500Z hf linear, general class study (part 5), "transistor" (no good ... motors!), transistor p.s. current limiter.

JAN 71. Split fones for dxing, Heath Tener mods, cw duty cycle, repeater zero beater, HEP IC projects, 10-15-20M parabolic ideas, lightning protection, IC rx accessory, attic ants, double-balanced mixers, permanent marker tool, ham license study questions.

FEB 71. Metal locator, varactor theory, AFSK unit, SSTV patch box, ATV hints, RTTY tuning indicator, tone encoder decoder, 220 MHz converter, SSTV magnetic deflection, IC code osc, 6M rx booster, general class study (part 6), RTTY intro, perf board terminal, low-ohmmeter.

MAR 71. IC audio filter, IC 6M converter, trap vertical ideas, digi counter info, surplus equipment identification, hf linear, simple fone patch, repeater audio mixer, digi RTTY accessories, coathanger groundplane, general class study (part 7).

APR 71. Intro to fm, noise blanker, repeater problems, Motorola HT, microwave repeater linking, dip..., tuneable 2M fm rx/tx, repe..., fm marketplace, meter ev..., reactor modulator, simple sig gen, touch tone hookup, hf preselector, 10M 12W tx.

SOLD OUT

MAY 71. 75M mobile whip, 2M preamp, transistor amp design, 10M qrp tx, portable fm transceiver directory, audio compressor clipper, transistor LM transmeter, 450 MHz link tx, simple af filter, 1 tube 2M transceiver, surplus 2M power amp, general class study (part 8).

JUNE 71. 2M beam experiments, 3 el 2M quad, multi-band dipole patterns, weather balloon vertical, pocket pager, squelch, two-er vfo, tuning mobile whips, transistor pwr supply, capacity decade box, 40M gain ant, general class study (part 9).

JULY 71. IC audio processor, audio sig gen, cw filter, 2M fm osc, 2M collinear vertical, FM supplier directory, Motorola G-strip conversion, transistor beta tester, general class study (part 10).

AUG 71. Ham facsimile (part 1), 500 Watt linear, dimensions for July collinear, 4 tube 80/40 station, vfo digi readout, Jupiter on 15M, general class study (part 11), pink ticket wave meter.

SEPT 71. Transformerless power supplies, solid state tv camera, IC substitution, two rf wattmeters, IC compressor agc, multichannel HT-200, ham facsimile (part 2), causes of manmade noise, vfo with tracking mixer, general class study (part 12), transistor heat sinking, IC pulse gen, fone-patch isolation, hcd wattmeters.

OCT 71. Emergency repeater cor, transceiver power supply, predicting meteor showers, digi switching, reverse-current battery charger, passive repeaters, earth grounds, audio "tailoring" filters, Swan 350 mods.

NOV 71. 3 el 15M beam, motor-tuned gnd plane, 2M gain vertical, transistor biasing, split site repeater, fox-hunting, audio filter, transistor/diode tester, xtal tester, 6M kw amp, 10-15-20M quad, transistor pi-net final, ant feedline, communications dbs, 2300 MHz exciter.

AUG 72. SSTV intro, speech processor, fm repeater info, test probe construction, GE progline ac supply, 432 rf testing, preamp-compressor, Six-er mods, fone patch, Two-er info, solar info, SCR regulator for dc/PS, "ideal" xtal osc, fm rx adaptor, auto theft alarm.

SEPT 72. Plumbicon tv camera, WWVB 60 kHz rx, cigar tube sig gen, cw active filter, rf testing at 1296-3500 GHz, balun ant feed, transistor power supply, IC 6M rx, IC fm/am detector (part 2), active filter design (part 3), K2OAW freq counter (part 3), 2M freq synthesizer (part 1).

OCT 72. Corrections for Aug. fm rx adaptor, 2M freq synthesizer (part 2), 6M transistor vfo, nanoampere meter, time-freq measurement (part 1), active filter design (part 4), repeater timer, extra-class Q&A (part 3), balloon vertical, ID gen, time delay relay, 432 filter ideas, DC-AC inverter, hc diode converter, rtl decade and nixie driver, plus minus supply for ICs.

