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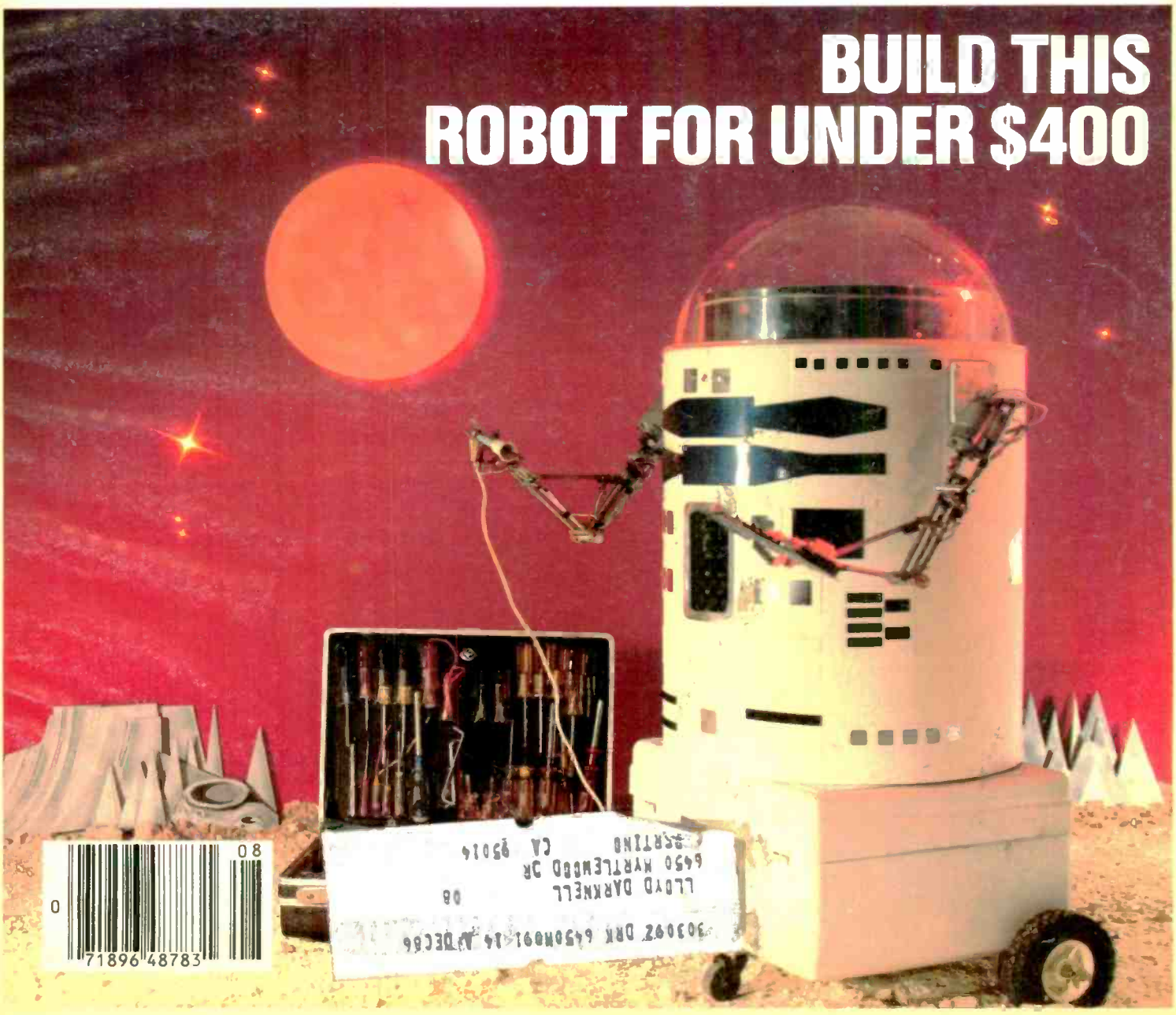
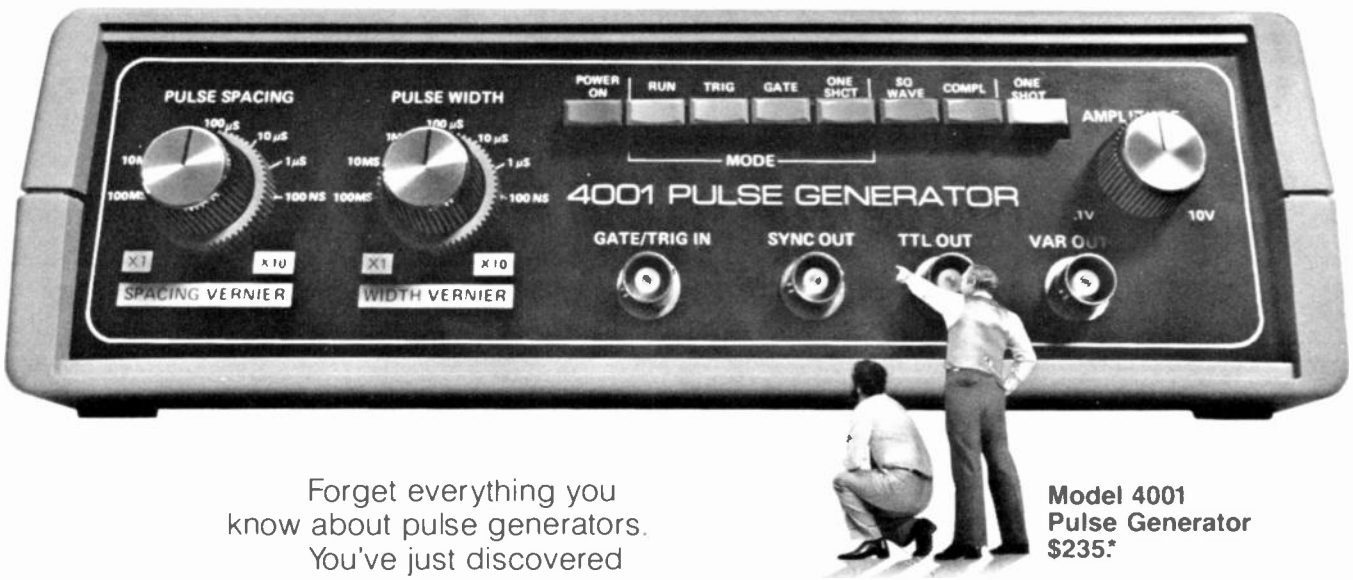
The ultimate turntable pickup arm?
Inside a VHS videotape recorder
Build your own raceway videogame



Digital discovery.



Model 4001 Pulse Generator $235.*

Forget everything you know about pulse generators.

You've just discovered our Model 4001 Ultravariable Pulse Generator™—so much more flexible and economical, it dramatically simplifies *all* your digital designing and testing.

It starts with a smarter way to set pulse parameters: *pulse width* and *pulse spacing* are each independently and continuously variable from 100 nanoseconds to one second over seven decade ranges. Providing outputs from 0.5 Hz to 5.0 MHz.

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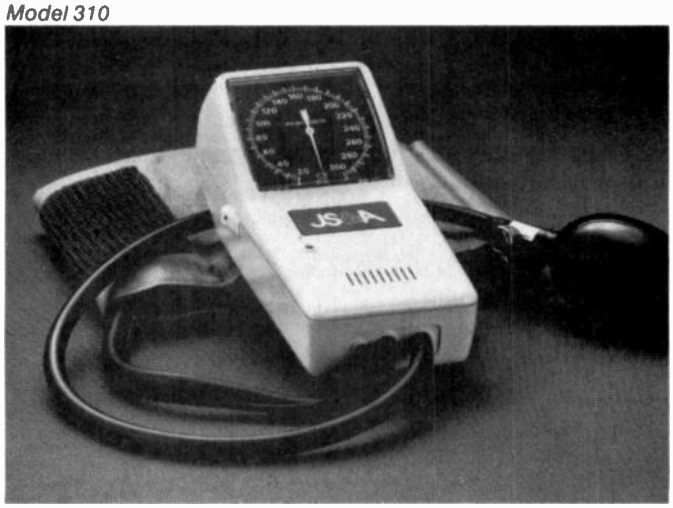
Extended Lifespan

JS&A was destined for failure when we introduced our first electronic blood pressure unit. But then a miracle happened.

Model 310



Model 410

Advertisements were starting to appear everywhere. JS&A had just introduced the world's first home electronic blood pressure unit in a massive national advertising campaign.

But something was strange. JS&A often tests its products in its catalog first before they are nationally advertised. If they sell well, we then start a national magazine advertising campaign. The blood pressure unit sold well in our catalog, but for some strange reason, it wasn't selling well in magazines.

SHOCKING DISCOVERY

And then we found the answer. A few months earlier after our blood pressure unit appeared in our catalog, our computer manager (let us call him Ralph to protect his identity) handed us a computer printout of the catalog sales results.

Scanning the results, we discovered that the blood pressure unit was the best-selling product in our catalog–far exceeding every other product by five times.

The results were so positive that we immediately placed hundreds of thousands of dollars in an advertising campaign launched in early 1978.

Just as the advertisements were starting to appear, Ralph walked into our president's office with some startling news. "There's been a mistake," Ralph said. "The computer printout was wrong. The blood pressure unit is actually our worst selling product but a computer error gave us the wrong information."

And so our president sat back and watched JS&A advertisements appearing everywhere, knowing full well that the campaign would cost his company almost the price of a new computer.

Then came the miracle. As if by plan, the American Medical Association came out with an advertising campaign urging consumers to take their blood pressure regularly to combat hypertension or high blood pressure. Ads appeared everywhere.

The campaign revealed that there may be as many as 25 million Americans who have high blood pressure and don't know it. Simply by taking their own blood pressure and discovering hypertension early enough, Americans could be saving their lives and reducing the chances of heart attacks. Suddenly our campaign started to sell blood pressure units by the thousands.

AWARD RECEIVED

This year JS&A's president received the Extended Lifespan award for "pioneering in the distribution of home health electronic devices" by the Committee for an Extended Lifespan. In accepting the award, our president made it very clear that the award was earned as a result of a computer error and not as a result of his brilliance.

This story is painfully true. And although it may be a slight embarrassment to us, there is one aspect that is not. JS&A was indeed the company that pioneered the electronic blood pressure units and has always selected the very best units available to offer at the very lowest prices possible.

NEWEST UNIT

Our newest unit shown above is another example. The model 310 sells for only **$69.95** plus $2.50 for postage and handling (Illinois residents, please add 6% sales tax.) You simply wrap the velcro cuff around your arm (you can even keep your shirt on) and inflate the cuff. Both an audible tone and a visible red light will indicate your systolic and diastolic readings. The system is extremely accurate, comes with a self-bleeding air valve and can be stored in a convenient carrying case that comes with each unit.

The deluxe model 410 functions similar to the first system except that the readings are displayed in digits, and the unit also displays your pulse reading. It sells for **$139.95** plus $2.50 per unit for postage, insurance and handling. If for any reason you are not completely satisfied with either unit, you may return it within 30 days for a prompt and courteous refund including your $2.50 postage and handling. To order either unit, credit card buyers may call our toll-free number, or you may send your check or money order to the address below.

Both units use solid-state components, come complete with instructions and a one-year limited warranty, and should give you years of trouble-free service. If service should be required, we maintain a service-by-mail center as close as your mailbox. JS&A is America's largest single source of space-age products–further assurance that your modest investment is well protected.

If you are concerned about your blood pressure or know somebody who is concerned about monitoring his or hers, we recommend JS&A's latest units.

Incidentally, Ralph left JS&A on his own accord and bought a farm in another state. There were no hard feelings when he left. How could there be? Order your blood pressure unit at no obligation, today.

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Hand-held computer power is here!

An autoranging DMM breakthrough from B&K-PRECISION.

B&K-PRECISION's new microcomputer controlled Model 2845 is a major advance in digital multimeter technology. At a price comparable to ordinary manually operated units the 2845 brings microcomputer intelligence to a handheld portable DMM. When applied to a circuit, its computer selects the range providing maximum resolution without the slow "hunting" action characteristic of many bench-type autoranging DMM's.

The 2845 is certainly the most user oriented hand-held DMM available. No other DMM can match its speed and simplicity of operation. With tilt stand, large display and optional AC power adapter, it becomes a remarkable inexpensive bench DMM.

- Microcomputer autoranging speeds operation and stabilizes readings
- Auto-skip program for best resolution in least time
- Easiest, fastest-to-use DMM available
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- 3½ digit, 0.5" LCD display
- Continuity test "beeper"
- Range-lock, holds selected range
- Measures AC/DC voltage; AC/DC current; resistance
- Meets tough U.L. 1244 safety standards

Available for immediate delivery from your local distributor. For additional information contact your distributor or B&K-PRECISION.

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Model 2845 $175

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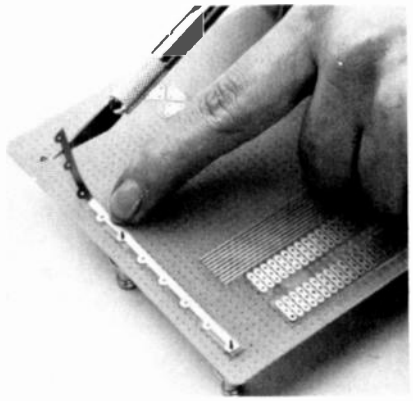
THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

Electronics publishers since 1908

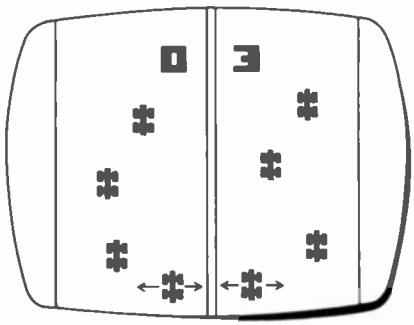
AUGUST 1980 Vol. 51 No. 8

ON THE COVER

Finally, the construction article you've all been asking for: An 8-part series describing a full blown, fully mobile robot complete with manipulator arms. Options include remote control operation, operation via external computer via the remote-control link and an on-board computer. Suggestions are given for adding senses such as sight and feel. The basic robot, minus the options, can be built for under $400. Get started building yours today. Complete details start on page 37.



A QUICK AND EASY way to make one-of-a-kind printed circuit boards. The details start on page 66.



RACEWAY VIDEO GAME you can build lets you pretend to be a *Indy 500* race-car driver without ever leaving the comfort of your armchair. Construction details start on page 42.

Radio-Electronics, (ISSN 0033-7862) Published monthly by Gernsback Publications, Inc., 200 Park Avenue South New York, NY 10003 Phone 212-777-6400 Controlled Circulation Postage Paid at Concord, NH One-year subscription rate U S A and U S possessions, $13 00. Canada, $16 00 Other countries, $18 00 Single copies $1 25

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looking ahead

What's new in color: The 1981 color-TV lines will emphasize random-access digital keypad tuning heavily, in both manual and remote models, with remote control getting greater stress, comb filters spreading to more brands, and audio output jacks appearing in an increasing number of models.

The popularity of cable TV is reflected in the new sets, too. Almost all brands now make it possible to tune at least the special midband cable channels, while Zenith and Quasar feature "105-channel" keypad tuners that can get both midband and superband cable channels. The comb filter, initiated by Magnavox in 1978, now is featured in a substantial number of models by RCA, Zenith, and Quasar, as well as Magnavox. The circuit, which uses a glass delay line in most brands, increases apparent resolution from about 260 to 330 lines and eliminates "cross-color" effects such as crawling dots and color patterns in black-and-white details. RCA uses a special IC which also incorporates horizontal and vertical peaking, instead of using discrete circuitry with a delay line. In addition to keypad tuning, some brands—exemplified by RCA and Zenith—add programmed channel-scan controls which automatically tune preselected channels in sequence.

Last year's rush to add high-fidelity audio amplifiers and speakers seems to have been moderated in many cases, presumably because consumers showed little willingness to pay for the good sound. However, an increasing number of sets now give viewers the options of plugging in their own hi-fi amplifiers, through built-in audio-output jacks. The only new sound gimmick for 1981 is Sony's Matrix Sound in its top-of-the-line 26-inch console, which uses twin hi-fi amplifiers and a bucket-brigade delay device to simulate stereo.

Some notable new one-of-a-kind color TV sets and gadgets: **1.** Zenith's *Space Phone,* featured on one 19-inch and several 25-inch remote sets, uses the TV set as a telephone amplifier. Plugged into a telephone jack, the set's audio system sounds a buzz when the telephone is ringing. Touching a button on the wireless remote unit shuts off the TV sound and brings in the telephone caller's voice over the speaker. A microphone built into the set lets viewers carry on a phone conversation without leaving their seats. **2.** RCA's 19-inch set does double duty as a TV monitor, containing 11 inputs and outputs, including two sets of audio and video inputs for monitoring two VCR's, video games, disc players or other devices. The outputs serve to permit recording from the set's tuner or the simultaneous display of tape or disc output on several sets. **3.** Sony's 3.7-inch AC/DC color set, weighing only seven pounds, can serve as a VCR monitor also, having input and output jacks.

Videodisc update: RCA has finally demonstrated the production prototype of its *SelectaVision* videodisc player, scheduled to be in national distribution early next year. The compact unit weighs about 22 pounds and contains a feature not displayed on previous experimental models—visual search. That is a pushbutton-activated system that scans the disc at about 10 times normal speed in either forward or reverse, while a high-quality picture is displayed on the screen, for location of any segment of the disc. The player has five pushbuttons—forward and reverse visual search, forward and reverse rapid access, and pause. The rapid-access feature lets the user find a segment of the disc by observing the elapsed-time LED. The only additional control is a load-play-unload lever. RCA reiterated that its discs would play for one hour per side, have monaural sound at the start, backed by an initial catalog of 150 titles, with new releases monthly.

Meanwhile, Sony announced that it was entering production of optical videodisc players and discs compatible with the Philips-MCA laser-reflective approach. However, it will concentrate on the industrial-institutional market and says it is uncommitted on which system to back for the consumer market—if any.

Cable progress: The sky seems to be the limit for mushrooming cable TV. At the recent National Cable TV Association convention, cable operators heard progress reports on new technology in their future. Pioneer Electronics demonstrated a developmental alphanumeric two-way home terminal, to be available in 1981, designed to include video channel selection, two-way viewdata access to information banks, home security, electronic transfer of funds, and electronic mail. An earlier Pioneer-made device, to be used in Qube cable systems in Cincinnati and Pittsburgh, can tune 110 channels by remote control and let the viewer tune in a virtually infinite number of "pay-per-view" channels. Many cable-equipment manufacturers showed 400-MHz systems, permitting carriage of 56 channels (or 112 or 168 channels with multiple cables.) Cox Cable announced a test of banking via cable this year in two of its locations. Subscribers will be able to charge purchases made via cable directly to their bank accounts.

Cable and VCR: Videocassette recorders and cable TV sometimes don't mix so well. Because a VCR can't tune to the special frequencies used by many cable systems for additional programs, a VCR-owning cable subscriber normally has the choice of either taping only the channel he watches (if he wants to tape a special cable channel) or taping only the standard numbered channels unattended. Various switching arrangements have been designed to get around that problem; another solution is to rent a second cable box for the VCR.

A new solution has recently been offered for the problem. Vidcor, of New York, is now marketing a small attachment that converts all special cable channels to standard UHF channels. That little converter, installed ahead of the VCR, permits the tuning of special cable channels on the UHF band of the recorder. It also will permit remote-controlled TV sets to be tuned to cable channels directly from the wireless remote unit. Incidentally, the converter is very similar to those used by Magnavox and others in their new-model sets for remote tuning of special cable channels. A similar unit is also available from Etco Electronics, North Country Shopping Center, Route No. 9, Plattsburgh, NY 12901.

DAVID LACHENBRUCH
CONTRIBUTING EDITOR

Facts from Fluke on low-cost DMM's

Conductance: What it is, and what it can do for you.

We've often referred to conductance as the "missing function" in DMM's – the capability so many of you have wanted in a DMM but couldn't find until we introduced the 8020A Analyst.

Since its introduction, the Fluke 8020A has become the world's best-selling DMM. And four more low-cost models with conductance ranges have been added to our line. But you'll still find this function only on Fluke DMM's.

Simply stated, conductance lets you make resistance measurements far beyond the capacity of ordinary multimeters. Until the 8020A, there was no way to make fast, accurate readings from 20 MΩ to 10,000 MΩ – ranges typically plagued by noise pickup. Yet, measurements at these levels are vital in verifying resistance values in high-voltage dividers, cables and insulators.

With conductance, the inverse of ohms, which is expressed in Siemens – Fluke DMM's can measure extreme resistances. Simple conversion of direct-reading conductance values, then, yields resistance measurements to 10,000 MΩ (and 100,000 MΩ with the 8050A), without special shielding and using standard test leads.

Here the 8020A is being used to check leakage in a teflon pcb. With a basic dc accuracy of 0.1% and an exclusive two-year warranty, this seven-function handheld DMM has made hundreds of new troubleshooting techniques such as this possible, and more are being discovered every day.

For more details, call toll free **800-423-0361**; use the coupon below; or contact your Fluke stocking distributor, sales office or representative.

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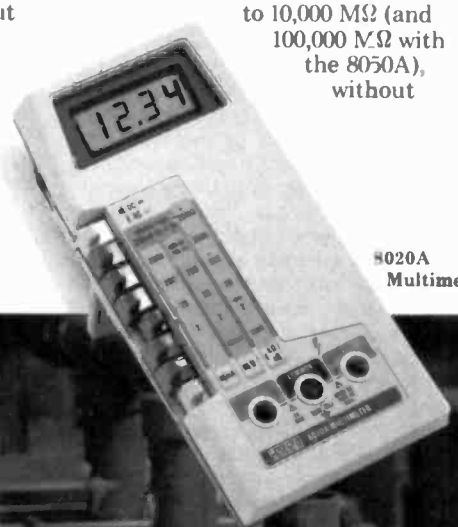
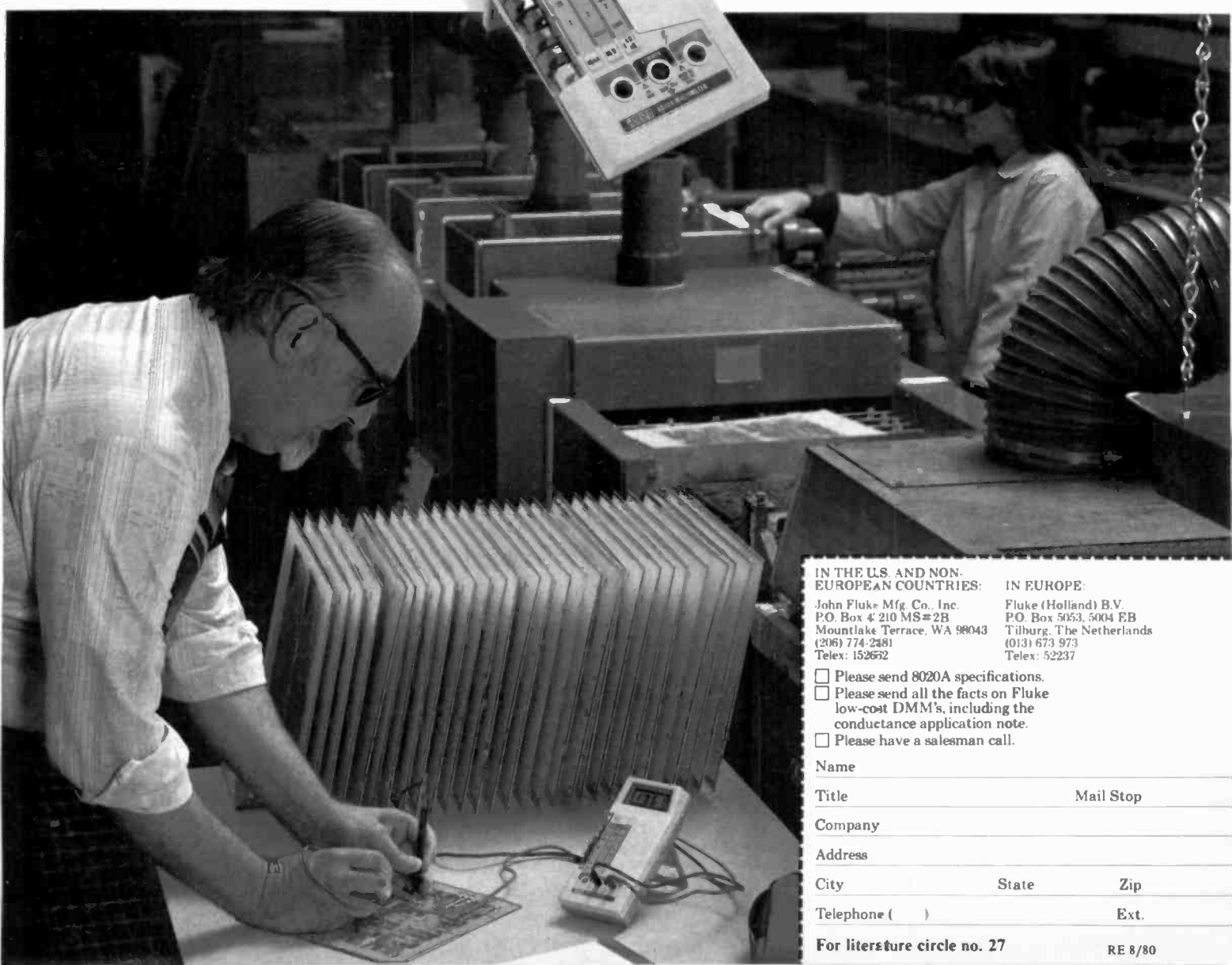


8020A Multimeter



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☐ Please send all the facts on Fluke low-cost DMM's, including the conductance application note.
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For literature circle no. 27 RE 8/80

what's news

Microprocessors oversee "Shining House of Dreams"

The Ahwatukee ("Shining House of Dreams" in the Crow language) House was built by Motorola engineers near Phoenix, AZ, to demonstrate microprocessor applications in a home environment. Computers provide up to 100% automatic control of various operations, always over-ridable in such a way that the homeowner always feels in absolute control of all operations.