NOV 72. Hf transistor power amps, RTTY select, IC hf rx, transistor keyer, emergency power, 220 MHz preamp, double-delta ant, simple converter using modules, hf RF tester, "lumped line" osc, 2M freq synthesizer (part 3), K2OAW counter errata, 2M preamp, extra class Q&A (part 4), hi Z voltmeter, Nikola Tesla story, vhf swr meter, transistor regen rx, 432 SSB transverter, AC arc welder, intro to computers, hybrid am modulator, HR10 rx mods, 10M transistor am tx, 40M groundplane, IC logic demonstrator, overload protection, if-rf sweep generator, digi freq counter, rural tx timing.

DEC 72. SSTV scope analyzer, 2M fm rx, tone burst encoder and decoder, universal if amp, autopatch hookup, LM380N info, voltage variable cap info, 2M 18 watt amp, SSB modulation monitor, xtal freq/activity meter, 10A var. dc supply, transmission line uses, radio astronomy, inductance meter, 75 to 20M transverter, LED info, 40M preamp, transistor vfo, 1972 index, 2M preamp.

JAN 73. HT 220 touchtone, 3 el 20M yagi, 50 MHz freq counter, speech processor, 2 tone gen, fm test set, tilt over tower, 6M converter using modules, tuneable af filter, six band linear, 10M IF tuner, diode noise limiter, cw/ssb agc, HW22a transceiver 40M mod, HAL ID-1 mod.

FEB 73. CW id gen, tone operated relay, toroidal quadrature ant, active filter, time freq measurement (part 2), repeater timing control, SSTV circuits (part 1), 2M converter using modules, multifunction metering, FET biasing, freq counter preamp, TR22 hi-power mod, transistor rf power amps (part 1), light bulb rf power indicators, 75A4 filters, capacitance measurement, Gonset 201 mod, world time info.

APR 73. FM deviation meter, 2M FET preamp, two 2M power amps, repeater control (part 1), repeater licensing, European 2M fm, fm scanner adaptor, RCA CMU15 mods, lightning detector, cb alignment gadget, transistor rf power amps (part 2), repeater economics.

JUNE 73. 220 MHz sig gen, vhf power meter, repeater licensing info, RTTY autoswitch, 40M hybrid vfo tx, ant polar mount, 10-15-20M quad, K2OAW counter mods, double coax ant, ham summer job, tone decoder, field strength meter, nicad battery pack, ohm meter, FCC regs (part 1).

AUG 73. Log periodics (part 1), tone burst gen, rf power amp design, transistor radio intercom, 160M ant, SSTV monitor, low cost freq counter, VOM design, qrp 40M tx, 432 MHz exciter, fm audio processing, FCC regs (part 3).

SEPT 73. Repeater control system, log-periodics (part 2), 2M rx calibrator, PLL ic applications, TT pad hookup, Heath HW7 "s" meter, Oscar-6 doppler, 2M coaxial ant, 2M converter, IC keyer, measure ant Z, FCC regs (part 4).

OCT 73. GE Pocketmate mods, microwave freq measurement, CA3102E 2M frontend, 2 kw hf linear, rf wattmeter, meter repair, 80-40 dipole, IC "hi" gen, vhf freq multiplier, FCC regs (part 5).

NOV 73. 450 MHz exciter, intro to ATV circuits, nicad voltage monitor, autopatch connections, IC meter amplifier, TR22 ac supply, indoor vertical, IC af filter, momentary power failure protection, 160M ant acoupler, Motorola HT info, SSTV ISB, Class-B af amp, FCC regs (part 6).

DEC 73. Code speed display, 2M kw amp, IC keyer, 8038 waveform gen, helical resonator design, sensitive rf voltmeter, proximity control switch, IC tester, sequential tone decoder, 2M portable beam, electronic calculator math, cw filter design, FCC regs (part 7).

FEB 74. SSTV monitor info, IC audio amps, scope sweep gen, 15/20M vertical, telephone line control system, pc board construction, var-Q af filter, blown fuse indicator, 40m cw stn with Ten-Tec modules, simple preamp-compressor, single IC rx, "432-er" final assembly, transistor keying circuit, 7 segment readout with nixie driver.

APR 74. Vox for repeaters, tone operated relay, hf transverter, 10 to 2m tx converter, remote control panel for scanner, RCA fm tx tuning, subaudible tone gen, FCC regs (part 9), Repeater Atlas.

MAY 74. Cd car ignition, audio compressor info, interference suppression for boats, auto burglar alarms, 2m ac preamp, 10m fet converter.