Lights, for example, are turned on and off by ordinary wall switches. But the switches are not connected to the lamps—they instruct a computer. Thus the homeowner can program given areas to light up automatically at given times or light levels, or even—with the help of the intrusion detector—when someone enters the room.

Environmental control is automatic. Once programmed by the homeowner, various areas are heated or cooled to maintain a desired temperature. The computer selects the cheapest way—opening or closing windows or turning on heaters or coolers—to adjust the temperature, thus saving energy costs.

Intrusion controls (motion detectors) and smoke detectors protect against burglary and fire by alerting the homeowner and sounding alarms or turning on lights. Even the conventional door key and lock is superseded by a pad resembling a calculator keyboard beside the door. When the person outside punches the proper code word, the door opens. The code can be limited to work at certain times only, or on certain days—to allow maintenance personnel to enter, for example.

The homeowner will control the computer with a keyboard that works with an ordinary TV set as a display. Besides control, he can use the system for information storage and display, entering—for example—tax information, savings account data and other material, to be called up when wanted, or displayed at a given data and time. A daily calendar, with reminders of events for the day, may be displayed.

The present features of the microprocessor home are only a beginning, and others, depending on the homeowner's imagination and—in some cases—on the development of new hardware, are bound to be added.

Stereo AM broadcasting approved by FCC

On April 10th of this year, the FCC, approved a stereo AM broadcast system. The system presented by the Magnavox Consumer Electronics Co. got the nod over three other competitors. It will be compatible with ordinary AM—that is, present broadcast receivers will pick up the stereo program as a monaural signal, much as a monaural FM receiver can receive an FM stereo program. Special receivers will of course be needed to receive the stereo AM as stereo.

AM stereo will have an advantage in that its range will be greater than that of FM, which is confined to a distance of a few miles from the transmitter. On the other hand, the narrower bandwidth of an AM channel will not permit as high-quality reception as the wide band of FM.

RCA sees *SelectaVision* highly popular in Europe

The mass market for the *SelectaVision* Video Disc system is at least as great in Europe as it is in the United States, RCA's Executive Vice President Herbert S. Schlosser told the recent Fourth International Video Disc and Videogram Conference in London.

SelectaVision is a capacitance system with a grooved disc played with a diamond stylus. The disc revolves at 450 rpm and has up to an hour of programming on each side. It can be attached to any color or black-and-white receiver.

Europeans, Mr. Schlosser pointed out, are much more limited in their opportunities to receive off-the-air TV than are Americans. About half the households in the United States can receive at least nine stations (and with cable, many more). But a TV viewer in London can pick up only three channels. The same is true in Paris or Hamburg. And there is practically no weekday programming in England or France until noon, while Germany has only limited morning programming. The European, therefore, has a greater need for a supplemental form of programming than his American counterpart. With the video disc, consumers can "choose the programs they want, and play them when they want.

The *SelectaVision* system is expected to reach the retail market early 1981, with units going to dealers for demonstration in December 1980. Retail price is expected to be under $500.

Dan Noble dies at age 78

Dr. Daniel E. Noble, FM pioneer and early leader in solid-state electronics technology, died February 16 last. He was 78 years old.

Dr. Noble was especially noted for his work in two-way mobile FM radios, having designed and put into operation the first two-way FM system ever used by a State police department, that of Connecticut. Later joining Motorola (in 1940), he was responsible for their commercial FM communications-systems development. After the war, he founded the Motorola research laboratory in Phoenix, AZ. The lab became the Semiconductor Products Division of Motorola.

Dr. Noble also had some distinction as an artist. Among his paintings are the January and May covers of the IEEE *Spectrum* magazine.

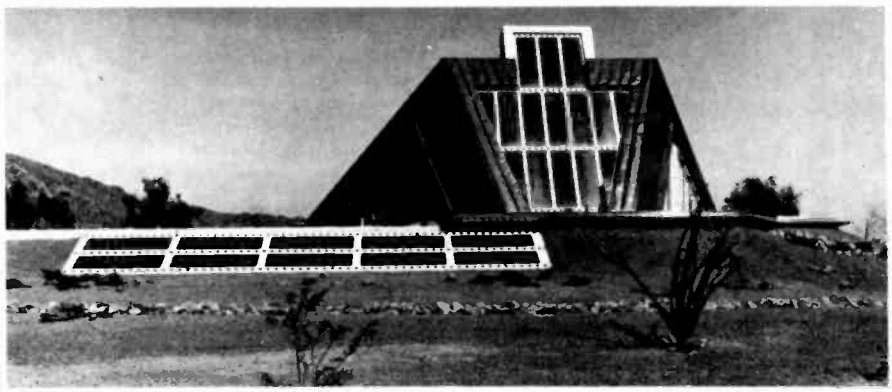
Crystal Clear records now available in dbx

Crystal Clear Records of San Francisco and dbx Inc, of Newton, MA, have joined in announcing plans to issue Crystal Clear albums in the dbx Encoded Disc format. The initial offering will include Volumes I and II of *Sonic Fireworks* (a collection of organ, brass and percussion music), *New Directions* by Laurindo Almeida, and *Taj Mahal Live*.

Each album, says the director of dbx's Encoded Disc program, has been expanded to include previously unreleased selections by the artists featured.

The dbx encoding consists of compressing all frequencies 50% in recording, thus doubling the dynamic range of the record. A dbx Decoder (which retails for $109) expands the record output back to its original volume for playback through stereo equipment.

continued on page 13



DESIGNED TO FIT its mountain and desert surroundings, the *House of Dreams'* unique features include solar collectors for heat and hot water supply and high earth banking against both heat and cold. (The Ahwatukee House has other non-electronic unique features. For example, there is not a square room in the house.)

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- PORTABLE — Palm-sized, light-weight, operates up to approximately 200 hours on a single 9V alkaline battery.
- EASY READING — big, clear, high-contrast 3½-digit LCD display, a full 0.5" high, readable anywhere.
- VALUE PACKED — Outstanding measurement capability and dependability. Outperforms DC time-constant meters, and even bridges costing 2 to 5 times as much.
- RELIABLE — warranteed for 2 full years.

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  dc voltage
  ac voltage
  dc current
  ac current
  resistance
  diode test
- 3½-digit resolution
- 0.25% basic dc accuracy
- LCD display
- Overload protection

Model 8020A: The Analyst

$179

Model 8024A: The Investigator

$219

NEW

- **Seven functions**
  dc voltage
  ac voltage
  dc current
  ac current
  resistance
  diode test
  conductance (1/R)
- 3½-digit resolution
- 0.1% basic dc accuracy
- LCD display
- Overload protection
- **Free case**
- Two year parts and labor warranty

- **Nine functions**
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  ac voltage
  dc current
  ac current
  resistance
  diode test
  conductance (1/R)
  logic level and continuity detect
  temperature (K-type thermocouple)
- Peak hold on voltage and current functions
- Selectable audible indicator for continuity or level detection
- 3½-digit resolution
- 0.1% basic dc accuracy
- LCD display
- Overload protection

KEITHLEY MODEL 130 DIGITAL MULTIMETER

NEW

$99

	RANGE	ACCURACY
DC VOLTAGE	200mV, 2V, 20V, 200V, 1000V	.5%
AC VOLTAGE	200mV, 2V, 20V, 200V, 750V	1%
DC CURRENT	2mA, 20mA, 200mA, 2000mA, 10A	2%
AC CURRENT	2mA, 20mA, 200mA, 2000mA, 10A	3%
RESISTANCE	200Ω, 2kΩ, 20kΩ, 200kΩ, 20MΩ	.5%

New Portable Digital Capacitance Meter

B+K PRECISION

MODEL 820

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- Measures capacitance from 0.1pF to 1 Farad
- Resolves to 0.1pF
- 10 ranges for accuracy and resolution
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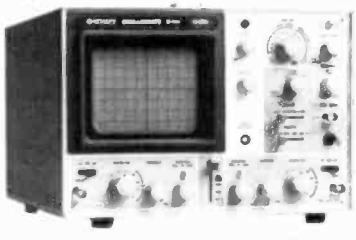

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New from NRI! 25" DIAGONAL color TV that tunes by computer, programs an entire evening's entertainment.

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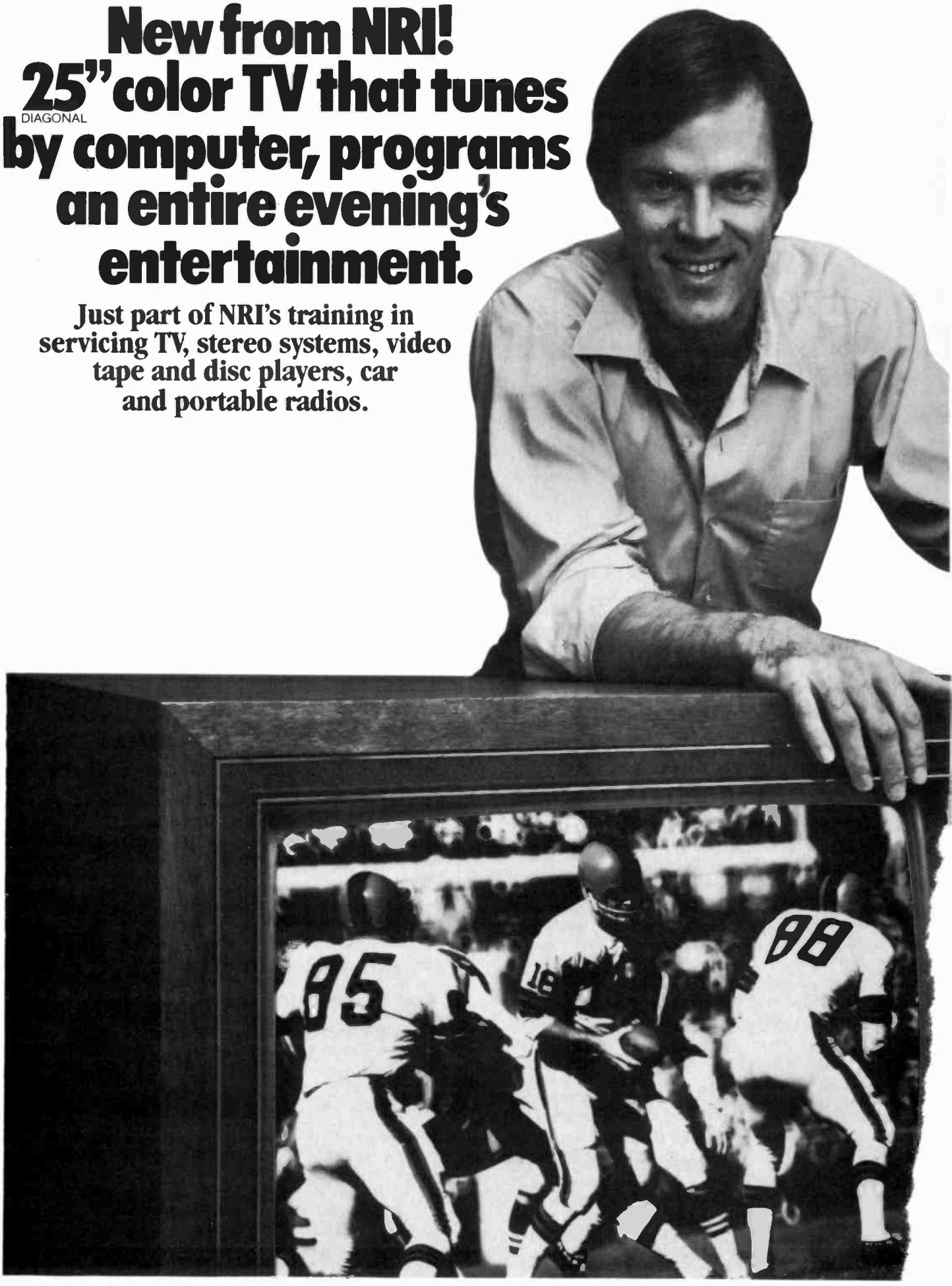

Only NRI home training prepares you so thoroughly for the next great leap forward in TV and audio...digital systems. Already, top-of-the-line TV's feature digital tuning, computer programming is appearing, and new digital audio recording equipment is about to go on the market.

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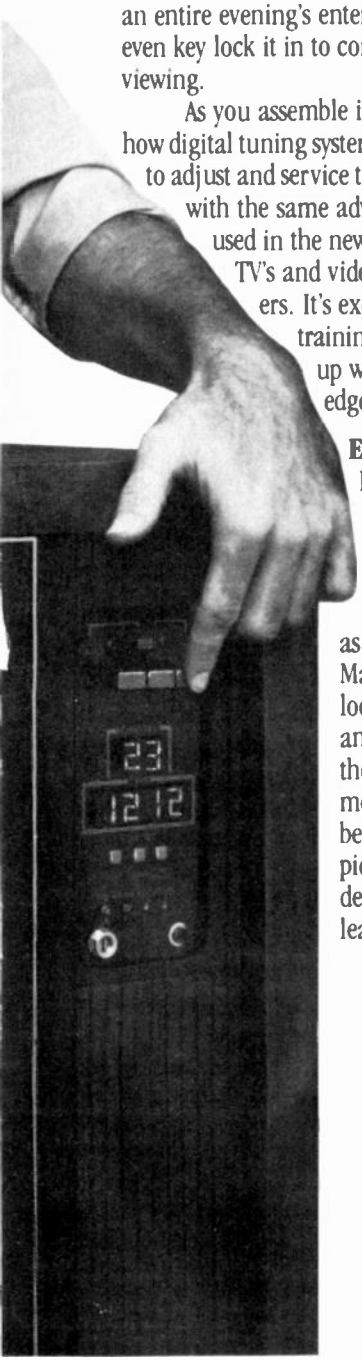

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what's news

continued from page 6

Radios will be optional on American Volkswagen cars

Volkswagen of American (VWOA) has changed its policy of supplying radios as standard equipment on more than 80% of the cars sold by it in the United States, reports the Custom Automotive Sound Association, which sponsored an antitrust suit against Volkswagen some months ago. With the announcement of Volkswagen's new policy, the suit has been dropped.

Radios may still be offered as standard equipment on the Volkswagen Sirocco, the Camper/Combi, Cabriolet, Jetta, and on the Audi 5000's and the 5000 Turbo. On other models, radios, and related sound equipment will be offered to the dealers as options.

Sony Corp of America cleared in antitrust case

A jury in the Federal District Court, Providence, RI, not only cleared Sony of antitrust charges leveled against it by a former distributor, but assessed damages against the complainant.

Lavine Distributors, Inc., of Providence, claimed that it had been illegally terminated in 1976, and that Sony had engaged in an illegal combination and conspiracy to maintain resale prices of Sony brand products. They sought $4.1 million in damages.

The 6-member jury found in Sony's favor, and further determined that Lavine had engaged in a warranty fraud scheme. They awarded Sony $21,000 on its counterclaim.

New programmable pacemaker adapts to patient changes

A new family of computerized, programmable heart pacemakers was introduced at the 29th annual scientific session of the American College of Cardiology by Medtronic, Inc., Minneapolis manufacturer of heart pacemakers and related equipment.

The new pacemaker, *Spectrax*, is not only extremely small and light (10 mm thick, weight 45 grams) but contains a computer chip that permits a physician to change the instrument's functions to meet changing medical conditions throughout a patient's lifetime. In the past, that required another operation and installation of a new and different pacemaker.

An external programmer generates a burst of radio-frequency energy that can tell the implanted pacemaker to change the patient's heart rate, the strength or length of the electrical stimulus, and a variety of other vital pacemaker functions. The chip inside the pacemaker that makes those changes carries codes and information that can cause the instrument to perform almost a million different combinations of functions. Yet the tiny size of the chip and its supporting electronics combines with the small, lithium-iodide batteries to make the *Spectrax* one of the smallest pacemakers available. The life expectancy of the lithium-iodide batteries is 8 to 10 years.

THE MEDTRONIC PACEMAKER programmer and two of the small *Spectrax-SX* pacemakers

Many adults have experienced changed conditions that demanded surgical removal of their pacemakers and replacement with ones matched to the new conditions. But children who need a pacemaker will find the programmable instrument particularly valuable. A young child's heartbeat is faster than that of an adult, and slows down as the child grows. In the past, children have required repeated operations to install new pacemakers. The new instrument is easily adjusted to the decreasing rate through childhood and adolescence—in fact is sold with a lifetime guarantee. (If a new implant is required, the pacemaker is supplied free of charge.)

Medtronics hopes to maintain that guarantee through design elements that have been proved in previous pacemaker models, the long-life power cells, simplified mechanical design, and laser welding of the outer metal covering.

Two-way cable television to affect U.S. policies?

Experiments with audience talk-back cable-TV shows indicates that government agencies may be very receptive to opinions voiced (or rather voted) by viewers of a TV show. A recent presentation by QUBE, the Warner-Amex interactive cable system, at Columbus, OH, featured Dr. Jere Goyan, Commissioner of the Food and Drugs Administration (FDA).

The point at issue was a controversy between the FDA and the drug manufacturers and pharmacists. The FDA proposes that prescriptions be accompanied by a slip or brochure giving information about the drugs contained in it. Dr. Goyan held that in view of the widespread and increasing use of prescription drugs, information about "possible side-effects or long-term hazards, and precautions about taking the drug" is vital. He pointed out that in 1979 tranquilizer misuse alone caused 1,500 deaths.

The manufacturers and pharmacists hold that supplying such information would increase the cost of a prescription 30 cents. The FDA sets the increase at 6 cents.

At the end of the show, viewers were asked if they would be willing to pay 30 cents more for the information. The "yes" votes were 69% via QUBE; 31% said "no." The second question, put to those who had voted "no" on the first, was: "Would you be willing to pay 10 cents (the FDA's maximum estimate) per prescription? Again the answers were 69% "yes," 31% "no."

At the end of the polling, Dr. Goyan stated that the FDA would "weigh carefully" the subscriber responses, and reported that after a similar show in 1979—on food labelling—the FDA had put forward a plan "to accomplish most of the things QUBE viewers had requested," especially in the area of including more percentages of contents and more nutrition information on food labels.

TV sales down, VTR's up in 1980's first quarter

Sales to retailers of color TV's were 2,297,056 receivers in the first 13 weeks of 1980, down 2.7% from the 2,360,170 units sold in the first quarter of 1979, the EIA reports. Black-and-white TV sales in the first quarter of 1980 were 1,272,703 units, a decrease of 11% from the 1,429,872 sold in the same period last year.

Videotape recorder sales in the first quarter of 1980 were 158,124 units, up 59.2% over the 99,346 units sold during the same period in 1979. Much or all of the increase, of course, may be due to the greater availability of videotape recorders this year.

Electronic telephone book planned for French phones

The French Department of Posts, Telecommunications and Telegraphs (P.T.T.) expects to try an experimental electronic telephone book by the end of 1981. About a quarter of a million subscribers in Normandy will get a small-screen terminal with a keyboard attached to their phones. Upon tapping out the area code and the name of the desired contact, the phone number will appear on the screen. The small-screen device may later provide restaurant information and a wake-up service, and automatically transfer telephone calls.

If the terminals can be produced for about $100, it will be cheaper than replacing telephone books regularly. **R-E**

editorial

Cable TV & Ma Bell When will we ever learn

Human beings are supposed to be able to learn from their mistakes ... but sometimes it sure seems as if we don't. Cable television and the Telephone Company form a case in point.

Effective June 7, 1980 it became legal in New York State for Ma Bell customers to connect their own extensions, do their own wiring, etc. In other words, the phone company brings its line into the house and the customer can then do the rest. This has happened only after many years of dispute, argument, court battles, and payment of millions of dollars to Ma Bell by customers who could have taken advantage of a less costly alternative. By the way, guess who paid for Ma Bell's legal costs in trying to prevent customer control.

Finally we have learned that it is less costly for telephone users, you and me, (and believe it or not, Ma Bell as well) to permit us to buy and hook up our own phones. We even have the option of buying our phone from Ma Bell.

We are told that cable television is different. Here the cable company must come in and hook up the set. It must provide the wiring, the adapters, the converters and all the rest of the required equipment. Here you must pay for each extension each month, and you cannot buy your own equipment.

How long does it take to learn a lesson? Why is it so hard to do it right from the beginning? There are 15 million families in the United States already signed up for cable TV, and that number grows every day.

Why can't we, right now, in the early days, decide to do it the way Ma Bell learned? Let the cable company provide only the cable. Since the FCC requires it, let the cable company terminate that line and hook up the first set. But qualified people should then be permitted to do the additional hookups. That means local TV service technicians, and other readers of **Radio-Electronics.** It is already law in one state, Rhode Island. It works in Canada. It should be a national law now. The equipment needed should have a purchase option attached to it just like the one the phone company provides.

Cable companies are going to give us many reasons why it won't work. If I had $225 million dollars a month at stake, I could find a bunch of reasons why it couldn't work, too ($225 million is the estimated monthly billing of cable-TV companies in the U.S.—and that's a very conservative estimate). But let's think of the public good for once, and early enough to do the public some good.

If you agree I'd like to receive your comments and recommend that you pass them on to your legislator. If you disagree, let me know too. We'd like to present your viewpoint to our readers. Discussion now might save a lot of dollars tomorrow.

ART KLEIMAN
Managing Editor

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satellite tv news

A summer-full of sports and politics

This summer's agenda of satellite-transmitted programming will be heavily augmented by a variety of new offerings—starting with a hefty dose of political coverage. Every major news organization will be in Detroit to cover the Republican convention; and what with the commercial TV networks, independent news gatherers, and local stations beaming reports via satellite we're likely to have non-stop coverage of the floor proceedings. The Democratic convention in New York may offer slimmer pickings, since the TV network coverage will be carried via cable locally within Manhattan to the networks operations centers.

In the sports area, there will be more baseball broadcasts via satellite, including a new Thursday-night series transmitted via RCA Satcom I Transponder 9 by UA-Columbia Satellite Services. And ESPN is stepping up its sports coverage by moving into ever-more-arcane areas; one of ESPN's latest contracts is with the United States Table Tennis Association. During the coming year, the all-sports channel (on Satcom I Transponder 7) will carry at least 52 table-tennis events of 90 minutes each. Meanwhile, the familiar sources of satellite programming are also beefing up their offerings. Showtime has expanded its offerings to 14 hours per day, signing on at 1:30 p.m. on most afternoons. The company has committed $14 million to new programming, so you'll be seeing a lot more made-for-pay TV shows on the Showtime transponders as well as on Home Box Office.

Second cable TV network now operating

The second cable TV network—a collection of about 15 program services aboard 11 transponders on Comstar D2—is now beaming its variety of shows, supplementing the primary cable network that is carried via RCA's Satcom I. Although there was the possibility of some minor rearrangements in transponder assignments aboard Comstar D2 (that is parked in orbit at 95° west longitude), here's the basic line-up with "V" standing for vertical polarization and "H" for horizontal polarization: 5V *ESPN*; 6V *Rainbow Communications* (for Prime Time Network, a program service designed for older Americans); 7V *Satellite Program Network* and other services; 8V *Showtime*; 9V and 9H *Home Box Office* (possibly for several new services HBO and its cousins in the Time Inc. family have planned); 10V *Satellite Communications Network*; 10H *Spanish International Network* (for its *GalaVision* Spanish-language pay TV channel); 11H *Warner Amex Satellite Entertainment*; 12V *United Video* (for Times Mirror Cable's programming to various cable TV systems); 12H *National Christian Network*.

Although there was originally a great deal of skepticism about the success of the second cable network, a number of recent developments seem to assure that it will be a success. The presence of such major program suppliers, and Warner-Amex Satellite Entertainment and HBO, will mean strong programming on the bird. In addition, a consortium of programmers who are putting their shows on Comstar D2 have banded together to buy earth stations that will be given away free to the nation's largest cable-TV systems. That will assure an audience for cable-TV systems that might otherwise have waited to install a second dish.

Getty-ing ready for Premier's premiere

If Getty Oil Company and four major Hollywood studios have their way, yet another all-movie pay TV service will be traveling via satellite soon after January 1. Getcom, a communications subsidiary of the giant oil company, and Columbia Pictures, Paramount Pictures, 20th Century-Fox, and Universal Studios have proposed to launch a new pay-TV service called *Premiere* that will show new movies before the films are released to Home Box Office or other pay-TV services. Some complicated arrangements are involved in the preliminary plans, including the use of Transponder 21 (the SPN transponder) on Satcom I for the West Coast feeds and use of Comstar D2 Transponder 5V for the East Coast prime-time evening transmissions. (The Comstar transponder was originally intended for ESPN, the all-sports network that, coincidentally, is 85% owned by Getty Oil; ESPN has another transponder aboard Satcom I.)

Complete plans for Premiere will be released later this year; and it could face a rocky legal road—since many of the current pay-TV companies have threatened to file an antitrust suit against the studios for alleged monopoly practices. Premiere will probably carry about 150 movies per year.

Lights, camera, satellite

Filmmaker Francis Coppola (director of *The Godfather, Apocalypse Now* and other hits) predicts "all films will be made electronically within five years" and that studios and remote locations will be linked via satellite to cut spiraling production costs. The innovative director, who has just bought a Hollywood lot with sound-stages and all production facilities, told a Los Angeles reporter "there is no reason studios can't be connected by satellites, sharing images and sound around the world."

Dependence on satellites will also include distribution to theaters to reduce print costs, Coppola predicted. He plans to earmark 50% of his Zoetrope Studios' profits for research and development, with heavy emphasis being placed on new electronic technology.

Around the satellite circuit

Sears has dropped out of the plan for a partnership with Comsat General to develop a direct-to-home satellite broadcasting service. The original idea called for Sears to handle the installation of small earth terminals that would be placed at customers' homes once the service started—which was presumably several years away. Now Comsat is looking for another partner in the venture, possibly one of the other large national retail chains with a big TV service/installation department.

There's more teleconferencing aboard the various satellites—mostly private meetings of industry associations and companies. The idea is spurred by the continuing energy crisis and inflation, which makes it very costly for companies to send executives around the country for meetings. So, instead, company officials meet at local sites and are interconnected via satellite hookups. Among the most recent companies to get into the business is Holiday Inns; they have established a subsidiary called HI-Net. HI-Net actually coordinates the programming from Home Box Office and other entertainment services that are beamed into motels around the country newly equipped with rooftop antennas. But during daytime hours, HI-Net is using the same transponder for private meetings between customers gathered at various Holiday Inns nationwide. Many other private organizations and government agencies are also stepping up their use of satellites for such teleconferences.

GARY H. ARLEN

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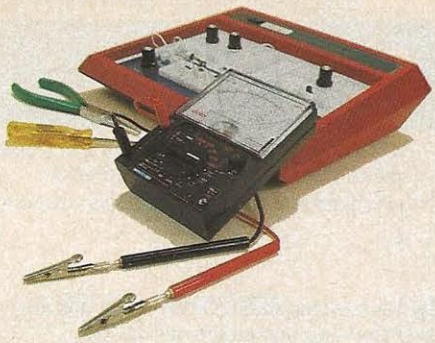

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SFG-1 Complete Set $16.00
SFG-2 Plans only $1.50

GARY McCLELLAN
La Habra, Ca

OOOOOOOOOOPS!

It was gratifying to see Bob Cooper recommend the Motorola wideband amplifier for a 70MHz IF strip in his article, "Backyard Satellite TV Receiver" (April 1980). Unfortunately, the device title was quoted as AWT-120; it should have read MWA-120.

The MWA-120 is one of a family of nine thin-film hybrid amplifiers in TO-39 packages. The MWA series have three frequency ranges: 0.1-400 MHz, 0.1-600 MHz, and 0.1-1.0 GHz. Each frequency range has three types of single-stage Class-A amplifiers biased at 10, 25 and 60 mA. The input and output impedance is 50 0hms and the amplifiers are unconditionally stable.

Should your readers require a data sheet of the MWA-120, or any other hybrid amplifier in the series, they should call the Motorola Literature Distribution Center at (602) 994-6561.

ALAN WAGSTAFFE,
Motorola Semiconductor Group,
Phoenix, AZ

TRIGGERED OSCILLOSCOPE

I would like to call attention to an error in figure 4 of the Triggered Oscilloscope (April 1980 issue.) A 10-μF capacitor (C306) should be connected from the cathode (bottom) of D303 to ground, with the positive end to the diode. Also the polarity mark on C319 is reversed.

For your readers who would like to duplicate the instrument, I can supply the four boards etched and drilled, along with a graticule for 3″ CRT for $15.00 at the following address:

DANIEL METZGER
7741 Fir Drive
Toledo, OH 43612.

TELEPHONE SYSTEMS

Telephone-construction projects, such as the music-on-hold telephone accessory, and telephone convenience items like automatic telephone dialers (both in the November 1979 issue) are becoming very popular. Part 68 of the FCC Rules addresses "network harm," but fails to outline necessary terminal device "characteristics." The result is that most of those devices will work in most circumstances—but not universally.

A few suggestions are offered for the authors and hobbyists. Telephone systems vary. While most modern systems maintain a constant battery potential, some older systems reverse that polarity to the caller during conversations. A diode bridge can be added if needed. 1200 ohms will hold the line in most cases, but that resistance may be too high. A telephone is nominally 200 ohms (±50 percent or more). The hold circuit should be slightly higher in resistance than the telephone, so that it will release when the telephone is lifted. A hold value of 400 ohms gives much more assur-

continued on page 24

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TELEPHONE SYSTEMS

Telephone-construction projects, such as the music-on-hold telephone accessory, and telephone convenience items like automatic telephone dialers (both in the November 1979 issue) are becoming very popular. Part 68 of the FCC Rules addresses "network harm," but fails to outline necessary terminal device "characteristics." The result is that most of those devices will work in most circumstances—but not universally.

A few suggestions are offered for the authors and hobbyists. Telephone systems vary. While most modern systems maintain a constant battery potential, some older systems reverse that polarity to the caller during conversations. A diode bridge can be added if needed. 1200 ohms will hold the line in most cases, but that resistance may be too high. A telephone is nominally 200 ohms (±50 percent or more). The hold circuit should be slightly higher in resistance than the telephone, so that it will release when the telephone is lifted. A hold value of 400 ohms gives much more assur-

continued on page 24

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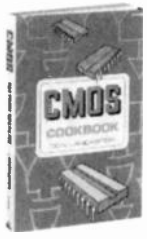

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LETTERS

continued from page 22

ance of holding the telephone system than 1200 ohms. (I don't know what effect the lower resistance would have on the hold circuit published.)

Upon reading the article, I made a simple test. My telephone system measured 50 volts open circuit and 40 mA shortcircuited. That computes to 1250 ohms resistance. With an additional 1250-ohm hold circuit, the current would be about 20 mA. There is no voltage polarity reversal. The published circuit should work in that case.

The telephone system generally supplies 50 volts through a resistive and inductive network and through wires (resistance) into the home. The R-L network is usually a relay coil—often 400 ohms. The relay pull-in current is generally 20 mA or greater. The hold current may range from 10 mA to near the pull-in current, depending on the relay (or electronics) characteristics. A simple drop-out test can be made with a variable resistance and an mA meter.

One final note: Sometimes modern ancillary electronic devices are used in telephone systems that have non-standard characteristics. There is a high probability that the music-on-hold would not work (as published) with such ancillary devices.

NAME WITHHELD

ENERGY ALTERNATIVES

My experience has shown that government bureaucrats and politicians are too involved with their own problems to consider suggestions and improvements that are not funded or credited to a government agency.

For several years now, I have researched many ancient manuscripts and have concluded that many secrets of energy have been known for thousands of years.

Your editorial in the November 1979 issue made reference to the discovery of chlorophyl as an additive in a solar cell by the University of Tokyo's Department of Synthetic Chemistry. I suggest that a close examination of the ATP (*A*denosine *T*ri *P*hosphate) molecule would reveal some startling things, and, furthermore, since chlorophyl increases the efficiency of the solar cell by 30%, I'm convinced that the addition of phosphate to the solar cell would not only extend that efficiency 30 to 50% but also the length of its usefulness. In other words, since the phosphate molecule is charged, it is kept in an unstable state long after the sun goes down.

Because the phosphate and sugar function as a complementary energy generator and transporter, it is my serious conviction that phosphate and sugar are very necessary as the electron collector in the solar cell, but a sugar-phosphate battery may be the answer to an efficient energy cell.

The ATP molecule is the secret to our life's energy and the chlorophyl triphosphate (CTP) cell may be the answer to solar energy; the phosphate battery may be the storage cell of the future.

For what it's worth, I wish to share this information with anyone interested enough to read it, and perhaps some reader will be able to develop it as a future energy source.

RALPH GARNER,
New York, NY

R-E

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Explorer/85's Level "A" system features the advanced Intel 8085 cpu, an 8355 ROM with 2k deluxe monitor/operating system, and an 8155 ROM-I/O—all on a single motherboard with room for RAM/ROM/PROM/EPROM and S-100 expansion, *plus* generous prototyping space.

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Level "A" at $129.95 is a complete operating system, perfect for beginners, hobbiests, or industrial controller use.

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System Monitor (Terminal Version): 2k bytes of deluxe system monitor ROM located at F000 leaving 0000 free for user RAM/ROM. Features include tape load with labeling ...tape dump with labeling...examine/change contents of memory ...insert data...warm start...examine and change all registers...single step with register display at each break point, a debugging/training feature...go to execution address... move blocks of memory from one location to another...fill blocks of memory with a constant...display blocks of memory ...automatic baud rate selection...variable display line length control (1-255 characters/line)...channelized I/O monitor routine with 8-bit parallel output for high speed printer... serial console in and console out channel so that monitor can communicate with I/O ports.

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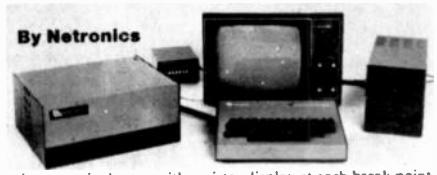

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Hex Keypad/Display Specifications

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Explorer/85 with Level "C" card cage.

Level "C" Specifications

Level "C" expands Explorer's motherboard with a card cage, allowing you to plug up to six S-100 cards directly into the motherboard. Both cage and cards are neatly contained inside Explorer's deluxe steel cabinet. Level "C" includes a sheet metal superstructure, a 5-card gold plated S-100 extension PC board which plugs into the motherboard. Just add required number of S-100 connectors

Level "D" Specifications

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Level "E" Specifications

Level "E" adds sockets for 8k of EPROM to use the popular Intel 2716 or the TI 2516. It includes all sockets, power supply regulator, heat sink, filtering and decoupling components. Sockets may also be used for soon to be available RAM IC's (allowing for up to 12k of onboard RAM).

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When connected to a computer, the computer must echo the character received. This data is received by the VID which processes the information, converting to data to video suitable to be displayed on a TV set (using an RF modulator) or on a video monitor. The VID generates the cursor, horizontal and vertical sync pulses and performs the housekeeping relative to which character and where it is to be displayed on the screen.

Video Output: *1.5 P/P into 75 ohm (EIA RS-170)* • **Baud Rate:** *110 and 300 ASCII* • **Outputs:** *RS232-C or 20 ma. current loop* • **ASCII Character Set:** *128 printable characters—*

BAUDOT Character Set: *A B C D E F G H I J K L M N O P Q R S T U V W X Y Z · ? : ° 3 $ # ( ) . , 9 0 1 4 ! 5 7 ; 2 / 6 8* • **Cursor Modes:** *Home, Backspace, Horizontal Tab, Line Feed, Vertical Tab, Carriage Return, Two special cursor sequences are provided for absolute and relative X-Y cursor addressing* • **Cursor Control:** *Erase, End of Line, Erase of Screen, Form Feed, Delete* • **Monitor Operation:** *50 or 60Hz (jumper selectable.*

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equipment reports

Leader LSG-16 RF Signal Generator

CIRCLE 101 ON FREE INFORMATION CARD

WHEN WE UNPACKED THE NEW *LSG-16* SIGNAL generator from Leader Electronics Corporation (151 Dupont St., Plainview, NY 11803), we discovered one of the smallest instruments of this type we had ever seen. It measures less than 10 inches wide, 6 inches high, and 5 inches deep and is obviously suitable for small work areas. Enclosed by a rugged steel cabinet, the generator weighs 5½ pounds. Its finish is gray with brushed aluminum.

The design of the *LSG-16* is very straightforward—no bells or whistles—and operation is simple.

Two features incorporated in the *LSG-16* are not usually found on low-cost equipment: A switchable line-voltage provision (120/240 VAC), and a crystal test socket. Type FT-243 crystals from 1-15 MHz (fundamental) may be inserted and tested for activity, or used as crystal-controlled markers. Perhaps it would have been better if they had used or added a socket for the more recent HC-18/U-type overtone crystals, but an adaptor for these can be easily fashioned.

The socket is a nice feature for test situations where CB or amateur crystals must be checked for condition and frequency, or when an accurate frequency standard is needed during a critical alignment procedure.

Most remarkable of all is the frequency stability of the generator. A FET oscillator is used and warmup time is negligible. As soon as we switched on the *LSG-16*, we zero-beat the output with the signal from a local broadcast station. No drift was observed. Even rapping the cabinet resulted in no shift in frequency. Crediting this stability to the low frequency we were monitoring (1200 kHz), we switched to the highest range of the instrument. An FM broadcast station was selected, and again the instrument was zero-beat against it. Still no drift! Equally remarkable was the accuracy of the dial readings. Specifications indicate a tolerance of ±1.5%. In practice, measurements were well within these limits.

The RF generator is tunable from 100 kHz to 100 MHz on fundamental frequencies; usable through 300 MHz on harmonics. The RF output level is adjustable, with 100 millivolts available up to about 35 MHz. Commonly used IF frequencies (455 kHz, 4.5 MHz, and 10.7 MHz) are prominently marked. A slide switch selects between high level (×10) and low level output, with a potentiometer included to fine-tune the level.

An internal modulator is also provided. It operates at 1 kHz with approximately 30% modulation. External modulation may also be injected. The unit will accept any audio frequency input from 50 Hz to 20 kHz at levels up to 1 volt. A fixed audio output is also available: 1 kHz at 1 volt (maximum).

Although the instrument is compact, the

continued on page 32

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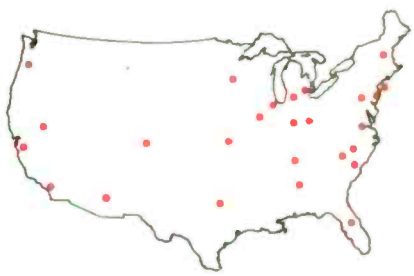

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dial scale is large, making it easy to read. The vernier tuning is quite smooth, without the usual rubbery feel associated with many other low-cost signal generators. Backlash is essentially absent.

The oscillator circuit itself is a frequency-stable Colpitts type, coupled through an R–C network to a bipolar buffer to reduce loading by the circuit under test. The oscillator is drain-modulated by a series bipolar audio transistor. The modulator is driven by a separate phase-shift audio oscillator.

The audio oscillator is also used as part of the crystal oscillator. In fact, it is possible to superimpose the crystal oscillator signal on that produced by the variable RF oscillator.

A regulated DC supply is used for the RF oscillator to assure good stability and low hum. Although some RF leakage is present, it is minimized by internal shielding and AC line-filter capacitors.

Signal input to the generator is accommodated by two banana terminals (one chassis-grounded) at high impedance. The RF output is available from two screw-type binding posts which can also accommodate banana plugs. Terminal spacing is correct for plug-in banana-connector coaxial test leads.

The instrument cabinet has a carrying handle, and rubber feet insure scratch-free desktop usage.

The instruction manual is quite comprehensive, and includes both block diagrams and a complete schematic diagram of the circuitry.

Everything considered, we were very impressed by the Leader *LSG-16* wideband signal generator. It is thoughtfully designed, expertly manufactured, and bargain-priced. The *LSG-16* signal generator sells for $149. **R-E**

MFJ Enterprises LSP-520BX Communications Speech Processor

CIRCLE 102 ON FREE INFORMATION CARD

MFJ ENTERPRISES, PROMINENT IN A BROAD line of amateur accessories, has introduced a logarithmic speech processor for the communications user. The *LSP-520BX* may be used with CB, ham, or other voice-communications service. To appreciate the benefits of a logarithmic speech processor fully, a brief review of speech-processing theory may be in order.

The average microphone faithfully reproduces voice frequencies and amplitudes as electrical signals that, in turn, are amplified and used to modulate the carrier wave of the transmitter. In single sideband transmitters, the audio level determines the level of the RF power output. Unfortunately, the average speech level frequently drops during weak sounds. That is where speech processing comes in.

A speech processor is a device that electronically selects the critical components of the voice and amplifies them to an optimum level. Overdriving, and its accompanying distortion, is no problem with a properly adjusted speech processor. The maximum modulation level is preset and can not be exceeded.

The *LSP-520BX* provides 30 dB of dynamic range using a type-741 IC logarithmic amplifier. Seven discrete transistors help contour the voice frequencies to an optimum passband. Three active filters assist that voice-shaping. By amplifying those frequencies that are normally of low intensity, but which contribute a great deal in intelligibility, average modulation percentage is increased substantially.

The *LSP-520BX* is self-powered, requiring an internal 9-volt battery. Since current drain while in use is only 3 milliamps, a standard "transistor-radio" battery will last many months with normal use.

The speech processor is available in two versions. The *LSP-520BX* has a front panel on/off slide switch, 2 standard ¼-inch phone jacks (input and output), and a COMPRESSION level control. It is in a standard wrinkle-texture enamel-painted metal cabinet. The *LSP-520BX II* is electronically identical, but it includes an additional 4-pin mike jack, a rotary function switch that selects the range of the audio passband, an output cable (no connector), and is housed in an attractive wood-grained enclosure.

Both units are designed to work with low output, medium-impedance microphones (typical communications mikes). If your station mike has a high output-level, it is a simple matter to add a resistor to reduce the input to a level that the processor can handle easily without distortion.

continued on page 34

You'll be a little richer after building one of these.

H-19 Professional Video Terminal

H-11A 16-Bit Computer with Dual Floppy Disk Storage

H-8 Personal Computer with Dual Floppy Disk Storage

Self-Instruction for Assembly and BASIC Programming

H-89 All-In-One Computer with Floppy Disk Storage

H-14 Serial Printer

Richer in knowledge
Once you build your own computer, you'll know it inside out. You'll know how to make it work for you, how to make it grow as your skills grow.

Richer in savings
Build-it-yourself kits cost less – about 30% less than comparable assembled computers. And you'll probably never need to pay someone for service because no one will know your computer better than you.

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Innovative software
Heath offers you innovative programs for running your home or business, and exciting games for your family. You can have Microsoft™ BASIC™, one of the most powerful and widely used languages.

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Choose from three computer systems:

The H89 All-In-One Computer gives you everything in one compact, convenient unit.

The flexible H8 gives you the freedom to combine memory and interfacing for exactly the system you require.

And the powerful H11A gives you 16-bit power for your most complex programs.

The Heathkit line includes video terminals, matrix and letter-quality printers and a complete selection of accessories. You'll even find award-winning self-instruction packages to teach yourself programming in BASIC or Assembly.

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CP-186

CIRCLE 32 ON FREE INFORMATION CARD

EQUIPMENT REPORTS

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The *LSP-520BX* comes with both a hookup diagram and a schematic, along with some brief operational hints. While the instructions appear unusually short, they are adequate for placing the processor into operation.

Our test

Following instructions, we removed the top of the cabinet and inserted a battery. A microphone connector was soldered to the output cable (ours was the *II* version), and a microphone was inserted into the input jack.

Proper adjustment was touchy at first, but became second nature after we understood the procedure. Basically, an internal trimmer is adjusted to avoid flat-topping (overmodulation), and a panel control is adjusted to the desired compression level (similar to adjusting a gain control). That's it.

Our on-air test consisted of listening to the original microphone without the compressor, and then listening to it through the compressor. We found that the compressor substantially increased voice power. Without the processor, modulation percentage fluctuated typically between 40-70%. It sounded natural, although a little hollow from our hard-walled room. Through the processor, the mike held modulation close to 100% with minimum distortion. Voice quality was vibrant. The II version has a rotary-switch position that permits the selection of a crisp-voice passband that has real punch. That position would be used for those marginal cases where interference posed a problem in the reception of a signal.

We felt that the speech processor was indeed a worthwhile addition to a voice communications installation, especially if the CB or ham transmitter did not have internal audio processing of its own. A liberal warranty policy is provided. The *model LSP-520BX* sells for $49.95, and the *LSP-520BX II* sells for $59.95. Both are available from MFJ Enterprises, Inc., P.O. Box 494, Mississippi State, MS 39762. **R-E**

Hickok Model 240 Video Pattern Generator

CIRCLE 103 ON FREE INFORMATION CARD

THE HICKOK ELECTRICAL INSTRUMENT Company. (10514 Dupont Ave., Cleveland, OH 44108) has been making high-quality test equipment for a long time. I have a Hickok 188 RF Signal Generator and two VTVM's on my bench that have been there for more than 40 years—still working fine. There are others, but those are the seniors. I've just received the latest descendant of those instruments. Lately, Hickok has been making some very good miniature instruments. This is one: the *model 240* Video Pattern Generator.

This little jewel isn't much bigger than a small calculator. It will fit into my shirt pocket. Tried it to be sure. Little or not, this is a complete video-pattern generator with all of the standard patterns, 11 in all, including two color-bar patterns: the stock 10-bar, and a 3-bar one. All of the standard convergence patterns are there: crosshatch, dots, vertical or horizontal lines, single vertical or horizontal line, cross (one of each), a center dot, plus one new and very useful one—a staircase for gray-scale testing, video-stage response testing with a scope, and many more.

The RF output of the *model 240* can be tuned to Channel 2, 3 or 4, by a screwdriver adjustment on the front panel. It has a video output at the standard 1.0-volt sync-negative level. Video level can be set to the 1.0-volt level with a variable control. There is also a chroma control that can set the chroma signal to any level up to 150% of normal. The remaining jack on the front panel is the scope-trigger output. That is composite vertical and horizontal sync, at a level of 11 volts P-P.

The video-pattern selector is an 11-position slide-type switch. To get any desired video pattern, just slide that selector switch along—the different patterns are pictured above and below—just line up the vertical mark with the pattern you want and that's it! There is a 3-position selector switch, with RF at left, OFF in center and VIDEO at right. At the top of the panel, between the CHROMA and VIDEO controls, a LED pilot light/battery-condition indicator shows up when it's on.

The *model 240* is powered by two standard 9-volt batteries, or by the AC adapter. The batteries do not have to be in the instrument when the AC adapter is used for bench work. If you want to use nickel-cadmium batteries, Hickok recommends using two GE TR805D1's, and connecting an 820-ohm resistor on the circuit board; that will let them recharge while the instrument is off and the AC adapter plugged in.

The *model 240* has two pairs of test leads. One pair is for the RF and video outputs with the handy push-on spade-lugs for easy hookup to the TV set's antenna-terminal screws. The other pair of test leads come with two mini-clips for video tests, scope trigger, and others. Those leads are black and coded: the one with the white stripe is the hot (output) side and the plain one ground. Incidentally, if your test needs video with positive going sync, you can get it by reversing the two clips. You can't use the scope trigger when doing that because the grounds are common.