JULY 74. 4-1000A linear, universal freq gen, universal afsk gen, 555 IC timer, 80M phased array, 135 kHz-432 MHz preamps, 10M qrp tx, 3000 vdc supply, how to read diagrams.

AUG 74. Toroidal directional wattmeters, 450 MHz FET preamp, use gdo to find "c", Trimline tt pad hookup, R390 & R392 rx mods, tracking cw filter, ...al voltmeter, universal regulated supply, slow scan converter, rtl logic probes, ID timer.

SEPT 74. MOSKEY electronic keyer (part 1), rx warning system, Heath IO-103 scope mods, qrp 40M am tx, rf speech clipper, audio noise limiter, wx satellite on SSTV monitor, universal IC tester, miniature rig construction, tower construction, infinite rf attenuator, electronic

(More)

photo flash ideas, IC "select-o-ject."

OCT 74. Microtransistor circuits, synthesized HT 220 (part 1), repeater government, regulated 5 vdc supply, fm selcal, removeable mobile ants, Motorola metering, 2M vertical collinear, Motorola model code, 2M coaxial dipole, 1.6 MHz if strip, MOSKEY electronic keyer (part 2), carbon mike circuit, hi power lo pass filter, 6M preamp, 3 wire dipole, ATV sync gen, NCX 5 mods, mobile whip for apartment dwellers, sstv auto vertical trig

NOV 74. K2OAW counter update, regulated 5 vdc supply, wind direction indicator, synthesized HT-220 (part 2), 20M 3-el beam, autopatch pad hookups, double-stub ant match, novice class instruction, digi swr meter (part 1), 6M converter (1.6 MHz if), "C-bridge," MOSKEY electronic keyer (part 3), Aug. sstv scan converter errata, repeater off-freq indicator.

DEC 74. Care of nicads, wind speed/direction indicator, wx satellite video converter, electronic keyer, hints for novices, unknown meter scales, SSTV tape ideas, TTL logic probe, public service band converter, tuned-diode test receivers, digi swr meter (part 2), telephone pole beam support, rhombic antennas, 1974 Index

FEB 75. Heath HO-10 scope mod for SSTV, electronic keyer, digital satellite orbital timer, Oscar-7 operation, satellite orbital prediction, Heath SB-102 mods, comparing FM & AM, repeater engineering, Robot 80-A sstv camera mod, neutralizing Heath SB-110A, "Bounceless" IC switch, tape keyer for cw tx.

APR 75. $50 walky for 2M, 2M scanning synthesizer, 88 mH toroid info, 8-function repeater controller, nicad battery precautions, TR22C preamp, telephone attachment regs, Guide to 2M Hand-held Transceivers, 2M 7-el beam, basic telephone systems (part 1), 10 min ID timer, modified hf Hustler mobile ant for 2M, 15M quad modified for 20M, 2M collinear beam, R-11A surplus rx conversion, 5/16 wave 2M ant, Hallicrafters SX-111 rx mods, 160M cw tx.

AUG 75. 146/432 MHz Helical ants (part 2), 10 min ID timer, digi swr computer (part 1), debugging rf feedback, DVM byer's guide, wx satellite monitor, cmos "accu-keyer," pc board method, sweep-tube final precautions, compact multiband dipoles, small digital clock, accessory vfo for hf transceiver, modern non-Morse codes, multi-function gen, 2M scanning synthesizer errata, KP-202 walky charger, 10M multi-element beam.

SEPT 75. Calculating freq counter, wx satellite FAX system (part 1), IC millivoltmeter, three-button TT decoder, troubleshooting sstv pix, 40M dx ants, 146/432 MHz helical ants (conclusion), digi swr computer (conclusion), reed relay for cw bk-in, NE555 preset timer, power-failure alarm, portable qrp rig power unit, precision 10 vdc reference standard, 135 kHz if strip, telephone handsets with fm transceivers,

There's little to get stale in back issues of 73 (our magazine is not padded . . . like others . . . with reams of activity reports), you or "giftee" have a fantastic time reading them. Most of the articles are still exciting to read . . . and old editorials are even more fun for most of the dire predictions by Green have now come to pass. Incentive licensing was every bit the debacle he predicted . . . and more. You'll really get a kick out of the back issues.

Motorola T 44 tx mod for ATV, 0-60 MHz synthesizer (part 10, ham radio PR).