The *model 240* is the latest in a group of mini test instruments. It includes a transistor tester and two digital VOM's all small enough to carry in a pocket or caddy. The case has a snap-on lid for protection and is made of a tough plastic. You can get a nice padded carrying case with a zipper, big enough to hold the test-leads and the instrument. Also has a belt-loop in case you want to do some "quick-draw" testing! Leave the AC adapter on the bench. Unplug it and you're ready to go on battery power.

These should be a very handy little group of instruments for either bench or field work, and they certainly do not take up much room on the bench. The suggested retail price of the *model 240* is $159.00 and is well in the ballpark for an instrument of such versatility and quantity. **R-E**

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Brief Specifications: DC Volts 100μV to 1000V in 5 ranges; AC Volts 100μV to 1000V in 5 ranges; DC Current 0.1μA to 10A in 6 ranges; AC Current 0.1μA to 10A in 6 ranges; Resistance 0.1Ω to 20MΩ in 6 ranges; Diode Test Current 0.1μA to 1mA in 3 ranges; Input impedance, 10MΩ on AC and DC volts; Power requirement, 4.5 to 6.5 VDC (4 "C" cells) or optional AC adapter/charger.

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Model 2015A Bench/Portable DMM:
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Same features and specifications as Model 2010A except with large, 0.5" LCD 3½ digit display.

Optional Accessories:
#AC-115, AC adapter/charger $7.95
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Model 8610A Frequency Counter:
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Features: 8-digit LED display • 10 Hz to 600 MHz guaranteed frequency range (5 Hz to 750 MHz typical) • 3 Gate times • 10 MHz TCXO Time base • Auto decimal point • Overflow indicator • Leading zero blanking • Resolution to 0.1 Hz • Built-in charging circuit for NiCd batteries.

Brief Specifications: Freuuency Range, switch selectable, 10 MHz, 100 MHz, 600 MHz • Sensitivity, ± 10mV RMS to 100 MHz, ±50mV RMS, 100 MHz to 450 MHz; 90mV RMS 450 MHz to 600 MHz • Impedance, 1 MΩ, 10 MHz and 100 MHz ranges; 50Ω, 600 MHz range • Gate time (switch selectable) 0.1 sec, 1 sec, 10 sec • Temperature stability, 0.1 ppm/°C • Ageing rate $< \pm 5$ ppm/yr • Accuracy, 1 ppm or 0.0001% • Input protection, 150V RMS to 10 kHz (declining with frequency) • Power Requirement, 4.5 to 6.5V DC @ 300mA (4 "C" cells) or optional AC adapter/charger (7.5 to 9V DC @ 300mA).

Also available Model 8110A, same as 8610A except maximum frequency is 100MHz and without battery charging circuit: $69.95 kit

$99.95

Ordering information

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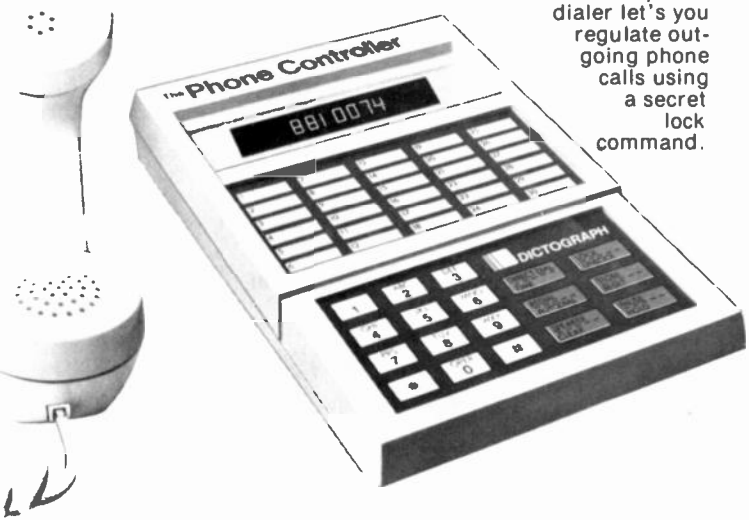
PHONE WIZARD



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It's an automatic dialer.

Think of the number of people you frequently call. The Phone Wizard stores up to 30 often used phone numbers (up to sixteen digits each) in its Memory Bank. Simply pencil in the name on the handy index pads, just press the appropriate key — one time!

Dial "Hands Free"

When dialing don't pick up the phone, just push the right button and listen. The built in loud speaker lets you hear the other person answer or the busy signal.

You actually see the number dialed.

Glance at the big bright LED display. You'll immediately know the right number is being dialed — no matter whether you're using the automatic dialer or are dialing manually.

More Outstanding Features

- Pressure sensitive keys, solid face (no buttons).
- Beep tones tell you that each digit is being dialed or stored correctly.
- Back-Space Erase lets you 'erase' a wrong number. Easy as pie.
- Want to confirm a stored number? Just press the storage button twice. Instantly you'll see a big read-out so you can verify.
- Automatically rings your number up to six times, then stops when your party isn't home.
- A three-position pulse switch allows the Phone Wizard to be connected to virtually any phone system in the world. Rotary dial or Touch tone.

Busy Number Buster and Emergency Dialer

Suppose the number you're calling is busy, just touch the Redial Key, to recall. Still busy? Just program the Phone Wizard to redial later on (up to 15 times, one per minute). A special sign on the display will indicate that the number is being redialed.

Emergency! Here's the quickest and easiest mechanism for dialing the Police or Fire Dept. This feature alone is worth the price of this amazing Dialer. Program the machine before you leave. Then the babysitter or Grandma just presses the Re-Dial Key. Instantly the call is put through.

Conference Speaker For Group Conversations

Activate the Conference Speaker by depressing a button. Everyone on your end and the receiving end can listen in and have his say-so — with the voice coming through loud and clear. Meet by phone, you'll save time, effort, and not to mention those high gas bills!

Digital Clock, Stop Watch and Timer

Time of day displayed in hours, minutes and seconds.

Stop Watch Feature times all calls automatically — great for gauging long-distance calls, keeping records, cutting down on expenses by limiting calls, etc.

You can even time a particular PART of a call. That's how exact this special feature is.

Want to recheck the time of the last call? You can — easily. Press the Clear Key and the Time Key. A big read-out will appear instantly.

How To Place A Call On Hold

Simply touch the hold button, the word 'hold' will flash on the screen. To resume your conversation touch the button again, and you're ready to continue your conversation.

Prevents Unauthorized Use

An ingenious combination electronic lock allows you to prevent unauthorized long distance out going calls while allowing you local calls. Simply press in the secret code. This locks the dialer unit and the phone itself. No long distance calls can be made, but all incoming calls will be received. To reactivate, simply press the secret opening code and a beep tone tells you the phone and dialer are ready for long distance calls. Only you know the codes for this amazing dialer. An instruction kit is included and explains all the secret codes.

Also is designed for wall mounting or desk, contour designed to allow you to locate emergency numbers even at night, gives you an adjustable voice control, no moving parts, LED readout numbers. Quartz crystal clock for accuracy, sloping display for easy reading, quick change of name labels — and more!

We can't even come close to listing all of the exciting features this outstanding Phone Dialer brings you. See for yourself! Use it for 15 days if you're not completely satisfied return it at our expense. Every cent will be refunded promptly.

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BUILD THIS

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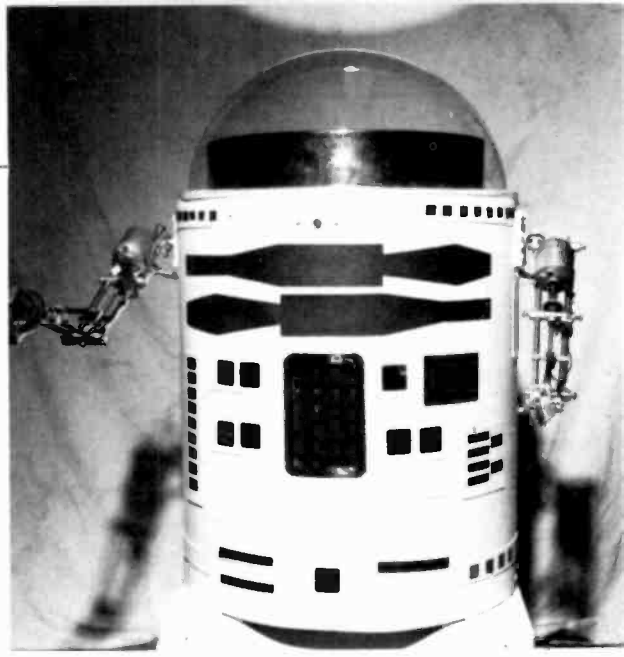


Ready for your own robot? You can construct one by following this multi-part series—and you won't need an engineering degree or special equipment, either.

JAMES A GUPTON, JR.

ROBOTS ARE BECOMING VERY HOT ITEMS. They have already made a name for themselves as movie and TV stars, chess players, artists, typists, advertising men, and assembly-line workers in Detroit. This past April, a three-day conference and an exposition on robotics was held in New York.

This series of articles detailing the construction of a robot called Unicorn-One (a name loosely derived from *Uni*versal *Con*trollable *R*obot) may not tell you how to build a device as elegant or articulate as *C3-P0*, but it will explain, step-by-step, how to design and assemble a robot that will be fully mobile, with manipulator arms to grasp, lift, and carry. Those features, in combination, will enable your robot to perform a wide variety of useful functions.

Unicorn-One is *truly* universal. The same robot body you will build can be operated from a control panel linked to it by cable, by remote radio control, or even by computer. It will even be possible to add an on-board computer to give the robot the ability to "think" for itself. As you will see, Unicorn-One's expansion capabilities are really limited only by what you want it to do.

The first parts of the series will deal with the construction of the mechanical portion of the robot—the object being to build a working mechanism for a reasonable amount of money.

You'll be shown how just a few common tools can be used to work steel and aluminum to almost machine-shop perfection. With a little ingenuity, an operational version of Unicorn-One can be built for about $200. Even if you purchase everything off-the-shelf, the cost should not exceed $400.

Easy-to-follow instructions will be provided to assist you in the assembly of the robot's manipulators (arms), end-effectors (hands), body, and mobility base, and will detail all wiring necessary to power its moving parts. For convenience, this wiring will be brought out to a terminal strip, where it can be connected to whatever type of control equipment you desire to use.

Later installments will describe how the robot can be controlled in any of several different ways—from a cable-connected console or by radio link, providing for both manual and computer-controlled operation.

Provision is also made for the installation of an on-board computer which can be programmed in advance, reprogrammed in mid-sequence, or even left to operate on its own.

The final portion will discuss ways of providing Unicorn-One with senses such as touch and sight, giving it a way to understand and communicate with people, and, in addition, giving it the ability to react to its environment without human intervention.

Basic mechanical components

Since we are building a robot from scratch, it might be a good idea to become familiar with some of the major components which affect its operation.

There are two electro-mechanical parts which are used to impart motion to the robot—motors and solenoids.

Motors are used for continuous motion (in the mobility base, for example, to get from one place to another, or in the arms, for lifting). Solenoids are usually used for a "one-shot" effort—say, opening or closing a grasping member.

Several different types of motors are used in Unicorn-One. Typically, they are low-voltage, high-speed, DC motors which are slowed down (they operate at several thousand RPM) to do what we want them to. That slowing-down is accomplished by gears, which gives us two benefits.

First, the rate of speed is reduced to a "real-world" level and, second, each time the speed is reduced by half, the torque (effective power) is doubled. That allows us to use inexpensive motors to give our robot a reasonable amount of strength. The same principle is used in automobile transmissions. (You can spin your wheels in low gear, but you can't start to build up any real speed until you get into second or higher.)

To put it in mechanical terms, if a motor spins at 6000 RPM, it won't do much for our robot arm unless it is geared down to make the action slower and more powerful. If we attach a 12-tooth gear to the motor, and mesh that with a 24-tooth gear, we'll achieve a speed reduction of 1:2 (12:24) and, at the same time, double the effective power of the motor. Every time the twelve-tooth gear turns once, the other will make only half a revolution, while transmitting the full power of the entire original revolution—which, if you add it up, doubles the original power of the motor.

GLOSSARY

Anti-backlash gear—Gear used to reduce or eliminate backlash. See BACKLASH, GEAR.
Angular motion—Rotary motion about an axis, as in the case of wheels or gears.
Backlash—Unwanted "rebound" movement in gear systems resulting from inertia.
Center punch—Pointed tool used to indent the surface of hard materials for marking purposes or to form a starting point for drilling.
Computer control—Direction by means of instructions programmed into a computer.
End-effector—Unicorn-One's "hand."
Gear—Toothed wheel or cylinder that meshes with another to transmit motion or to change speed or direction.
Gear ratio—The relation between the number of teeth on one gear and another. The higher the ratio, the greater the reduction in speed and the greater the increase in torque.
Manipulator—Unicorn-One's "arm."
Mobility base—The part of the robot that gives it locomotion.
Radio control—Direction by means of instructions transmitted by radio to a receiver located at the object being controlled.
Robot—Machine that works automatically or by remote-control. Generally assumed to be manlike in shape and function. NASA's space and planetary probes, however, are robots, and they don't look the least like us.
Robotics—The science of robots.
RPM—Revolutions per Minute
Scribe—Pointed tool used to mark hard surfaces to indicate areas to be cut, sawed, or drilled.
Sensor—Device which responds to a stimulus. A photo-electric cell would be an example of a light sensor.
Shaft—Rotating rod or bar which transmits mechanical power.
Solenoid—Electromagnet with a ferrous-metal rod through its core. An induced magnetic field causes the rod to move in or out of the core.
Sprocket gear—Large-toothed gear whose teeth ride in the links of a chain and impart motion to it.
Switch-control—Operation of an electrical or electronic device through the opening or closing of a circuit.
T—Abbrev. for "teeth."
Tap—Screw-like cutting tool designed to cut threads into drilled holes.
Tap drill—Drill bit whose diameter is best suited for use with a particular tap.
Thread—Spiral or helical ridge of a screw, bolt, nut, etc.
TPI—Abbrev. for "threads-per-inch."
Torque—Force that produces a twisting or rotating motion.
Unicorn—*Univ*ersal *Con*trollable *Ro*bot.

Using various gearing systems we can easily reduce the speed of a 10,000 RPM motor to an effective 167 RPM, allowing us to use that motor to give real-time motion to the robot's arms.

If we use what is known as a worm gear, we can not only change the speed of the motor—and increase its torque—but also change the direction of the motion. Such an effect can be used effectively in the robot's mobility base.

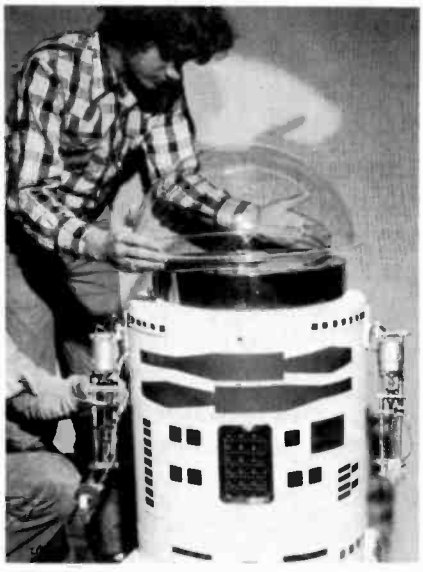
Various gear assemblies can also change a motor's output from angular (around the axis of the shaft) to linear—that is, from rotary to straight-line, as would be needed in order to push a "hand" forward.

Gears can also be used simply to change movement from one direction to movement in another (say, through an angle of 45°).

The second type of motor used in Unicorn-One is the *stepper motor*. That type of motor responds by turning just a little bit for each electrical pulse it receives. Thus it is possible to move a stepper motor just a fraction of a degree at a time, as might be required in steering the robot. If large amounts of motion are required, multiple pulses are applied.

In addition to the motors, we also use *solenoids* to control the robot's motion. A solenoid is an electromagnet which has a ferrous-metal core. When the magnet is energized, the core—usually a free-sliding metal rod—is either pulled into, or pushed out of, the magnet's coils. Unicorn-One uses solenoids to actuate its grasping members (hands/fingers). If power is applied, the solenoid is actuated and pulls the core inwards. That movement causes the "fingers" to close and to grasp the object in question; the grasp will be maintained until power to the solenoid is cut.

Some solenoids also incorporate gears,



UNICORN-ONE nearing completion. Humans at work give idea of robot's size.

and rotate the gears, and their attachments, through a specified angle, when they are actuated. (They may turn a wheel 45° at a single, momentary command, for instance.)

Finally, we have to consider *limit switches*. Those are absolutely necessary to the well-being of the robot. If we actuate a motor and do not, later, tell it to shut off, we are liable to do damage to the mechanical parts of the robot or even to burn out the motor itself. The limit switch is a device which senses when a mechanical part has reached the predetermined limit of its travel and opens (or closes) the appropriate electrical cricuit to stop the device which is causing the part to move. Limit switches are an inexpensive way to give a measure of control to your robot without your having to pay attention to its every movement.

In addition to the above, we will also use cables and pulleys, anti-backlash gears, bearings, and other mechanical devices to give motion to Unicorn-One.

As we encounter those various components in the construction of Unicorn-One, we'll go into a greater description of their function and operation, and explain why we are using them.

Manipulator construction

The construction of a robot, judging from the available literature, is an expensive proposition, involving skills, materials, and tools not normally encountered in the type of project presented in **Radio-Electronics.** We'll dare to be different here, however, and show you how you can build Unicorn-One using tools you probably have on your work bench and materials that are easy to come by. Even if you have never worked with metals before, we'll provide you with the knowhow to construct a working robot.

The drawings in Fig. 1 show the dimensions for a robot of ideal size. You may, however, decrease or increase those dimensions to suit your budget or needs. Bear in mind that, for radio or remote control, where the power source must be self-contained, the robot's overall weight becomes a very important factor and you may want to deviate from the dimensions given.

The first portion of Unicorn-One that we'll construct will be the manipulators (arms). They will be fabricated from steel rod and aluminum plate, and dimensions and instructions for the metalworking will follow. We'll describe the construction of one manipulator. If you want a two-armed robot, do everything twice. Before you proceed, though, read and heed the following precautions about metalworking:

- Always wear safety goggles or glasses when sawing, drilling, tap-

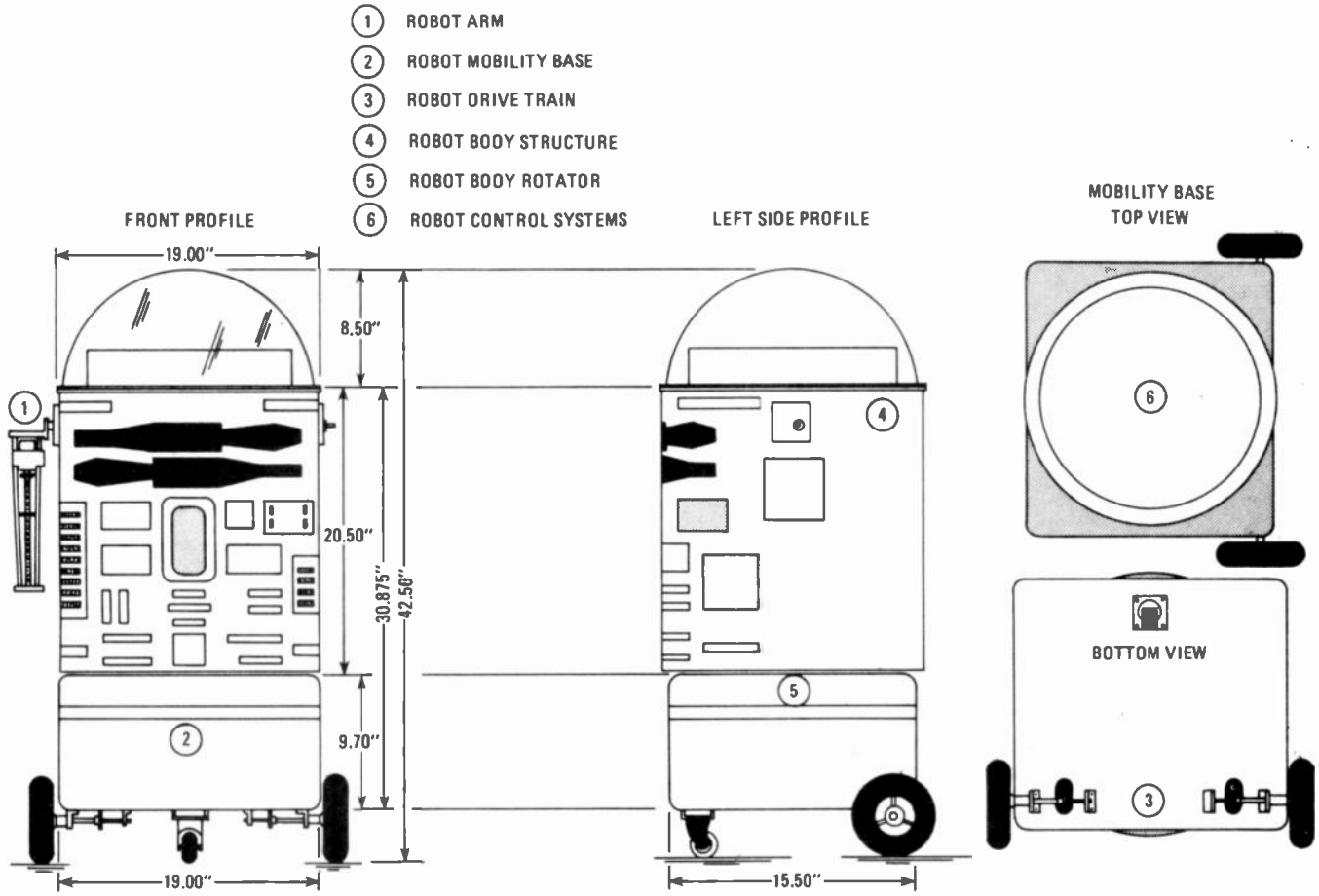


Fig. 1—DIMENSIONS of Unicorn-One as described in text. Size is not critical, though, and scale or dimensions may be altered to suit the requirements of the builder.

ping or filing metal (or wood or plastic)
- Never wear ties or loose clothing when operating power tools
- Hold tools properly and make sure pieces being worked on cannot move around

The instructions which follow are intended to be used in conjunction with the diagrams which accompany them. Do not try to rely only on one or the other. If you have a question, the diagrams can probably supply the answer if you study them.

Basically, there are only two different diameter steel rods used to make all the manipulator sections. The cross members are cut from 0.375-in. (3/8-in.) steel rod and the side rods from 0.2497-in. (1/4-in.) material. The threaded steel rod is 1/4 inch in diameter with 20 threads-per-inch. The shoulder and elbow hinges, and the two contractor-bar pivots, are cut from 0.250-in. (1/4-in.) aluminum plate.

The aluminum parts should be made first since they require more work than the rod sections. To keep costs low, use scrap material wherever you can.

The first step is to mark the dimensions of the aluminum part. Do that with a scribe, pointed nail, or even a knife. Don't use pencil, since it rubs off easily. When you cut the part, cut along the *outside* of the lines. You can always file off excess, but it's impossible to put back a little bit too much you removed while cutting. Use a vise to hold the piece steady and use a hacksaw blade with 24–32 teeth-per-inch to give a smooth cut.

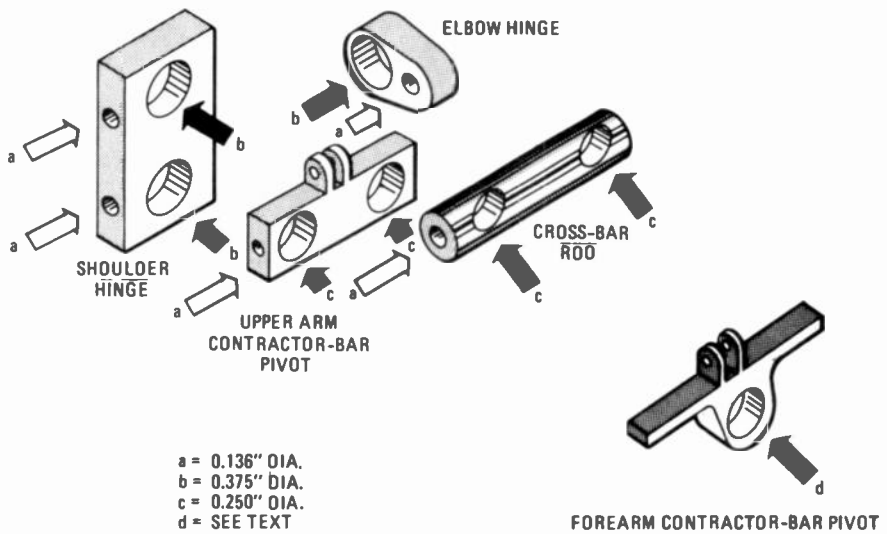


Fig. 2—DETAILS of the aluminum parts which must be fabricated. Steel cross-bar rod is also shown as an example. Note that there are several different versions of this part.