OCT 75. A deluxe TTY keyboard (part 1), Op Amps: a basic primer, an introduction to microprocessors, 2m Synthesizer (conclusion), Satellite Fax System (conclusion), regulated supplies (dispelling the mystery), Digital Logic made simple, FCC interview, a contest uP system, digital clock time bases, the operating desk, QRP 432, ham PR.

NOV-DEC 75. Blockbuster double issue! Flip-flops exposed, breakthrough in fast scan ATV, strobing displays is cool, the tuned lunch box (antenna tuner for HF transceivers), a deluxe TTY keyboard (part 2), the 127' rotating mast, less than $100 multi-purpose scope for your shack (part 1), predicting third order intermod, feedline primer, QRMing the Third Reich, why tubes haven't died, instant circuits — build your own IC test rig, the K2OAW synthesizer PROM-oted, a ham's intro to microprocessing, Ground Fault Interrupter (a keep alive circuit for yourself), a $1 strip chart recorder, an even simpler clock osc., the Fun City surplus scene, updating the Heath IB-1101 counter, 256 pages!

JAN 76. Clocks — Really Simplified, De-Strain your Ham—M, An Automatic Dialer for the Deluxe Mob[...] [...]ging Dead Nicads to Life, The Computer QSO Mach[...] [...]wered Counter, Save Money on Coax, How [...], Using a Bargain Surplus Keyboard, Impro[...] with the FRAMER, and more. The first *73* in new lar[...]at (Includes 1975 index to *73*). SOLD OUT

FEB 76. Build a Starfleet Communicator — Trekkies Special, Synthesized IC Frequency Standard, You Can Make Photo PC Boards, How's Your Speech Quality?, ASCII to Baudot Converter, RTTY Autocall — the Digital Way, Improving the FT-101, Night DXing on 10 and 15m, Really Soup Up Your 2m Receiver, Put Your SB-10 on 160m.

MAR 76. Special Surplus Issue — Tun[...] [...]M Receiver Strips, Surplus Circuit Boards [...] Space Age Junque, A PC Board Bona[...] [...]plus Is It All Gone?, Stereo — A New Type o[...] [...]rter, Build This Exciting New TVT, The Smart Power Supply, How to Use Surplus Pots. SOLD OUT

APR 76. Special FM Issue — A Programm[...], Put That AM Rig on FM, A COR for Your Recei[...] Amplifier, Build a 220 MHz Repeater [...] Your Regency, Long Distance Ca[...] [...]ew TT Decoder, One IC Tone Burster, Th[...] [...]raveler, A Versatile TTY Generator, The PLL - Exp[...], TR-22 Tips, Computers Are Ridiculously Simple. SOLD OUT

MAY 76. Special Antenna Issue — The Magnificent Sevens Microhelix, An Allband Inverted Vee, Closed Loop Antenna Tuning, The 75-80m Broadbander, The Magic of a Matchmaker, How to Coax Your Antenna, 40m DXing — City Style, The Secret 2m Mobile Antenna, An Inverted Vee for 160/80m, The Dipole Dangler, Amateur Weather Satellite Reception, Scan Your HR212, A Very Cheap I/O — the MOdel 15, Code Converter Using PROMs, A Nifty Cassette-Computer System, The Ins and Outs of TTL, Build a CW Memory, 5/8 Wave Power for Your HT, 555 Timer Sweep Circuit for SSTV, AM is Not Dead — It Never Existed at All, Computer Languages -- Simplified.

JUN 76. VHF Special — Super COR — Digital of Course!, Touchtone Decoder — Using a Calculator Readout, Simple Amateur TV Transmitter, Amateur TV Receiving System, Mobile Autodialer, Autocall '76 — Using a Touchtone Decoder, Build This Lab Type Bridge — and Measure Transformer Impedances, How Those Triangle Things Work — a Sort of Op Amp Handbook, Those Exciting Memory Chips — RAMs, ROMs, PROMs, etc., ASCII/Baudot with a PROM — for Ribbonless RTTY on Computers, Aim Your Beam Right — With a Programmable Calculator.