The shoulder-hinge sections are two rectangles, 1 × 1.4 inches, drilled to accept two 3/8-inch rod sections (Figs. 2 and 5). There are two ways by which the steel rods can be secured to those hinge sections: a 1/16-inch hole can be drillled through each for use with roll or dowel pins, or a No. 44 bit (.086 inches) can be used to make a hole which can be tapped for a 4-40 machine screw. Figure 3 shows some of the taps and tap drills that can be used in the construction of the robot.

For the elbow hinge (Fig. 2), outline the part on the aluminum plate and, using a punch, mark the places where holes will be drilled. Saw out a rough rectangle and drill the .375- and then the .136-inch holes. With the holes drilled, the part can be cut and filed down to the proper size.

The two contractor-bar pivot parts (Fig. 2) require a little more work. Again, cut the parts roughly to size (see Figs. 2 and 5). As in the shoulder-hinge pieces, either a dowel pin, or a 4-40 machine

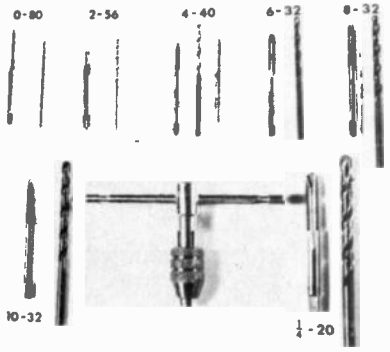


Fig. 3—TAPS AND TAP DRILLS. First number indicates size; second, threads-per-inch.

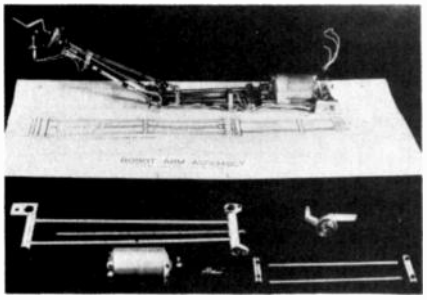


Fig. 4—MANIPULATOR ASSEMBLY. Finished unit and separate pieces are facing opposite ways.

screw, may be used to provide the pivot support. The upper-arm pivot part has a tapped ¼-20 hole for the ¼-20 threaded rod used to provide elbow action. That hole may be made either with a #7 bit (.207-in.) and tapped to ¼-20 or drilled out slightly larger—.413 in. minimum—

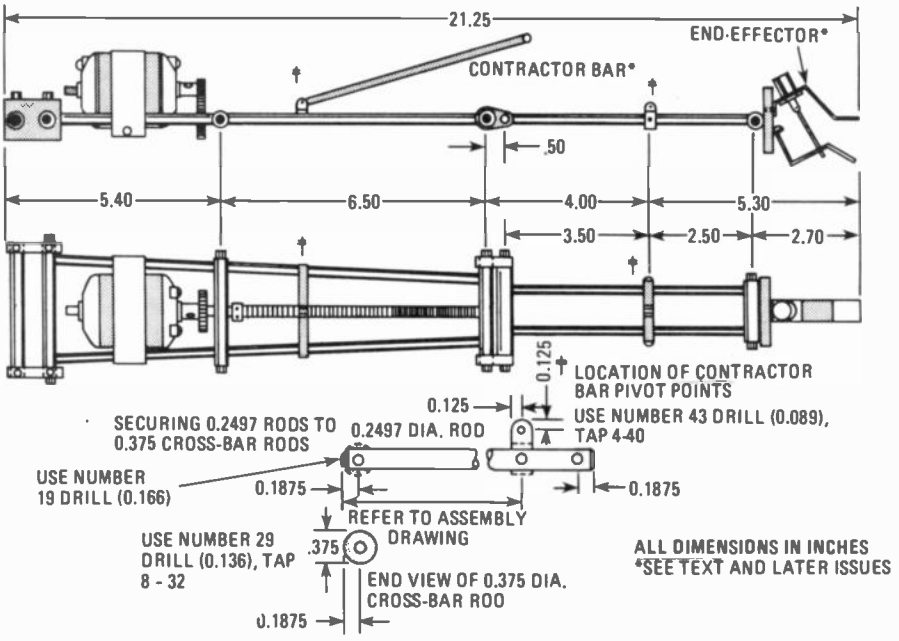


Fig. 6—SIDE AND TOP views of the assembled manipulator. End-effector and contractor-bar will be covered in the next installment.

to accept a threaded insert, which will give a smoother action. The latter approach is preferred, but the former will give satisfactory results, provided the work is done with care. Both pivot parts should be carefully cut and filed to shape.

To prepare the six steel cross-bar rod sections, cut each length slightly longer than called for. There will be two 3.25-inch sections, two 2.6-inch sections, one

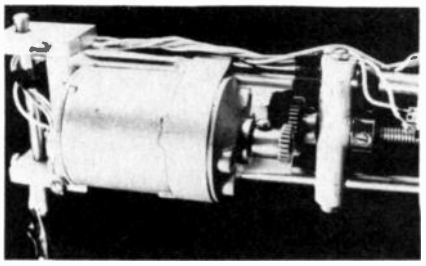


Fig. 7—MOTOR AND GEAR arrangement used to drive threaded rod, as described in text.

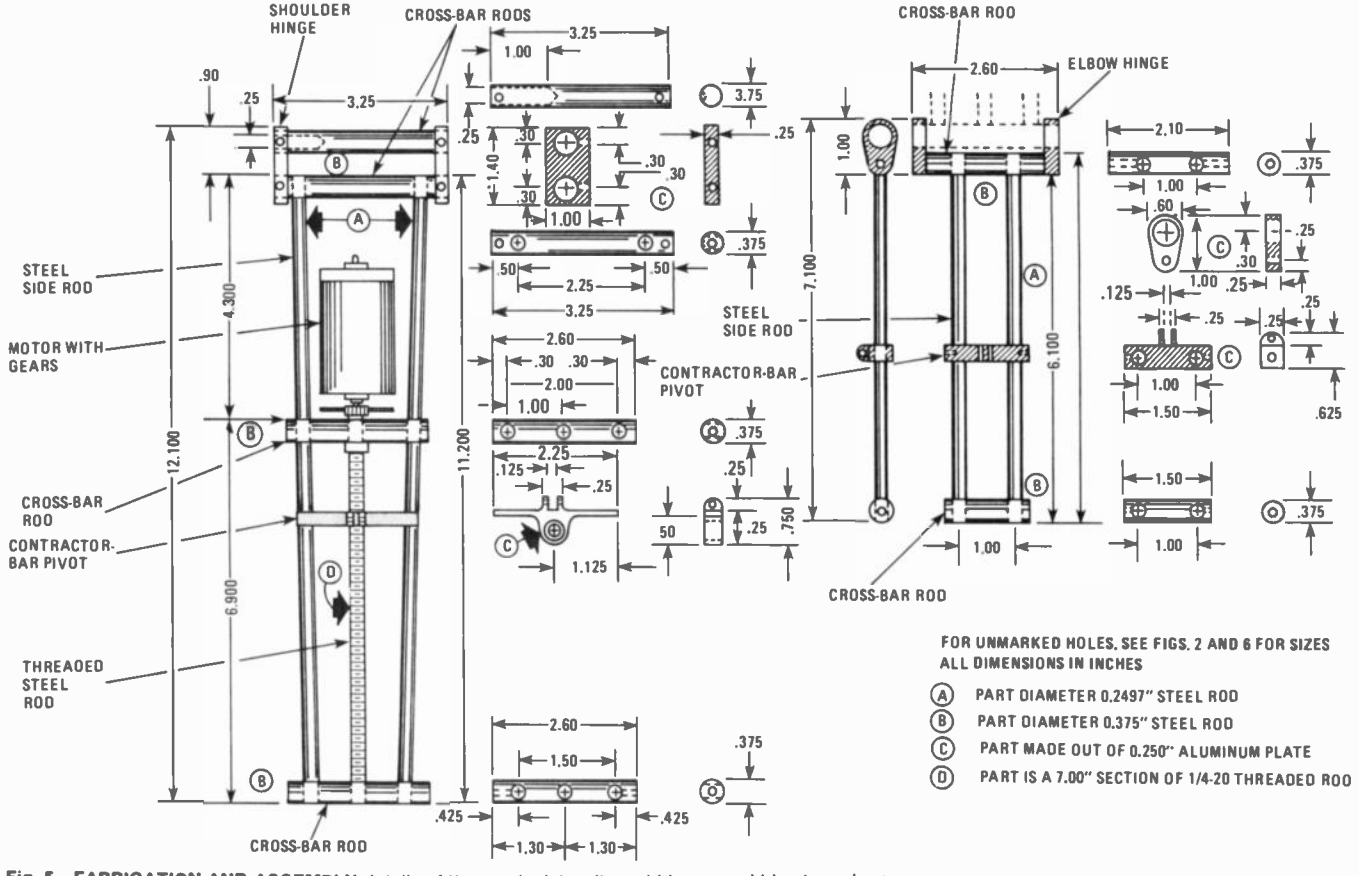


Fig. 5—FABRICATION AND ASSEMBLY details of the manipulator. It would be a good idea to make a copy of this and keep it near your workbench for reference.

PARTS LIST

Item	Size	Quantity	Supplier's part no.	Supplier
Steel rod	0.2497 in. diam.	72 in.	SR 500	Ⓐ
Steel rod	0.2497 in. diam.	72 in.	SL–14	Ⓑ
Steel rod	0.375 in. diam.	36 in.	SR 375	Ⓐ
Steel rod	0.3497 in. diam.	36 in.	SI–33	Ⓑ
Sheet aluminum	0.0625 in. thick	6 x 12 in.*	SA 625	Ⓐ
Sheet aluminum	0.250 in. thick	1 x 18 in.	SA 250–18	Ⓐ
Sheet aluminum	0.250 in. thick	1.5 x 6 in.*	SA 250–9	Ⓐ
Threaded insert	OD 0.413 in. TPI ¼–20	2	TI 1420	Ⓐ
Threaded rod	¼–20	14 in.	TR 25020	Ⓐ
Threaded rod	¼–20	14 in.	TI–7	Ⓑ
Reduction gears	20 T, 0.458 diam. ¼–in. bore, 48-pitch	2	G 20 T–48	Ⓐ
Reduction gears	48 T, 1–in. diam. ¼–in. bore 48-pitch	2	G 48T–48	Ⓐ
Shaft collar	OD 0.50 in. ID 0.2497 in.	4	C 525	Ⓐ
Shaft collar	OD 0.50 in. ID 0.2497 in.	4	C5–7	Ⓑ

Item	Size	Quantity	Supplier's part no.	Supplier
Dowel pins	OD 0.0625 in. ⅜–in. long	6	D16–625	Ⓐ
or				
4–40 screws	4–40 x ⅜ in.	6	Z9–4–40–A10	Ⓑ
8–32 screws	8–32 x ½ in. socket-head screws	44	Z9–8–32–A8	Ⓑ
Elbow motor	12 VDC, ¼–in. diam. shaft	2	P–42,670	Ⓒ

SUPPLIERS:

Ⓐ **The Robot Mart**
Room 1113
19 W. 34th St.
New York, NY 10001
(Catalog $3.00)

Ⓑ **Winfred M. Berg, Inc.**
499 Ocean Avenue
Rockaway, NY 11518

Ⓒ **Edmund Scientific Co.**
101 East Gloucester Pike
Barrington, NJ 08007

The above suppliers have catalogs available upon request.

NOTES: Items grouped together are interchangeable. Items marked with "*" include quantities for end-effectors. Suppliers shown are not necessarily the only source for items indicated.

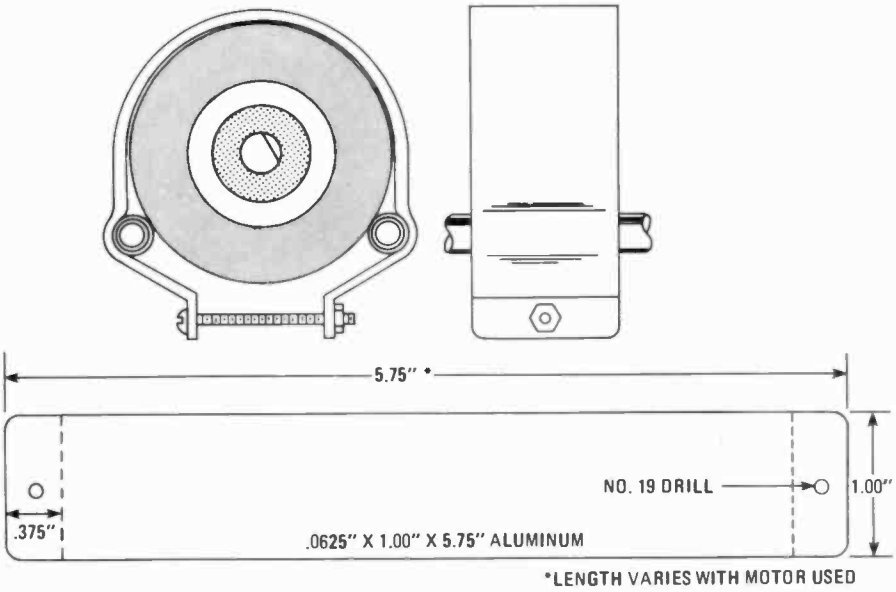


Fig. 8—ATTACHMENT OF DC motor to side rods. Clamp dimensions will vary according to the particular motor used.

2.1-inch section and one 1.5-inch one. Lock each piece into the chuck of a variable-speed electric drill and remove the saw marks by running the drill slowly and filing the rotating rod. When the saw marks have disappeared, angle the file approximately 45° to the rotating stock and lightly bevel the end of the section. Reverse the rod and repeat the procedure on the other end. Next, with the rod still in the chuck, polish its surface with "A" grade silicon-carbide paper. That will give the rod a high-luster finish and remove any remaining surface scratches. The procedure is best carried out by two people.

Carefully drill the rod sections to receive the 0.2497 in. side rods. Each hole drilled must be perpendicular to the rod and parallel to the other hole. If they are available to you, a drill press and "V"-block should be used to make sure of this. To allow the arm to taper, enlarge the holes slightly by "wobbling" a hand-held drill in them.

Figure 4 is a photograph of a fully assembled manipulator (with end-effector) and assembly details are given in Fig. 5. Also refer to Fig. 6. Those should help you to picture what has to be done, and where.

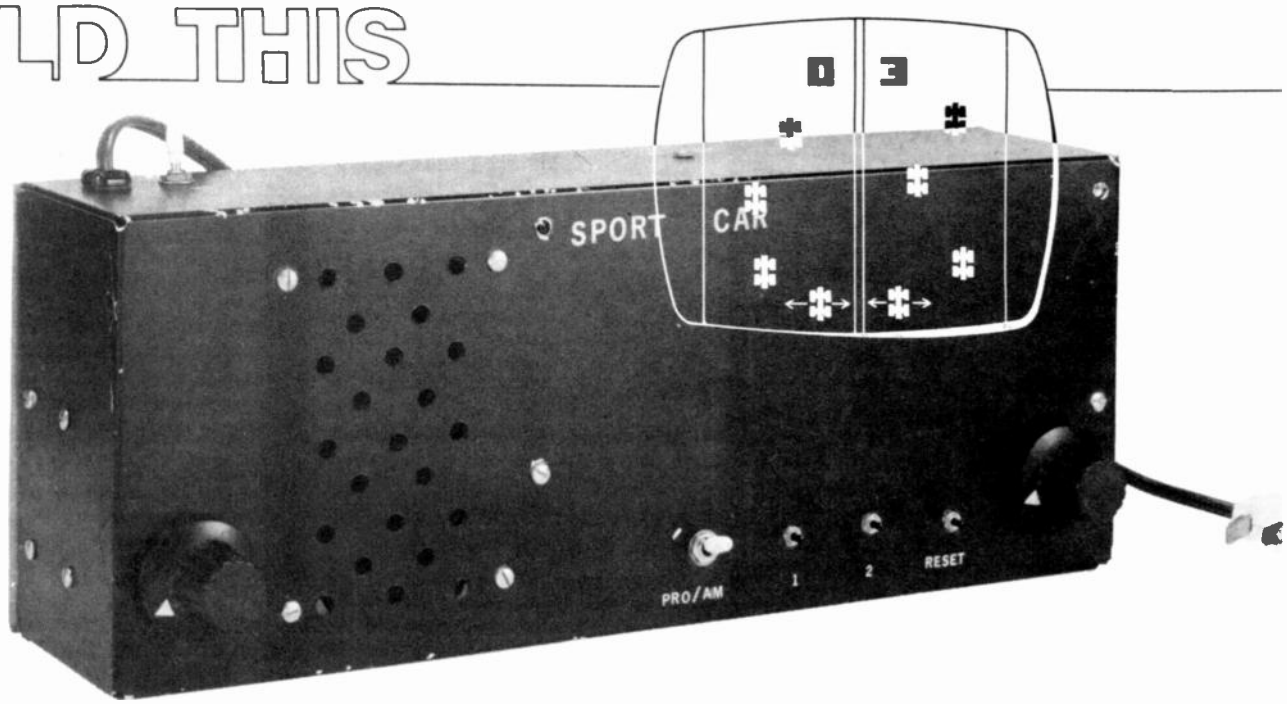
Drill into both ends of five of the six rod sections using a No. 29-bit (.136 in.). Use a punch to mark the center of the rod's diameter and to avoid slippage of the bit. Drill deeply enough to penetrate the .250-inch side-rod holes made previously. One of the 3.25-inch sections—the one which will be used at the top of the arm—gets a .250-inch hole, 1 inch deep, in one end. That will later be used to anchor the arm to the body.

Assemble the two 3.25-inch cross-bar rods and the rectangular shoulder-hinge plate. Use a center punch to mark the rods *through* the .136-inch holes in the plate. Take the assembly apart and use a No. 19 bit (.166 in.) to drill into the rods at the four places marked. Then tap those holes for an 8-32 thread. Also use an 8-32 tap on the .136 in. holes which were drilled into both ends of five of the rods.

Check your work against the diagrams

continued on page 76

BUILD THIS



RACEWAY VIDEOGAME

Build this road-race game and enjoy all the excitement of the arcade version on your own video screen. Gentlemen (and ladies) . . . Start your engines!

L. STEVEN CHEAIRS

AMONG THE POPULAR ARCADE GAMES, THE road-race type has always stood out. Many varieties of that game exist; they range from the animated types to the more recent video units, of the type we're about to describe. There is a major difference between the game described here and the average Arcade road-race—the average Arcade game's price tag is in the thousands of dollars; while this game will cost you less than a hundred dollars.

In the pages of **Radio-Electronics** magazine we have presented two other video-game kits: a tank and a motorcycle game. The tank game (Nov. 1978) required two players; while the motorcycle game (Jan. 1979) was only for a single player. The present game allows both single- and dual-player operation. Thus, if you find yourself alone, or where no one else seems to want to play the game when you do, you can use the single game mode. But, when two or more players are available. . . .

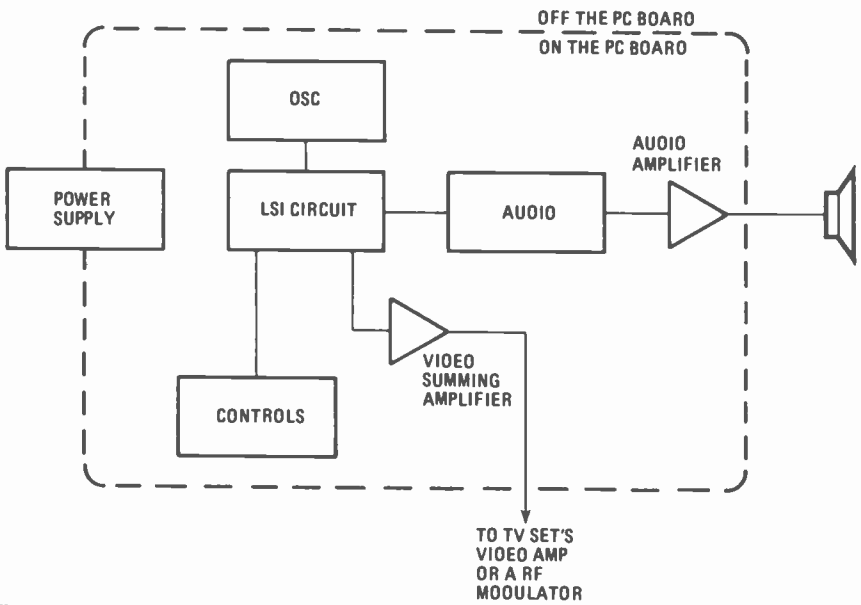


Fig. 1—BLOCK DIAGRAM of the Raceway videogame showing the major components of the system. Block labelled "Controls" is actually located off the board (controls are mounted on case).

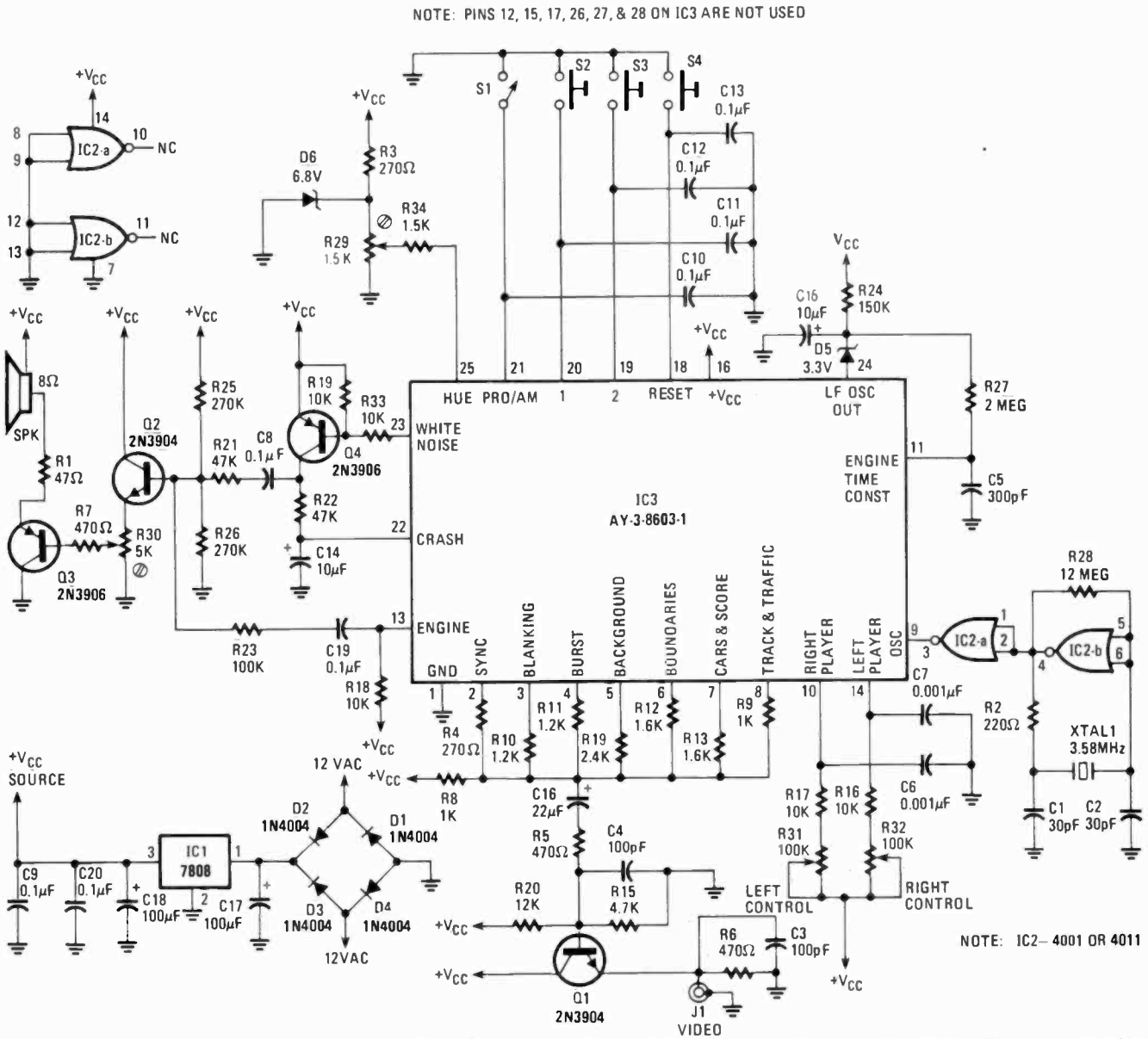


Fig. 2—COMPLETE SCHEMATIC of the Raceway game. The project may be built on a PC board using the foil pattern in Fig. 4 or wired point-to-point following this diagram.