JUL 76. Perfect CW — Drive 'em Crazy with the Keycoder I, The Mini-Mite Allband QRP Rig — A Mighty 7 Watts, A Fun Counter Project — Under $50, Build a FAX from Scratch — Then Get Satellite Pictures and Other Things, Der Repeatermeister -- Repeater Control with ID, The Giant Nixie Clock, Creative SSTV Programming, CW Regenerator/Processor, What's Up on 156 MHz?, TT Pad for the Wilson HT, Power Supply Testing — To Save Your Digital Circuits, A RTTY/Computer Display Unit, Your Computer Can Talk Morse, Gain for Your HT — a Half Wave Whip, The Super Transmatch, Simple VHF Monitor

AUG 76. How Do You Use ICs? — Fundamentals, Surprising Miniature Low Band Antenna — the DDRR (Part II, MINI-MOS — the Best Keyer Yet?, The Skinflint's Delight Breadboard — Cheap Imitation of a Commercial IC DIP Board, More PLL Magic, The Logic Grabber -- Selected Interval Logic Tracer, Global Calculations for the DXer — Using a Hand Calculator, Instant Counter Calibration — Using Your TV Set, Simple 450 MHz Rig — Go ATV With a $42.50 Module, The First Computer Controlled Ham Station — Grand Prize Winner, The Which Chip Dilemma! — 4, 8, 12, or 16 bits: pros and cons, Meaningful Conversations with your Computer — What All Those Mysterious Languages Are All About, A Baudot Monitor/Editor System, A Logic Probe You Can Hear, Satellite Orbit Predicting — Using a Pocket Calculator, FSK with the SB-401, Build the Safari RTTY Terminal, El Cheapo Signal Tracer — Test Gear for the Cheapskate.

SEP 76. The Surprising DDRR Low Noise Antenna (part II), Ultrasimple Regulation with New IC — Power Supply Design Greatly Simplified, Can an Indoor Antenna Work — Making the Best Out of a Bad Bargain, Inexpensive 12 Volts for Your Base Station, A Test Lab Bonanza — Using a Transistor Radio, Protect Your VHF Converter — Novel Antenna Relay, Ridiculously Simple RTTY System, How to Catch a CBer, A 450 MHz Transceiver for Under $130, Space Age Junque II, PROM Memory Revisited, Eight Trace Scope Adapter, The PROM Zapper, Sneaky Baudot — With an ASCII Keyboard!, Simple Graphics Terminal — Using surplus, Counters are Not Magic — They're Simple.

OCT 76. Build a Weird 2 Band Mobile Antenna, Build a Counter for Your Receiver, How do You Use ICs? (part II), QRP Fun on 40 and 80 — Have a Real Ball with Just 5 Watts, The Hybrid Quad — Low Windload, Expense, Hassle!, Frequency Detector for Your Counter, Programmable CW ID Unit — for RTTY, Repeaters, Mobile, etc., New ICs for the Counter Culture — Simpler Counters with Less Used Power, Is My Rig Working or Not? — Build an Effective Radiated Field Meter and Know!, Quickie Collinears for 15 and 10 — a Satisfaction Guaranteed, Build a Super Standard — Goes Right Down to 1 Hz, The Incredible Lambda Diode, Mechanical RTTY Buffer, Have You Used a Triac Yet?, How to Interface a Clock Chip — Baudot, BCD, or ASCII Conversion, A TTL Tester — Great for Unmarked Bargain ICs, The New Ham Programmer — Making Those Confounded uPs Work, BASIC? What's That? — the Basics of BASIC, The Soft Art of Programming (part I).

NOV 76. Blockbuster 288 pg issue! Cordless Iron Tips, Bicycle Mobile, Build a Simple Lab Scope — Costs Less Than $70!, Get on Six with Surplus — The El Cheapo RT-70 is a Natural, The Beam Saver — Rotor Memory System, Updated Universal Frequency Generator, The Shirt Pocket Touchtone, Liquid Crystal Display Guide, Self-Powered Mike Preamp, The Wind Counter, The S38 is Not Dead!, The Amazing Inverted L — Antenna for 20, 40, and 80m, Battery Chargers Exposed, How Do You Use ICs (part III), Thirty Years of Ham RTTY, Big Noise Burglar Alarm, Dandy Digital Dial Decoder, Weather Satellite Display Control, Ham Time-Sharing is Here for You!, The Soft Art of Programming (part II), OSCAR Orbits on Your Altair, ASCII/Baudot Converter for Your TVT, The Smoke Tester — Power Supply Tester, The Man Who Invented AC — Tesla, the Greatest Pioneer of Them All!, Baudot to ASCII — You Want to Learn Programming?, Baudot and BASIC — an Interpreter for a Baudot Computer, Toward a More Perfect Touchtone Decoder, Using a Wireless Broadcaster, The Quiet Spy — Amateur Uncovers Spy Ring in the US!, The Benefits of Sidetone Monitoring — And How to Do It.