System description.

The raceway game contains an assembled PC board and the switches, transformer, case and other hardware required for project assembly. Assuming that you wish to connect the system to a standard NTSC 525-line TV set, you will also need an RF modulator—many of which exist in the hobbyist's market.

The components contained on the printed-circuit board form seven distinct circuits. Two of those circuits contain components that are off the card; refer to the block diagram in Fig. 1 and the schematic in Fig. 2. The power supply provides 8 volts DC using a 12-volt AC, power source located off the board. The 12 volts AC is rectified by four silicon rectifiers and then filtered to reduce the 120-Hz ripple that is created by the full-wave bridge. A three-terminal linear regulator develops the operating voltage—additional filtering is provided at the regulator's output.

The control section is composed of two potentiometers, four switches, two R–C timing networks, and four capacitors. The potentiometers are used to vary the R–C time constant; that time constant is proportional to the position of the user's race car image on the TV screen. One or two race cars can be steered using these controls. Switch S1, labelled PRO/AM, is used to select the level of difficulty. Two normally-open switches are used for selecting the number of players (S2, labelled 1, selects the 1 player option; S3, labelled 2, selects 2 players.) The third push-button normally-open switch S4 is provided to reset the game. A minor amount of debounce is provided by the capacitor across the switch contacts.

The 3.579-MHz crystal oscillator is formed using a CMOS gate, two resistors, two capacitors and a crystal. Another CMOS gate is used as a buffer between the oscillator and the LSI integrated game circuit. Next, the audio amplifier and filtering circuit is formed using three transistors and a few capacitors and resistors.

The video summing circuit is of the passive-resistive type. The resistors R4, R9–R14 are chosen such to give a video signal with an appearance similiar to Fig. 3. The video signal out of the summing network is AC-coupled to the video amplifier Q1 which is wired as an emitter-follower. Note: if you use an RF modulator you may need to adjust the output

Fig. 3—COMPOSITE VIDEO SIGNAL typical of that produced by the summing network. It is a combination of raw video, sync and blanking signals generated by the IC. See text for explanation.

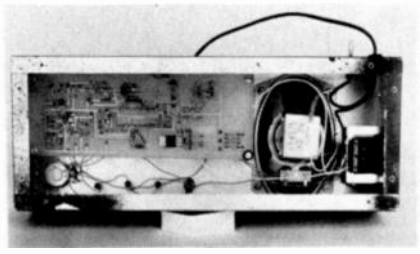
impedance of the amplifier. You do that by changing the emitter resistor. Normally, however, the adjustment will not be required. The final section is the LSI integrated circuit. That is a 28-pin DIP MOS IC that contains the game logic.

Construction

The raceway game may be assembled using either point-to-point wiring or wirewrap or a printed circuit board. Working from the schematic diagram shown in Fig. 2 any of those construction methods may be used. If you decide to build using the printed-circuit approach, then use the foil pattern shown in Fig. 4. Components are placed on the board as shown in Fig. 5. (An etched and drilled PC board is available—see the parts list.) Also, for those who do not have an adequate source of all the components, the source mentioned in the parts list will provide all of the hard-to-locate components on an individual basis or a complete kit that includes all electronic components, the PC board and the required hardware—including a blank unpunched case.

Assuming that you have chosen the PC board approach, start by laying all the electronic components out on a workbench. Make sure that the MOS and CMOS IC's remain in their conductive packages. Compare the components to the parts list to make sure you have everything you need. Mount the four corner spacers on the foil side of the printed circuit board with the hardware mentioned in the parts list; that way the spacers will act as table legs and raise the PC card off the work surface.

Install the two IC sockets in the proper location noting the proper orientation of pin 1 (see Fig. 5). Place a piece of cardboard on top of the sockets and by keeping a firm pressure on top of the cardboard and the PC board rotate them



COMPLETED UNIT. Components on bottom of board have been relocated in version described here.

upside-down so that the foil side is now up. Solder all of the pins using a 40-watt soldering iron with rosin-core solder. Replace the board with the component side up.

Install all of the resistors and capacitors. Verify their location and solder. Follow that step by installing the diodes, rectifiers, transistors, and voltage regulator; again, after placement and orientation, solder the components to the board. Lay the PC board aside until final assembly.

Locate the enclosure; drill the holes required for the potentiometers, switches, transformer attachment, PC-board attachment, speaker mounting, video output jack, and a line-cord strain-relief grommet. Next, paint the exterior of the case. After the paint is dry use dry-transfer lettering to label the controls. Follow that procedure by spraying the case with

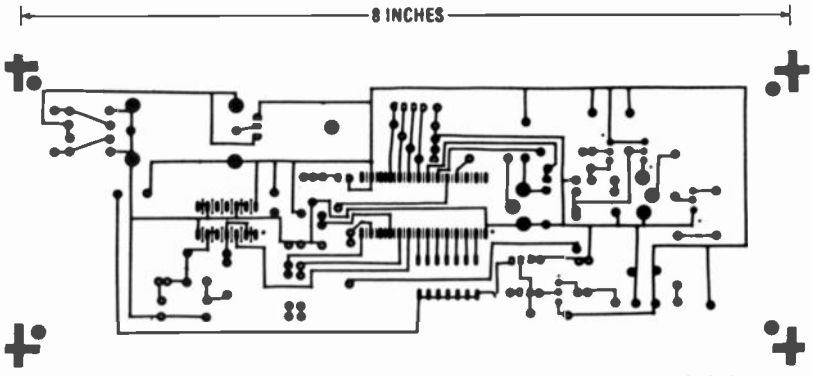


Fig. 4—FOIL PATTERN for the printed circuit board. For those who prefer not to etch their own, one is available from Quest-Star Electronics. See parts list for ordering information.

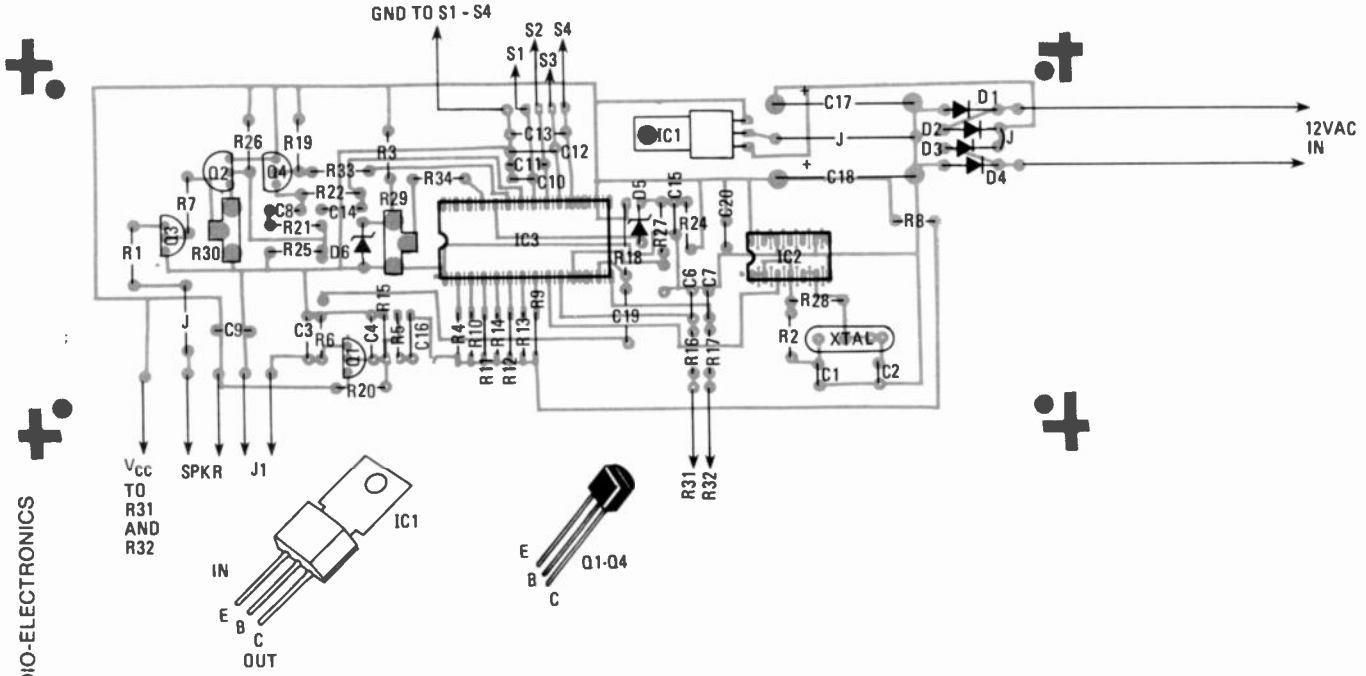
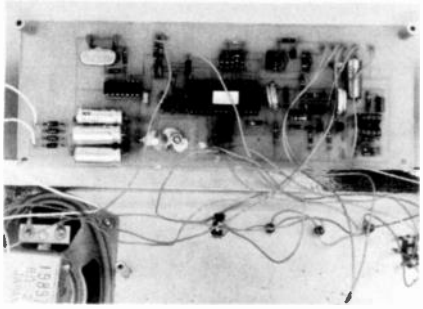


Fig. 5—PARTS PLACEMENT DIAGRAM. Power transformer, control potentiometers and switches, speaker and video jack are mounted off the board, on the case.



PC BOARD prototype.

PARTS LIST

Resistors ¼ watt, 5% unless otherwise noted

R1—47 ohms
R2—220 ohms
R3, R4—270 ohms
R5–R7—470 ohms
R8, R9—1000 ohms
R10, R11—1200 ohms
R12, R13—1600 ohms
R14—2400 ohms
R15—4700 ohms
R16–R19—10,000 ohms
R20—12,000 ohms
R21, R22—47,000 ohms
R23—100,000 ohms
R24—150,000 ohms
R25, R26—270,000 ohms
R27—2 megohms
R28—12 megohms
R29—1500 ohms, potentiometer, PC mount
R30—5000 ohms, potentiometer, PC mount
R31, R32—100,000 ohms, potentiometer
R33—10,000 ohms
R34—1500 ohms

Capacitors

C1, C2—30 pF
C3, C4—100 pF
C5—300 pF
C6, C7—.001μF
C8–C13—0.1 μF
C14, C15—10 μF, 15 volts, tantalum
C16—22 μF, 15 volts, tantalum
C17, C18—100 μF, 15 volts, electrolytic
C19, C20—0.1 μF

Semiconductors

D1–D4—1N4004
D5—1N746A Zener diode, 3.3 volts, 5%, 400 mW
D6—1N754A Zener diode, 6.8 volts, 5%, 400 mW
Q1, Q2—2N3904
Q3, Q4—2N3906
IC1—7808 voltage regulator, 3 terminals, 8 volts
IC2—4001 quad 2-input NOR gate or 4011 quad 2-input NAND gate
IC3-AY-3-8603-1 raceway game IC
S1—SPST miniature toggle switch
S2–S4—SPST normally open miniature push-button switch
SPKR1—small speaker, 8 ohms
J1—miniature phone jack
XTAL1—crystal, 3.58 MHz

Miscellaneous: knobs, line cord, 12-volt, 850 mA (or higher) transformer, case and hardware.

Note: The following may be ordered from Quest-Star Electronics, 5412 Burntwood Way, Las Vegas, NE 89108: Kit of all parts $59.95, AY-3-8603-1 game IC $27.00, PC board $12.95. Add $1.75 for shipping. Nevada residents add local taxes.

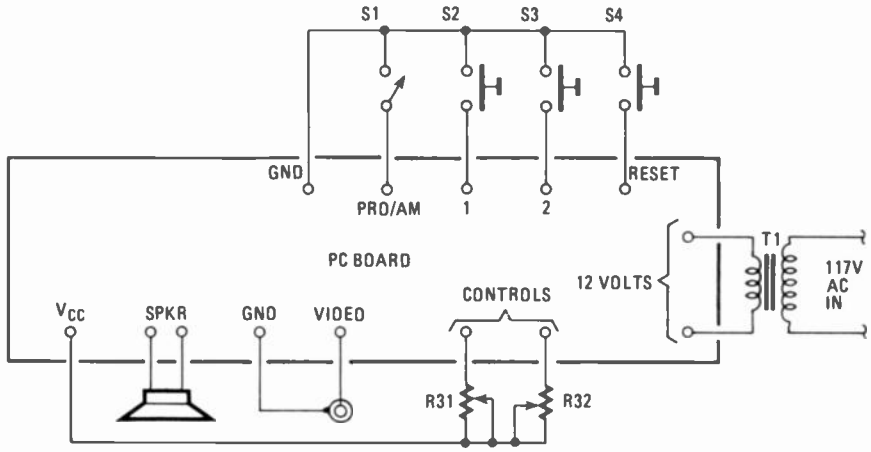


Fig. 6—DETAILS of off-the-board component connection. This should be used in conjunction with the parts placement diagram, Fig. 5. Also refer to photographs.

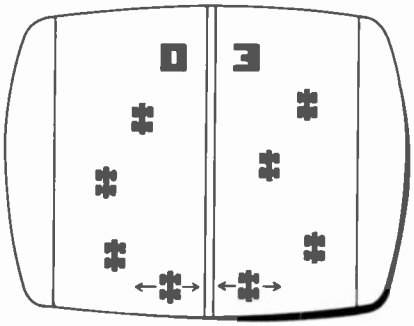


Fig. 7—RACEWAY VIDEOGAME display as it would appear on TV set or video monitor.

a clear lacquer paint to protect the finish—let the case dry for 12 to 24 hours.

Install the controls, transformer, linecord, output jack, and speaker. Wire those components as shown in Fig. 6. Recheck the wiring! Plug the line cord into a wall outlet and check to see if the proper DC voltage exists—around 8 volts. If so, discharge the filter capacitors and then install the IC's. Remove the spacers from the wiring side of the PC board and reinstall them on the component side of the board. Next, mount the PC board in the case. The assembly is now complete. Note: if an RF modulator is used it may be installed in the enclosure or inside of the TV cabinet. That is up to your discretion.

About the game

A typical game display consists of a two-lane highway with two player-controlled cars and randomly generated traffic. Each lane has a score at the top of the screen—see Fig. 7. The driver for each car is located at the bottom of each track. Adjust the TV contrast so the road is displayed as a white field; while the embankment, center line, player cars, and scores are gray. The traffic is displayed as black images. The car has horizontal motion only; that is a function of the potentiometer position. After the reset button is pressed the game starts. The TV screen shows the two tracks with the drivers' cars and the traffic. The scores are set to zero. Both tracks have the same set of random traffic. The traffic on the right is 24 horizontal scan lines ahead of the traffic on the left side of the screen. Thus, if the two-player game is selected, both players will encounter the same degree of difficulty.

The speed of the traffic in relation to the driver increases every two seconds, for up to a maximum of seven speeds, until one of the two players crashes his car into one of the obstacle cars. At that point all video motion stops and a crash sound is generated. The game again restarts in the slow motion and increases in speed every two seconds once more; during this time realistic engine sounds are simulated. The engine sound starts from a low and increases in pitch at four-second intervals during the periods when motion is observed on the screen. Every time a crash occurs, a point is scored for the opponent. The game ends when one of the players reaches 15 points.

The single-player game proceeds as outlined above, with the exception that only one of the player cars is present. The right car is removed—the left car is operatable. After every eight cars that the driver passes he scores a point; those must be consecutive passes. The occurrence of a collision resets the pass counter—thus those cars passed between the last score and the crash will not be counted toward a new point. The score above the right track records the number of crashes. Thus the user is playing against the machine, since the first score to reach 15 points wins the game.

As can be seen, a realistic raceway game may be produced for use with a standard television receiver fed through a video modulator. (Several suitable video modulators are available on the market. You can get them through **Radio-Electronics** advertisers and computer stores. If you have an option, select one with a UHF output.) This game provides realistic motor and crash sounds. Also, skill selection is provided for easy or difficult driving conditions. Scoring is automatic and on-screen; it is color-keyed for each player. Both one- and two-game selections exist; all the timing signals for

continued on page 77

6 ACCESSORIES For AUDIO TESTING

Some of the most useful audio test equipment is very hard to find. Here are six easy-to-build accessories that will make your lab work easier and quicker.

GARY STOCK

NEARLY EVERY AUDIO TEST BENCH USES a similar array of test instruments to service and evaluate the performance of stereo components—an oscillator, distortion analyzer, VTVM, and dual-trace oscilloscope are the most common pieces of equipment, although many others are also used. There is also a whole range of accessories that are used in conjunction with those major instruments. These smaller components are often so specialized that they are not available from any manufacturer.

The key addition is a central switch-panel for interconnections between instruments and the various components under test, that is usually designed by each technician to suit his particular needs and manner of operation. In addition a whole range of other small filters, attenuators, and loads are used. In the following section you'll see how you can build six of them and discover how they can be used best. All are passive devices, so power supplies are not needed. Any one of them can be built in a couple of hours, using off-the-shelf parts. They will significantly expand the testing and diagnostic capabilities of any test bench.

High-power Load Bank and Standardized Reactive Loads for Amplifier Testing

EVERY AUDIO-TEST BENCH REQUIRES some sort of resistive load so the power output of an amplifier can be tested. The load must have enough power dissipation to be able to accept, without overheating, the output of large amplifiers. It must also have a stable, accurate, and non-reactive resistance value, typically either 4 or 8 ohms. Many testing laboratories use loads made up of large, wirewound non-inductive power resistors. Usually one or more 50-watt resistors are combined in order to get the required power-handling capability.

An inexpensive alternative is to construct the oil-cooled load bank shown in Figs. 1 and 2. This bank uses many 1- or 2-watt carbon composition resistors connected in parallel by busbar to derive precise 4- and 8-ohm loads. By constructing the resistor "ladder" on the inside surface of the lid of a one-quart paint can, and then immersing it completely in mineral oil, with which the can has been nearly filled, the total power dissipation of the resistors is increased substantially over their free-air dissipation, by a factor of three or more. Thus a ladder of twenty 82-ohm, 1-watt resistors would have an effective resistance of 4-ohms and a power-handling capacity of 60 watts continuous or

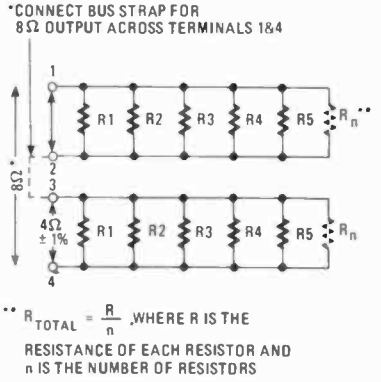


FIG. 1—SCHEMATIC illustrating principles of resistor-ladder construction.

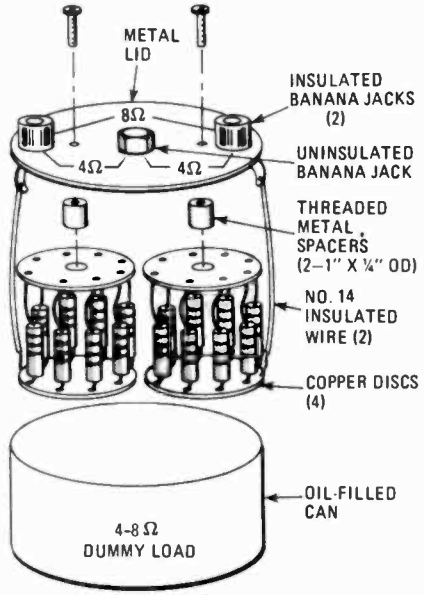


FIG. 2—PICTORIAL DIAGRAM of high-power load bank. Subassemblies contain twenty resistors each.

more when oil cooled, at least for the relatively brief periods normally involved in testing. To permit testing of the amplifier's performance into both 4- and 8-ohm loads, each load bank is made up of two 20-resistor ladders, each having a value of four ohms. These can be used separately to give two four-ohm loads or connected in series (see Figs. 1 and 2) by a short loop of busbar to provide an eight-ohm load.

A second load device, particularly useful when conformity to published specifications is one of the important considerations of the test, is an IHF-standardized loading network that deliberately simulates the reactive-impedance characteristic of a typical hi-fi loudspeaker with a resonant R-L-C network. The loading network tests the ability of the amplifier to deliver power into a loudspeaker at frequencies near the speaker's fundamental resonance, where substantial voltage/current phase angles exist.

The simplest way to use such a load

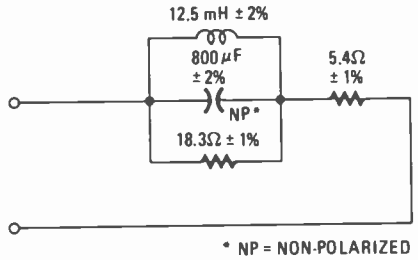


FIG. 3—IHF-STANDARDIZED load used for speaker simulation. Component values are critical.

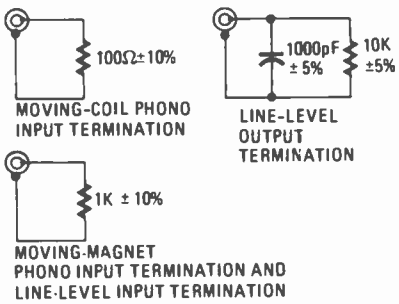


FIG. 4—SCHEMATIC DIAGRAM of the three common low-level input and output loads.

is to measure the difference between an amplifier's power output into a resistive load and into the reactive load, using an input signal in the 40- to 70-Hz range. The more involved procedures and formulae for formally determining an amplifier's *reactive load rating* as defined by the IHF are contained in their publication IHF A 202 (available for $7.00 from EIA-Institute of High Fidelity, 2001 Eye St. NW, Washington, DC 20006. Make check for $7.00 payable to EIA/CEG). These should be used when you test to verify an amplifier's published performance. Construction details are shown in Fig. 3.

The third loading device is a box that contains the standard low-power loads connected to the inputs and outputs of an amplifier or receiver for phono and line-level testing. These have also been standardized by the IHF, and schematics for several types of input and output terminations are shown in Fig. 4. They may be easily built into a chassis box with phono or BNC connectors.

White-noise "Pinking" Filter

ONE OF THE MOST COMMONLY USED signals in high-fidelity testing is random noise. It is a noise signal that has, at any given instant, a gaussian (random) distribution of both frequencies and amplitudes. So it also has a long-term average amplitude that is linear across the audio spectrum. That distribution enables rapid testing of audio components. A random-noise signal is injected into the device under test and the device's output is analyzed for changes in the noise spectrum. Any change, of course, indicates a nonlinearity.

For use in lab testing and service work, random noise commonly comes in two varieties: "white" noise that has equal total energy distribution per *cycle bandwidth*, and "pink" noise that has total equal energy distribution per *percentage bandwidth*. When analyzed by a constant-cycle bandwidth analyzer (a 1-Hz or 10-Hz band analyzer, for instance) white noise exhibits flat total amplitude response; while pink noise exhibits flat total amplitude response when measured by a constant percentage bandwidth analyzer, such as a 1/3 or 1/10 octave analyzer.

Each type of noise is commonly used with its complementary analyzer. Using white noise with a constant-percentage bandwidth analyzer, that has

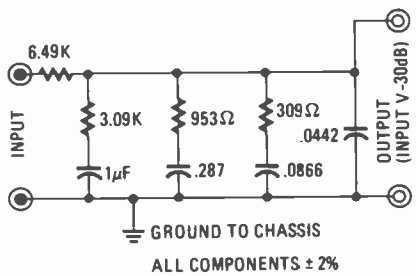


FIG. 5—PINKING FILTER. This device converts "white" noise into more useful "pink" noise.

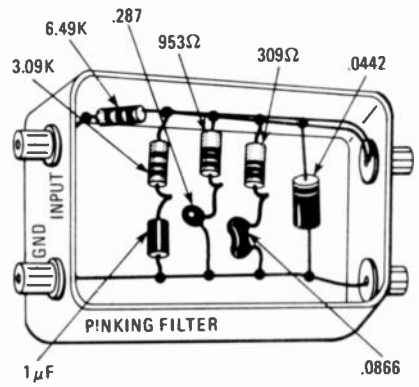


FIG. 6—PICTORIAL DIAGRAM showing suggested layout of pinking filter components.

an analysis window that becomes wider and wider as frequency rises, yields a noise-amplitude characteristic that rises at a predictable 3 dB per octave. Pink noise analyzed by a constant-cycle bandwidth analyzer, whose window has a width that remains constant regardless of frequency, produces a response that falls at 3 dB per octave.

Most audio analysis work calls for constant-percentage bandwidth analyzers, so pink noise is by far the handiest test signal to have on the bench. Yet many noise generators produce only white noise. To convert a white-noise source to pink noise, a pinking filter is required. The filter (see Fig. 5) is a passive R-C network, so there are some limitations on the impedances of the equipment to be tested, if accurate frequency response is to be achieved. The output impedance of the device preceding the filter (usually a tape out or preamp out) should be no greater than 1k. The input impedance of the stage following the filter no less than 20k. The filter may be built into a small metal box (Fig. 6). Its input is connected via banana plugs directly to the front-panel outputs of the random-noise generator. A second pair of banana jacks, binding posts, or a phono jack are used for the output connector.

Component values here are critical. See May, 1980 "Hobby Corner" for information on making your own precision resistors.

Step Attenuator for Input Signals

AUDIO MEASUREMENTS ARE USUALLY made at specific output levels. For power amplifiers, often at full power, −3 dB, −10 dB, and −20 dB. The simplest way to make such measurements rapidly is to insert a step attenuator in series with the input signal. With the attenuator in its bypass position (all resistive elements out of circuit) the amplifier's full output can be measured. Then sequential attentuation of the input signal in steps permits evaluating distortion at the various lower output levels. Details for such a step attenuator are shown in Figs. 7 and 8.

The unit provides up to 41 dB of attenuation for low-power signals in six steps. It can be built into any type of shielded metal box, using DPDT toggle or rocker switches. Binding posts, BNC's, or phono jacks are used for input and output connectors. The uses of the device extend beyond testing of power amplifiers. It is equally valuable for evaluating tape recorder and loudspeaker performance.

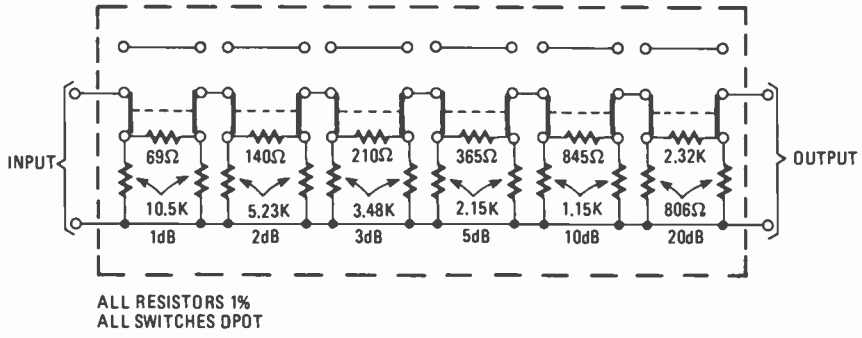


FIG. 7—STEP ATTENUATOR schematic. This device permits evaluation of output signals at predetermined input levels. DPDT switches may be either toggle or rocker type.

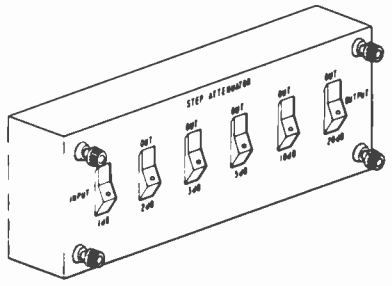


FIG. 8—POSSIBLE LAYOUT for an input signal step attenuator.

RIAA-Equalization Inverter

ALL CONVENTIONAL RECORDS ARE CUT with an equalization curve that reduces the bass and increases the treble. A complementary bass-boost, treble-cut equalization is applied during playback by the phono preamplifier. The exact shape of this curve, is called the RIAA curve, after the organization—the Recording Industry Association of America—that standardized it.

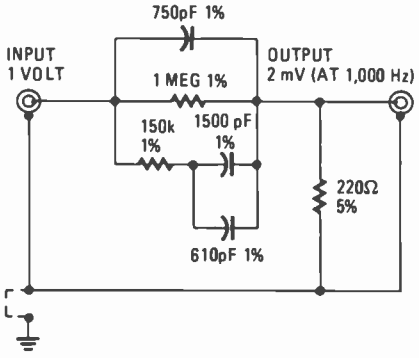


FIG. 9—RIAA EQUALIZATION inverter. Component values and tolerances are very important.

One important specification when measuring a phono-preamp stage is the accuracy of the equalization, since any deviation from the standard curve in effect introduces an error in frequency response. For many years, ±1 dB was considered an acceptable figure. Improvements throughout the record-playback chain and greater interest in the sonic colorations of different preamplifiers, have convinced many reviewers and design engineers that a good preamp section should be accurate to within 0.25 dB or even better.

The simplest method of evaluating the RIAA-equalization accuracy of a preamplifier is to insert an inverting filter, which precisely matches the standard curve, in series with the input test signal. The preamp section's output, as monitored with a precision voltmeter or strip chart recorder, should be constant at all frequencies in the audio range. Any meter deviation or wiggles in the chart recorder's graph indicate equalization errors.

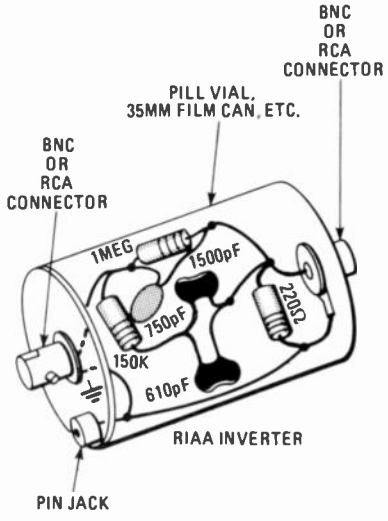


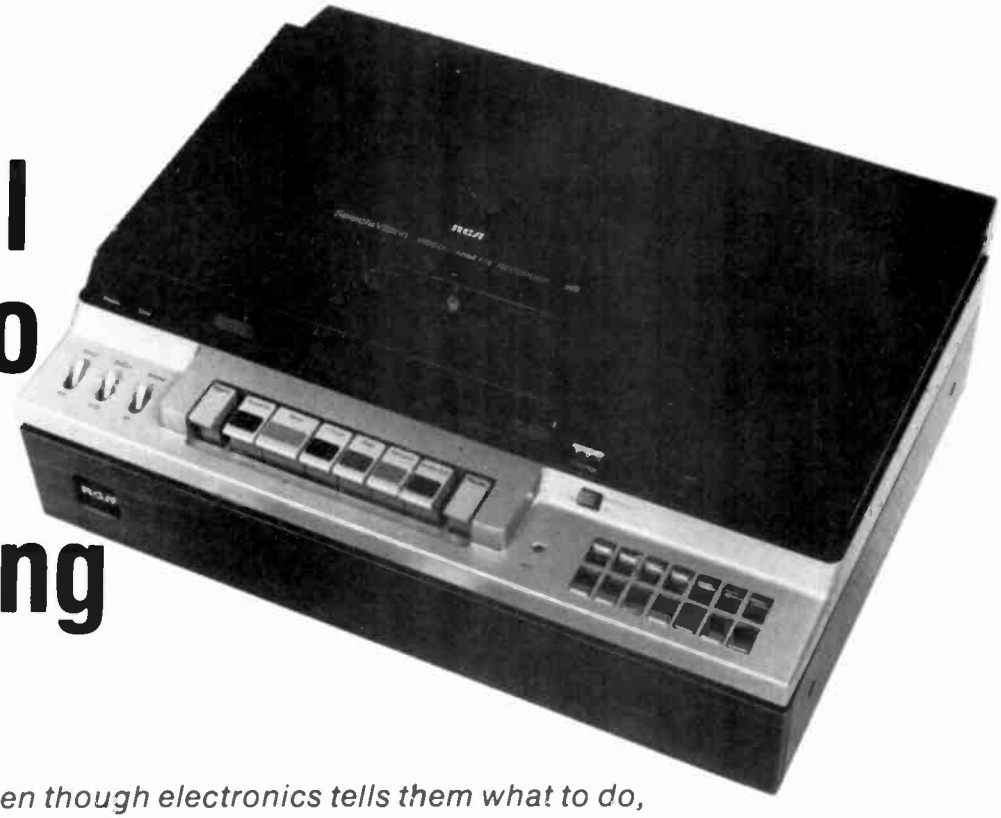
FIG. 10—CONSTRUCTION OF INVERTER using in-line enclosure. Pin jack permits separate ground.

Details for the construction of an RIAA-inverter are shown in Figs. 9 and 10. Note that the inverter circuit also attenuates the input signal considerably, to match the sensitivity of most preamp sections (typically 2mV or less for full output).

As you can see, the component tolerances necessary to deliver the required degree of accuracy are quite tight. You may have to individually measure and pre-select or trim the component values to obtain the tolerances needed. The inverter can be built up on a perforated circuit board, and housed in a chassis box. Use RCA or BNC connectors for input and output. It's a good idea, by the way, to make provisions for isolating the connector shields from chassis grounds. Different preamplifiers react in varying ways to phono-grounding arrangements, and maximum flexibility is desirable here. **R-E**

"I'm afraid your computer has a terminal illness."

Pictorial Guide to VHS Threading



Even though electronics tells them what to do, mechanical devices do these jobs.

FOREST BELT

A VHS CASSETTE RECORDER THREADS tape into the transport only for the PLAY and RECORD modes. Pressing the STOP button causes the mechanism to unthread the tape and then return it to the cassette.

That's something you need to know. In Beta machines, if you remember, inserting the cassette and pressing the carrier down until it latches makes the tape thread immediately. Beta tape remains wrapped around the video head drum and through the transport path during the record, play, fast forward, and rewind modes. It stays that way in the stop mode, too. Only when the EJECT button is depressed does the tape unwrap and return to the Beta cassette.

Not so in a VHS unit. Several things happen to make the machine ready to operate when you insert the cassette and press down the cassette carrier, but threading is *not* one of them.

Genuine familiarity with a video cassette recorder comes through experience. If you have access to a VHS machine, you can follow these explanations directly. Lacking a machine, study the photos. They should prepare you for the reality of opening up a VHS recorder to troubleshoot the mechanical portions of a threading or unthreading fault.

As you see each mechanical device pointed out in a photograph, the caption tells you what it does and how it works. In some instances, fault symptoms may not be obvious; however, the captions tell how to recognize the malfunctions. (**Note:** The VHS machine used for those photos is an RCA *model VCT400*. Other brands and models contain similar threading mechanics.)

WITH SIDE, TOP AND BACK COVERS OFF cassette carrier—chamber that holds cassette—becomes accessible. Removing four screws frees carrier cover. Pawl trips latch at end of cassette gate, a door in the cassette itself that protects tape inside, and, as carrier is pressed down, metal post near corner lifts gate to uncover tape at front of cassette.

Most common defect: warped cassette carrier assembly or bent metal post. Either is often caused by owner inserting cassette backward or upside down and then trying to FORCE carrier down to latching position. Only practical cure is replacement of entire carrier assembly. But metal parts can hardly ever be straightened to the tight tolerances necessary for operation.

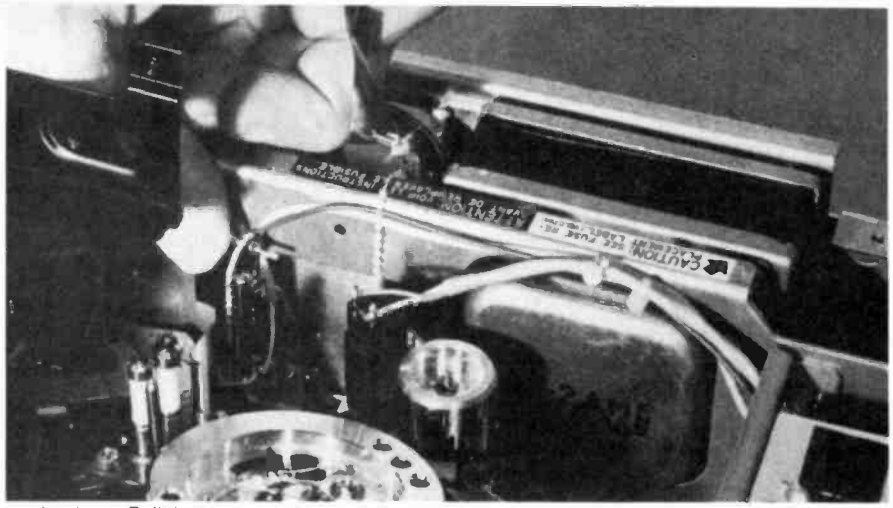
To inspect threading this way, press down on cassette and depress the PLAY button. **Note:** Continue pressure on cassette during operation; slight looseness with carrier cover off lets tape misalign and either tangle, break, or shut machine off. As long as you hold cassette down tight, machine should function in Play mode, sending picture and sound to TV monitor. If tape does not thread with PLAY button depressed, perform tests the way the following photos describe.

OPERATION WITHOUT CASSETTE can be accomplished by pushing the cassette carrier down until it latches. Then stick black tape over phototransistors at each side of mechanism. Otherwise, automatic shutoff lamp illuminates them and prevents PLAY button from latching. Even bench or room light can trip the auto-shutoff system, which instantly unlatches any operating button you might push.

Mechanical or electronic? With both phototransistors covered, press PLAY. If the button does not latch, listen for clicking of auto-shutoff solenoid each time you try to press the button down. Solenoid is just behind row of operating buttons, and hidden by them. A click indicates that the solenoid is unlatching the button. Trouble probably is electronic, in auto-shutoff system, or caused by some error or malfunction that activates auto-shutoff.

If there's no clicking, but you still cannot get the PLAY button to latch down, look for mechanical trouble. Solenoid might be stuck.

Two spring-loaded roller arms keep cassette carrier down. Pull them away and press EJECT to release cassette carrier. From up position, push carrier down slowly keeping downward pressure on PLAY button at the same time. At bottom of carrier travel, roller arms should slip over top of carrier-tray ends. If that does not release block on PLAY button, mechanical interlock is not working right.



THREADING MECHANISM in the stop mode leaves tape unthreaded (photo at left). Path of tape before threading leads across front of cassette, with gate up and exposing tape. Mechanism moves to threaded positions in play mode (photo at right). Drawing illustrates tape path in unloaded mode, and labels key parts of threading mechanism.

With PLAY button latched down, switch closes to apply 12 volts to six-transistor stage that drives loading motor. Motor pulley drives worm gear. Two leading gears engage teeth around perimeter of two loading rings. Teeth cover only about one-third of circumference of each loading ring.

Loading or threading posts are part of loading rings. When motor drives rings, those posts move in arc, in slots on guide plate. If cassette were in place, both posts would protrude inside cassette, between tape and reel. Also "inside" tape path is *threading guide post*, right next to left-side loading-ring post. At right corner of cassette, also "inside" tape path, is capstan.

Loading motor turns rings, and ring posts move outward, each moving partway around one side of video-head cylinder. If a cassette were there, tape would be pulled outward from the cassette by each of these loading-ring posts.

Threading-guide post moves outward, too; but it is pivoted on arm and swings leftward, guiding tape in that direction. Threading-guide post establishes path that holds tape against full-erase head.

As that post approaches leftmost travel, its pivot arm levers another pivoted arm. *Tension post* on the second arm swings rightward and encounters tape. Attached to base of that tension arm is brake band that encircles base of supply reel turntable. If tape were to slacken a bit, brake band would tighten. Drag on supply reel would keep slack out.

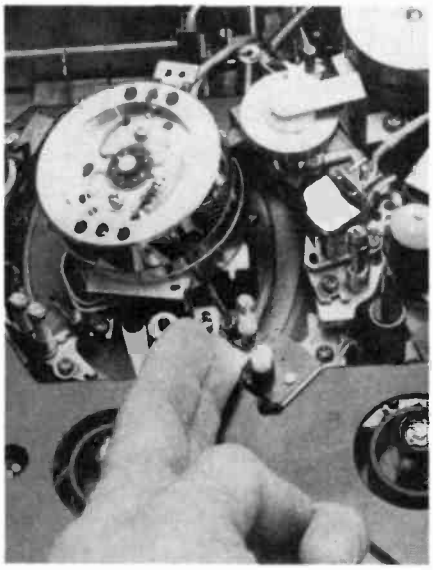
As loading-ring posts pull tape outward along each side of cylinder, tab on left-side ring pushes impedance roller back slightly, to allow tape past. Then impedance roller returns into contact with tape. Impedance roller contacts tape firmly just before 90-degree direction change around left loading-ring post.

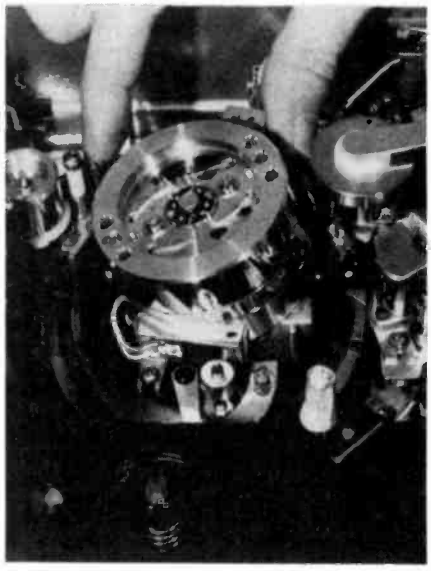
An *angle-post* right beside loading post changes tape direction another 90 degrees. At the same time, angle post orients tape to lie flat against canted cylinder.

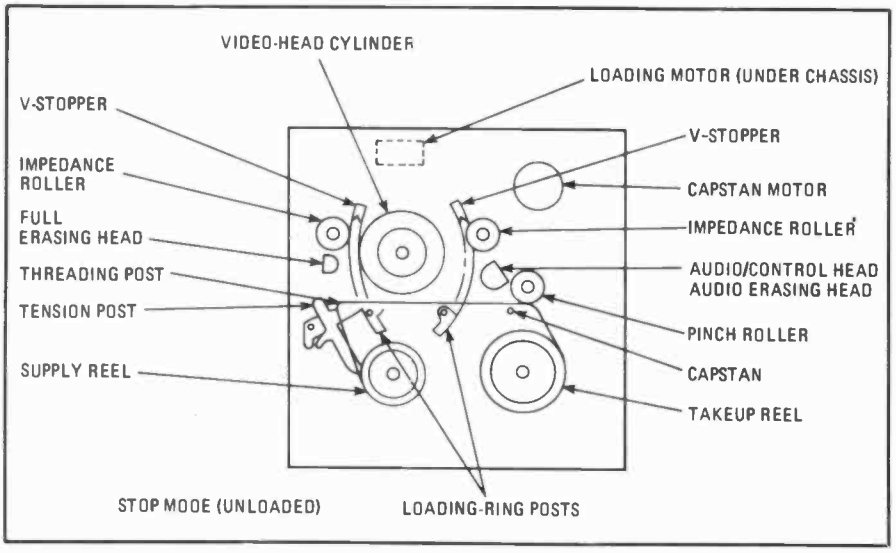
As all that occurs on left side, right-side loading-ring post pulls tape from that side of cassette. But there are no threading-guide and tension posts on right side; another impedance roller positions tape close against right-side loading post. Angle-post there straightens up angle as tape comes from around cylinder. Tape path from impedance roller to capstan goes past audio and control head and holds tape in contact with that head.

When both loading rings have moved their posts through complete arcs (about 110 degrees), both posts encounter V-shaped stop blocks. A loading-end switch signals loading-motor drive stage to stop motor. Similar signal activates pressure-roller solenoid, which draws roller against capstan.

That completes loading. Capstan motor has turned on, as has cylinder drive circuitry. (Video-head cylinder operates from servo-controlled three-phase internal drive motor. In some machines it operates continuously, even in stop or unthreaded mode.)







LEAF SWITCHES signal when threading or unthreading has finished. Tab on left-side loading ring pivots arm that pushes loading-end switch closed.

In earlier VHS models, loading-end switch applies 12 volts DC (logic high) to logic circuits that turn off threading motor stages, activate pressure-roller solenoids, and switch electronics to playback. Unloading-end switch, activated by projection on right-side loading ring, grounds logic input when it closes. This applies logic low to stop reversed threading motor.

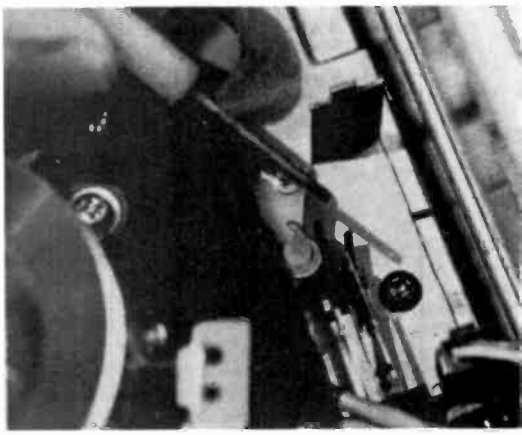
Some later VHS models have been altered to take logic low from both switches—that is, each switch grounds its respective circuit connection when it closes at end of action.

Microswitches often become misadjusted, but leaf switches seldom do. It's easy to tell by inspection whether a leaf switch closes as it should. However, leaf-switch contacts are susceptible to oxidation. Occasional burnishing is an important part of preventive maintenance.

Most noticeable symptoms of faulty end-switches: Slight swishing sound of loading motor as its pulley slips in belt, motor having failed to shut off after loading. In unloading or stop mode, capstan may keep running after unthreading has supposedly finished.

Observe those switches. Normal operation calls for whichever switch is closed to open as threading or unthreading *begins*. Thus both stay open during actual load/unload activity. Failure of either switch to open thwarts this operation. Machine may refuse to load; may load and then kick out PLAY button but not unload; or may fail to unload when returned to stop mode either by auto-shutoff or manually.

Replacement is best, of course. Inept adjustment of a leaf switch often aggravates problems just described.

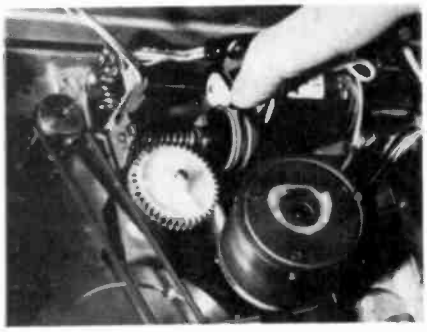


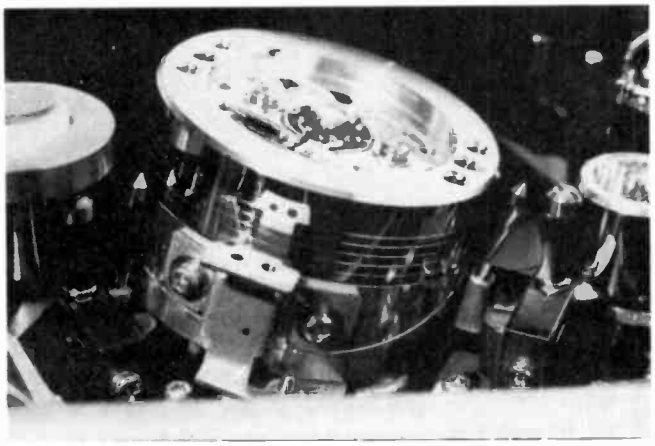
SIMPLE FAILURE of machine to load tape after PLAY button has latched down can point to broken or slipped drive belt. Characteristic of this symptom: slight whine of loading motor running but no hint of movement in threading mechanism. After several seconds without loading activity, automatic shutoff takes over and pops PLAY button back up.