DEC 76. Go Tone for Ten — Simple Subaudible Encoder, World's Simplest Five Band Receiver?, How Do You Use ICs? (part IV), A Super Cheapo CW IDer, The ZF Special Antenna, CT7001 Clockbuster, Saving a CBer, A Ham's Computer, What's All This LSI Bunk? — an Ostrich's Eye View of the Microprocessor, The Soft Art of Programming (part III), Put Snap into Your SSTV Pictures — Using a $20 Frequency Standard, What's all This Wire-Wrap Stuff? — Talk About Cold Solder Joints!, Exploding the Power Myth, Exploding the SWR Myth, The IC-22 Walkie — Portabilization with Nicads, Watch DX with a Spectrum Analyzer, DXing with a Weather Map.

HOLIDAY 76. 55 article issue! An Inexpensive 400 Watt HF amplifier, How Do You Use ICs? (part V), Mobile Smokey Detector — 10.5 GHz: Use It or Lose It!, Add RIT to Your Transceiver, DXpedition: Memories for a Lifetime — Reflections of HK1TL, Design Your Own QRP Dummy Load, Failsafe Super Charger — Multi-rate too!, The Amazing 18" Antenna for 160m, Replacing the Knife Switch — Simple TR System for the Novice, Now You Can Synthesize — the VHF Engineering Approach to 2m Happiness, Hutchinson's Remedy — the Chirpless CW Machine, The Mod Squad Does the Pocket Scanner — Radio Shack Pro-4 Update, TR-22 Mod Squad, What Computers Can and Can't Do, A Ham Shack File Handler — Program in BASIC for QSLs, Repeaters, etc., Print Your Own Logbook — On Your Nearest Computer, Shoeing Your HT, Cash In on the CB — Installation for Fun and Profit, Tuning Those Big Antenna Coils, The 2m Mod Squad Tackles the Weather Radio — and Wins!, Hamming by Laser, A 60 Foot Antenna on a 20 Foot Lot — Solving a 40m Novice problem, Dual Voltage Power Supply, An Autopatch Busy Signal, Inside the GLB — a Gutsy Look at a Synthesizer, How to Bug an Automatic Keyer, A 450 Duplexer — That Fits in Your Car, Will Silver-Zinc Replace the Nicad?

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☐ APR 69
☐ MAY 69
☐ JUNE 69
☐ JULY 69
☐ AUG 69
☐ SEPT 69
☐ OCT 69
☐ NOV 69
☐ DEC 69
☐ JAN 70
☐ FEB 70
☐ MAR 70
☐ APR 70

☐ MAY 70
☐ JUNE 70
☐ DEC 70
☐ JAN 71
☐ FEB 71
☐ MAR 71
☐ MAY 71
☐ JUNE 71
☐ JULY 71
☐ AUG 71
☐ SEPT 71
☐ OCT 71
☐ NOV 71
☐ AUG 72
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☐ OCT 72
☐ NOV 72
☐ DEC 72
☐ JAN 73
☐ FEB 73
☐ APR 73
☐ JUNE 73
☐ AUG 73
☐ SEPT 73
☐ OCT 73

☐ NOV 73
☐ DEC 73
☐ FEB 74
☐ APR 74
☐ MAY 74
☐ JULY 74
☐ AUG 74
☐ SEPT 74
☐ OCT 74
☐ NOV 74
☐ DEC 74
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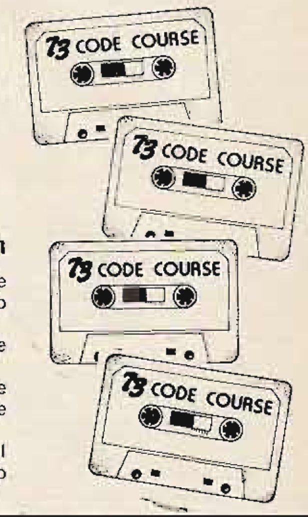

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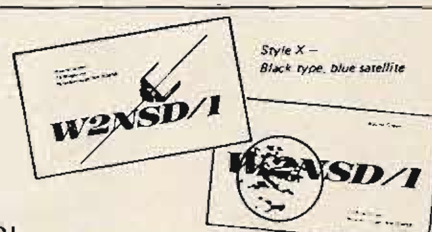

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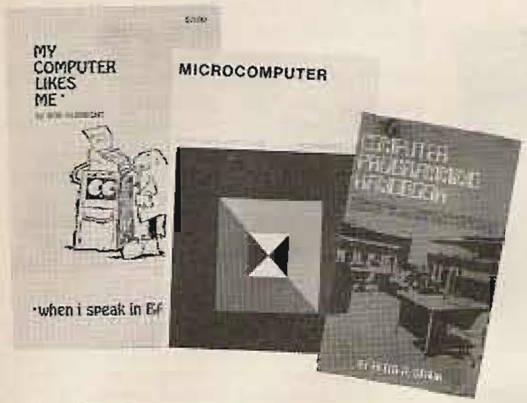

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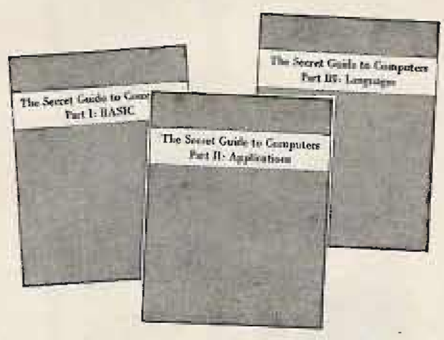

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CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7A	7	3	3	3	3	7	7	14	14A	14
ARGENTINA	14	7A	7	7	7	7	7A	21	21	21	21	21
AUSTRALIA	14A	14	7B	7B	7B	7B	7	7	14	14	14	21
CANAL ZONE	14	7A	7	7	7	7	7A	21	21	21	21	21
ENGLAND	7	7	7	3A	7	7	7B	14	14	14	7B	7B
HAWAII	14A	14	7	7	7	7	7	7	7A	21	21	21
INDIA	7	7	7B	7B	7B	7B	3B	7A	7A	7B	7B	7B
JAPAN	14	7B	7B	7	7	7	3A	7	7	7B	7B	14
MEXICO	14	7	7	7	7	3	3	7A	14	14	14	14
PHILIPPINES	14	14	7B	7B	7B	7B	3A	7	7	7	7B	14
PUERTO RICO	14	7	7	7	7	7	7A	14A	21	21	14A	14
SOUTH AFRICA	14	7	7	7	7B	7B	14	21	21	21	14	14
U. S. S. R.	7	7	3A	3A	7	7	7B	14	14	7B	7B	7

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7A	7	3	3	3	3	3	7	14	14	14
ARGENTINA	14	14	7B	7	7	7	7B	14	21	21	21	21
AUSTRALIA	21	14A	14	7B	7B	7B	7	7	14	14	14	21
CANAL ZONE	14	7A	7	7	7	7	7	14	21	21	21	21
ENGLAND	7B	7	7	3A	7	7	7B	7B	14	14	7B	7B
HAWAII	21	14A	7A	7	7	7	7	7	7A	21	21	21
INDIA	14B	14	7B	3B	3B	7B	3B	7	7	7	7	7B
JAPAN	14A	14	7B	7B	7	7	7	3A	7	7	7B	14
MEXICO	14	7A	7	7	7	7	7	7A	21	14A	14A	14
PHILIPPINES	14A	14	7B	7B	7B	7B	7B	7	7	7	7B	14
PUERTO RICO	14	7	7	7	7	7	7	14	21	21	21	14
SOUTH AFRICA	14	7	7	7	7B	7B	7B	7A	21	21	14	14
U. S. S. R.	7	7	7	3A	3A	3A	3A	14	14	7B	7B	7B
EAST COAST	14	7A	7	7	7	7	7	14	14	21	21	14

A = Next higher frequency may also be useful
B = Difficult circuit this period
FG = Fair to Good
P = Poor

1977 NOVEMBER 1977

SUN	MON	TUE	WED	THU	FRI	SAT
		1 F	2 F	3 F	4 P	5 P
6 P	7 F	8 F	9 P	10 P	11 F	12 FG
13 FG	14 FG	15 F	16 F	17 F	18 FG	19 FG
20 FG	21 FG	22 FG	23 FG	24 F	25 P	26 F
27 F	28 F	29 F	30 F			