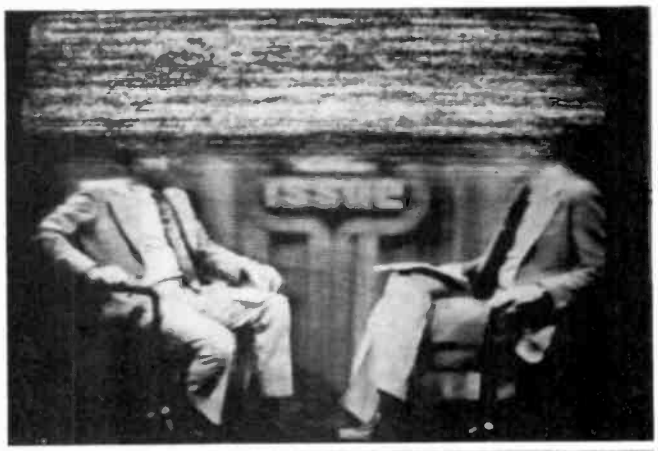
Occasionally, jammed threading mechanism prevents loading. That situation generally is accompanied by some noticeable effort of loading rings to turn. Again, though, auto-shutoff takes over presently. A stray object jamming the machinery can often be dislodged by turning loading-drive worm gear backward by hand. Bent parts would require replacement. Do not try bending them back yourself; bending might work for a while, but will result in callbacks and wasted time.

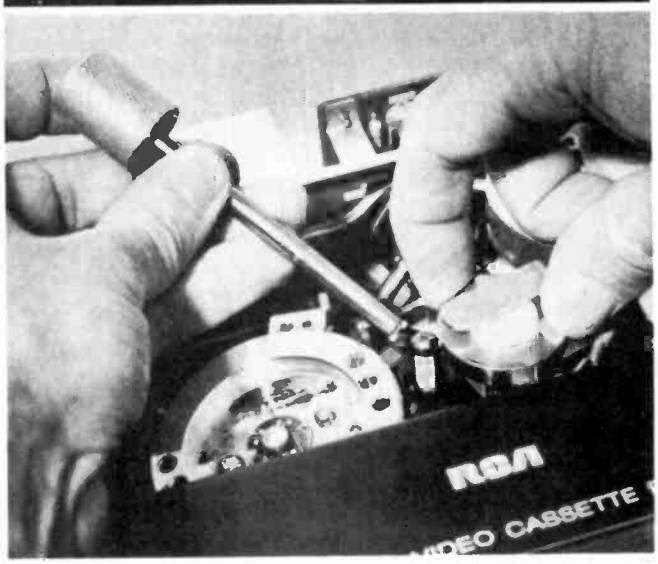
Slipping drive belt takes the same cure as in a high-grade record changer or audio tape recorder. Clean pulleys and belt thoroughly with alcohol. Best to replace belt. Do not touch either pulleys or inside surface of replacement belt. Be sure you have right belt; wrong size can create intermittent.

If loading motor fails to run, do not blame motor until you have checked out motor-drive stages. Transistor fault there, as often as not, lets motor run in one direction but not in other.









TAPE POSITIONING in transport can be critical. Guides and posts along path take care of that positioning. However, probably the most crucial are guide posts on loading rings (photo above). They align tape with respect to head wheel and thus with spinning video heads. Even slight misadjustment of just one guide post delivers band of snow (photo above, right). In some cases, you see multiple bands across picture. This symptom may not be too bad with tapes recorded on same machine.

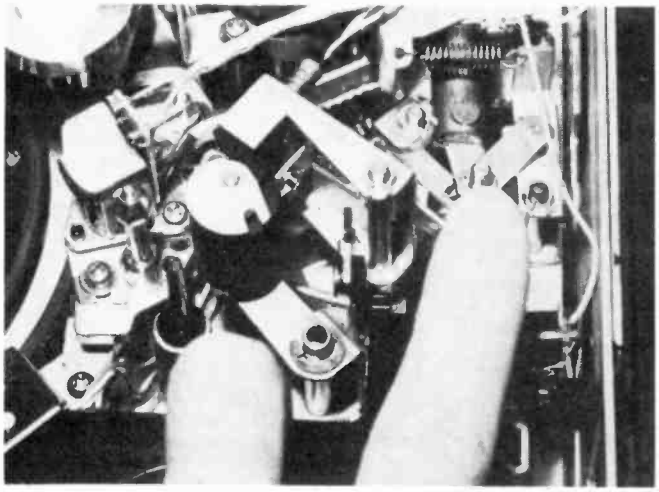
Examine tape itself. If tape shows crinkling along one edge, cause is likely in guide posts on loading rings.

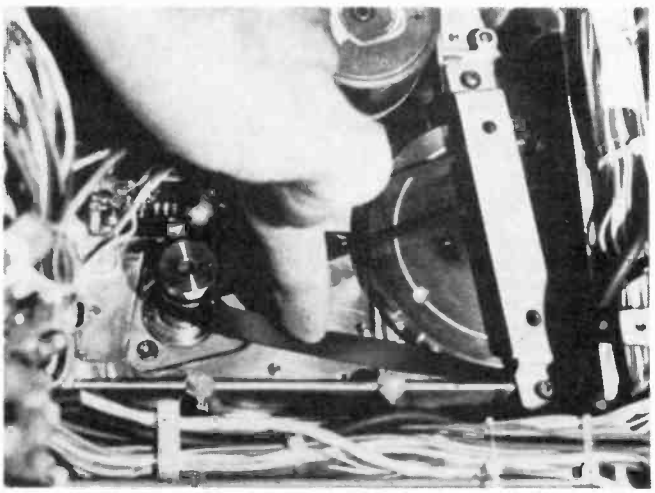
Heights of post guides are independently adjustable in most machines. It's easiest if you remove cassette-carrier cover. However, you can manage preliminary trial adjustment with only machine cover off.

Insert cassette (*not* your alignment cassette). Press PLAY. When the machine has threaded, turn off main power switch. That leaves posts out beside head wheel and accessible. To reach right-side post, you may have to push the impedance roller aside, as shown in photo at bottom right). Use only special tool for adjustment (RCA No. 144389; Magnavox No. VFK0137/171455-13). (When you turn machine back on, it automatically unthreads and cycles out to stop mode, since power was interrupted.)

Make your trial adjustments only slight—never more than one-half turn of alignment screw each time. After one attempt, play properly recorded tape and observe snow band. If it has become wider, you have gone in the wrong direction or have adjusted a post that was not out of line.

P.S. Misalignment of head wheel assembly *could* cause the snow bands: but that is not likely unless head wheel has been replaced and its supports improperly seated.



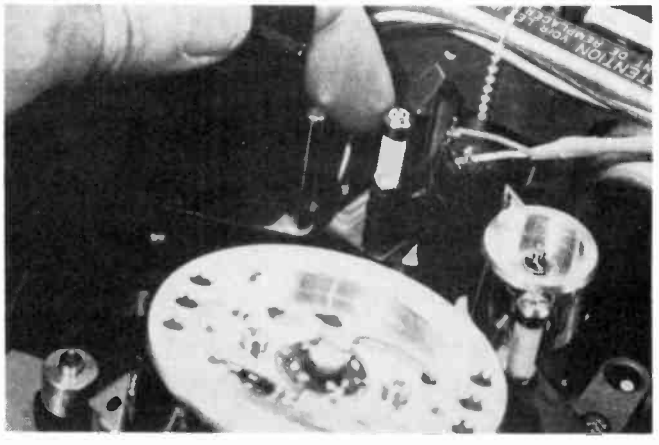


STEADY MOVEMENT OF TAPE through transport depends largely on capstan and pressure (pinch) roller. Minor speed variations are noticeable first in audio track. As "wow" grows worse, picture begins breaking up—and sometimes mutes completely, blanking off both video and sound. Control servos try to smooth out minor speed errors, but severe changes reach beyond their range. Indeed, too much slippage trips machine's automatic shutoff.

Transport or tape-movement faults fit into at least four categories. (1) Inadequate pinch-roller pressure, or flatted or aged roller. (2) Capstan-drive slippage. (3) Excessive drag at supply-reel turntable. (4) Faulty cassette. A faulty cassette, which seldom happens, can be handled easily by simply substituting a known good cassette.

Pinch-roller trouble can develop from fault in solenoid (see photo above, left) or its linkages. Hardening rubber on pinch roller can allow slippage, and calls for new roller. Thorough cleaning of capstan shaft with alcohol should help, and should be done with any replacement roller. Keep finger-marks from both capstan and roller.

Capstan shaft has flywheel underneath deck, driven by flat rubber belt from pulley on capstan drive motor (see photo above, right). Aging belt or accumulation of oil or dirt on pulleys can induce slippage. Any video recorder should have new set of drive belts installed every year or so, or after 1000 hours of operation, as preventive maintenance. Suggest that to machine owner, when an older machine comes in. But you'd better not replace them without explaining first, unless they're actually defective; someone might accuse you of installing unneeded parts.



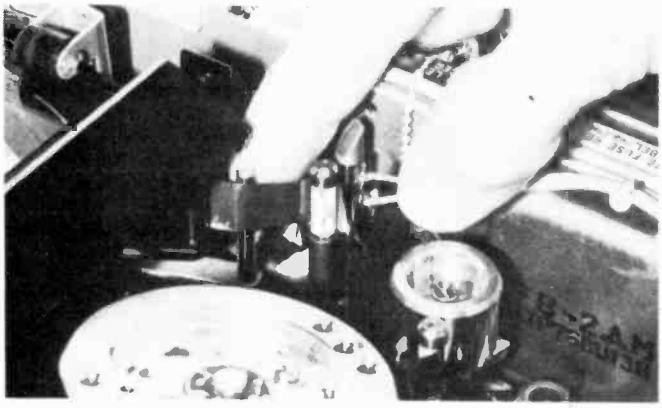
DURING PLAY OR RECORD operation, only motion applied to supply-reel turntable comes from tape being drawn out of cassette. Yet, turntable cannot be left free to "coast." Tape tension must be maintained so that tape stays in close contact with heads throughout transport.

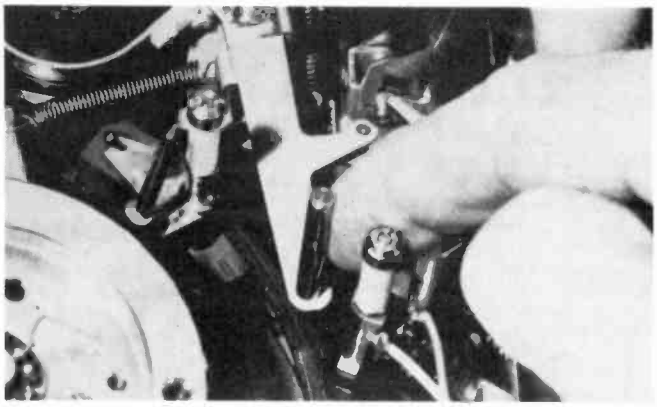
When loading posts move outward, drawing tape with them, threading-guide post moves leftward. Its motion operates another *tension arm* on which is *tension post* that moves rightward, encountering tape. You can gauge motion of those two posts in photos above; thread positions are in photo at above right. Also, to help you visualize those actions, photo at bottom left shows tape route between these two posts.

Other end of tension-post arm attaches to brake band at base of supply-reel turn-table (see photo at bottom right. If tape tries to slacken, slack allows tension post to move rightward, which tightens brake band around supply turntable.

That brake is thus self-regulating under most circumstances. Too much braking overtightens tape and forces tension post slightly leftward, loosening brake band. However, misadjustment might leave the brake band entirely too tight and present too much drag on supply reel.

Foreign material, such as debris from broken tape, might work its way down alongside either turntable. That could impede rotation of turntable. Stuck takeup turntable causes tape to spill. After several seconds, in some machines, this condition activates the auto-shutoff circuitry.





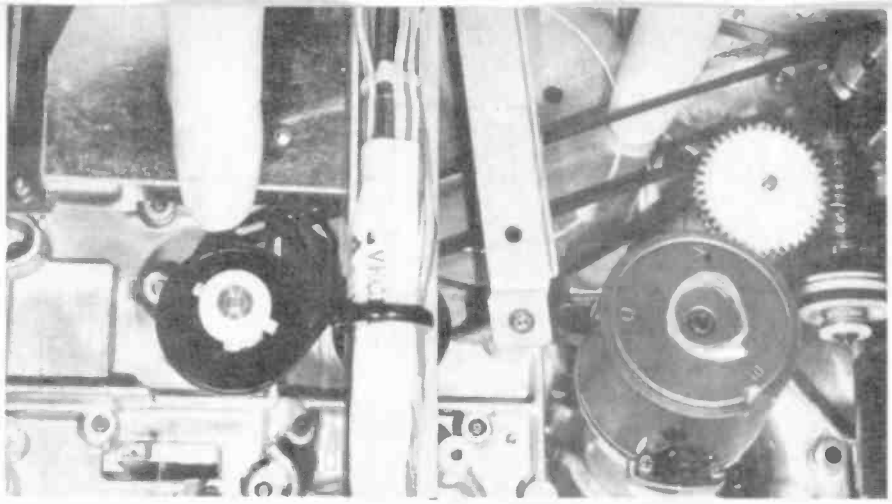
FAST FORWARD AND REWIND both operate only with tape unthreaded. Tape path carries it across front of cassette, with gate open, of course. Either operating button closes switch contacts that turn on capstan drive-motor. (Video-head cylinder, which has its own drive, remains off, in some machines.)

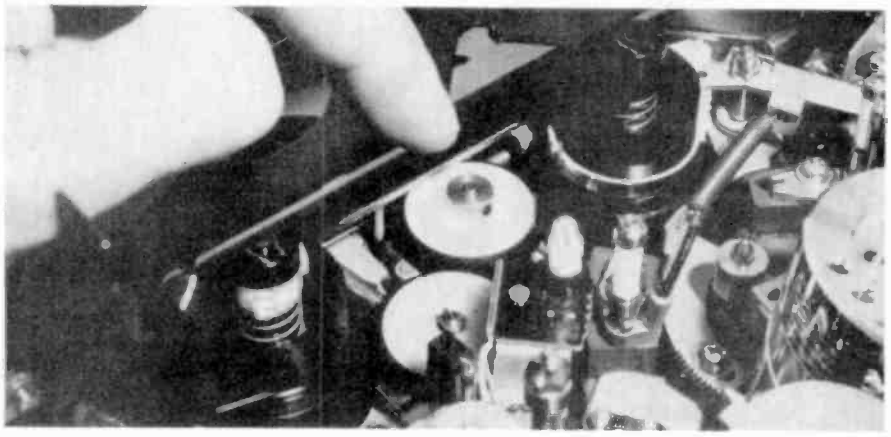
Rubber belt from pulley on capstan motor (see photo at top) spins fast-speed drive wheel (where finger points in photo at bottom). Mechanical coupling from REWIND button pulls fast-speed wheel into contact with rim of supply turntable. Result: turntable spins "backward" at high rpm, winding tape back onto supply reel very rapidly.

Pressing FAST FORWARD button pulls fast-forward idler wheel into contact with both fast-speed wheel and rim of takeup turntable. That pulls tape rapidly from supply reel and winds it up on takeup reel.

Defects are generally mechanical. (1) Button linkage may fail to pull correct wheel or idler into contact with proper turntable rim. (2) Turntable in question might be stuck, but that would also affect Play or Record modes. (3) Turntable may have lubricant on its rim. (4) One of idler wheels with rubber tires may be afflicted by defects common to such parts: aged and cracked or hardened rubber tire; dirt or lubricant accumulation; or chafed bearing at wheel center. (5) Drive belt may have broken, slipped off, or stretched. (6) Pulleys beneath deck (photo at top) may have accumulated grit or oil, or set screw might have come loose.

Cleaning takes care of dirt and oil. Replacement cures bad drive belt. Replacement is surest corrective for bad idlers. In every case, however, even after replacements, clean entire drive system with alcohol before you call any job complete.





SOME PRECAUTIONS are appropriate once you have found and cleared threading/unthreading problems.

Before you start reassembly of covers—even before you put cover back on cassette carrier—remove two strips of black tape covering end-sensor phototransistors. Otherwise, machine could damage video tape.

Inexperienced technicians reaching that phase of VCR repair often can't find or identify correct screws for replacing covers. To avoid such confusion, buy compartmented trays at hardware store and label each compartment. Less expensive: commandeer styrofoam egg carton from kitchen (see photo below).

With all covers in place, insert blank cassette tape and test all functions: Record from camera and tuner, at both speeds, using monitor; playback into monitor; pause; fast forward; rewind; and, of course, stop. Be sure machine goes automatically to Stop mode and unloads at both ends of tape travel, and whenever you slow down capstan or head wheel by hand. **R-E**

BUILD THIS

$10 LOGIC PROBE

If you need to know what is—or isn't—going on in your digital logic circuitry, build this economical logic probe and find out.

FRED BLECHMANN K6UGT

ANOTHER DIGITAL LOGIC PROBE? YES, BUT THIS ONE HAS A number of advantages over many probes available in kit-form or ready-made. It only takes about 30 minutes to assemble from a complete kit that's available. The high input impedance—about 1 megohm—keeps the probe from affecting most circuits, and the long, slim probe body makes it easy to get "readings" in crowded circuitry. A low parts count, using standard easy-to-find components, results in low final cost. This probe works with both TTL and CMOS circuitry, and is powered by the circuit under test. Perhaps best of all, the complete kit is under $10!

Circuit

The schematic (Fig. 1) shows the simple, no-frills circuit. The 555 timer (IC1) is connected to function as a Schmitt trigger, set to a fixed threshold value. The 555 acts as a comparator, with the output inverted relative to the input. With no input signal, pin 2 floats to a logic high level, holding output pin 3 low, so LED1 (the logic high indicator) lights. When the input is connected to a logic low level, pin 3 snaps high and LED2 (the logic low) lights. Resistors R1 and R2 isolate the LED's from each other and control the current through them. Resistor R3 provides feedback between the control voltage and threshold inputs. Diodes D1 and D2 isolate input pin 2 from spurious noise. Diode D3 protects the 555 from reverse polarity connection of the power leads.

Construction

The circuit could be assembled on perforated board and mounted in any tubular container using some kind of metal probe pin. For those readers who are not handy at making their own enclosures, and prefer the compactness of a slim probe, a

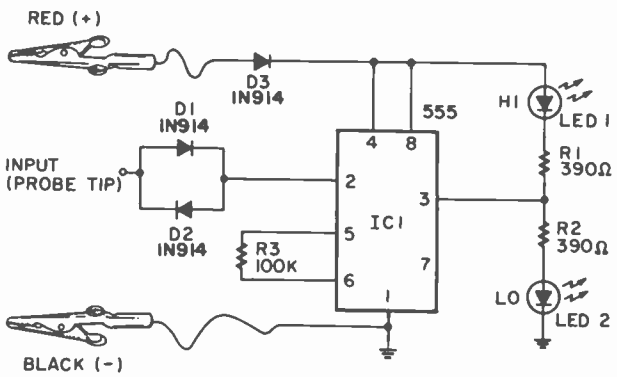


FIG. 1—SCHEMATIC DIAGRAM of the logic probe. Device can be powered by 3.5 to 15 volts tapped off the supply in the device under test.

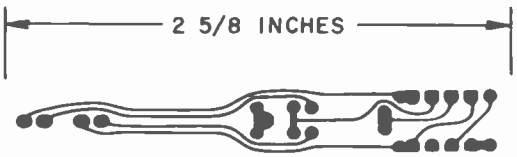


FIG. 2—FOIL PATTERN of the logic probe's PC board.

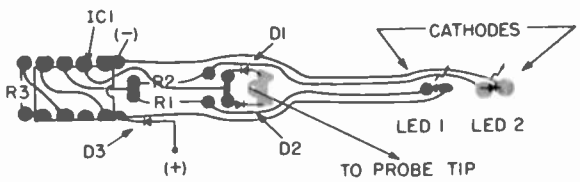


FIG. 3—COMPONENT LAYOUT shows approximate positioning of the parts on the PC board.

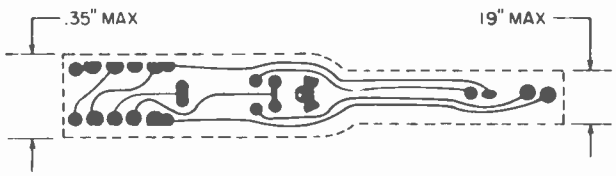
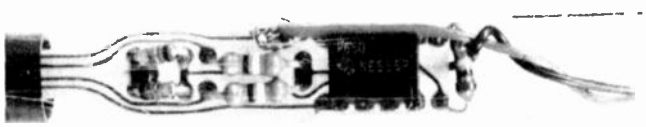


FIG. 4—THE PROBE CASE IS SMALL so the PC board must be trimmed to the dimensions shown.



CLOSE UP OF COMPONENT SIDE of PC board is shown in this view of probe-tip assembly.

PARTS LIST

All resistors are ¼ watt carbon.
R1—390 ohms
R2—390 ohms
R3—100,000 ohms
D1-D3—1N914 or equal, signal diode
LED1, LED2—Mini red light-emitting diode
IC1—555 timer
Miscellaneous: body, tip, pin, solder, wire, end cap, clips, insulators, PC board or perf board, cement.
All of the above parts, except the cement, including a drilled, plated PC board and clear plastic see-through body, are available from: PPG Electronics Co., 14663 Lanark St., Van Nuys, CA 91402. The complete kit is $9.95 plus $1 shipping and handling, USA. The PC board alone is $2 postpaid, USA. California residents add 6% sales tax.

kit is offered (see parts list) that includes a special probe-tip assembly and slim acrylic plastic tube for the body. A thin, solder-plated printed circuit board is supplied with the kit (or sold separately), that makes the assembly very easy and avoids unnecessary crowding of parts.

Figure 2 shows the foil side of the PC board, and the parts layout is shown in Fig. 3. The probe housing is small so the PC board must be trimmed as indicated in Fig. 4. There are only a few things to watch out for. Since the small-diameter probe body does not allow space for a socket, it is especially important that you orient pin 1 of the 555 properly. Also, be certain the bases of the LED's are only about 1/16 inch above the board and that the cathodes are oriented as shown in Fig. 3. See Fig. 5 to identify the cathode lead. Also, be sure the diode polarities are as shown—the banded end is the cathode.

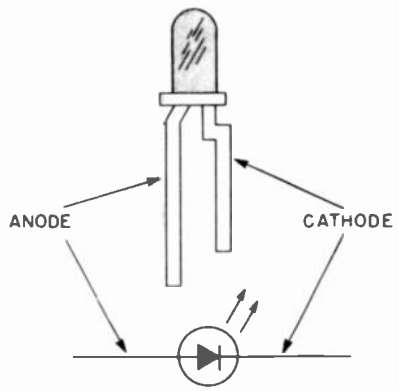


FIG. 5—LED POLARITY is often indicated by having the leads shaped as shown—the cathode lead is the shorter. In addition, the plastic package often has a flat on the rim immediately above the cathode lead.

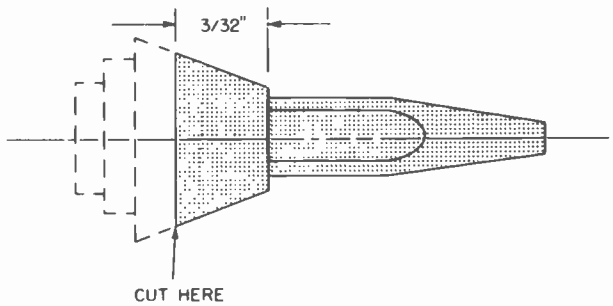


FIG. 6—THE PROBE TIP IS SALVAGED and adapted from the housing of a popular ballpoint pen.

Assemble and solder all components to the board, keeping all parts *close* to the board. D1 and D2 will have one end raised, so they are at about a 30-degree angle to the board, unless the particular diodes you use are very short. The extra hole between the junction of D1 and D2 at the narrow end will be used later. The same is true for the hole next to pin 1 of the 555. Diode D3's cathode (black band) is soldered in the extra hole next to pin 8 of the 555. The diode lies flat on the board; its anode is connected later.

Now you must prepare the probe-tip assembly. Recognize the

continued on page 73

SERVO-CONTROLLED PICKUP ARM

An unusual dynamically balanced pickup arm from JVC replaces many mechanical components with electronics to reduce the effects of resonance to a minimum.

LEN FELDMAN
CONTRIBUTING HI-FI EDITOR

THE CHIEF FUNCTION OF ANY PICKUP arm in a record-playing system is to keep the cartridge's stylus in intimate contact with the record groove without impeding movement of the stylus as it traces the complex microscopic undulations that are a physical representation of the music waveforms to be reproduced. One of the problems associated with pickup arms is arm resonance—the interaction of the arm's mass and the compliance of the cartridge's stylus assembly. The frequency of that resonance may be below 10 Hz. The higher the cartridge compliance, the lower the arm's resonant frequency.

Some arm/cartridge combinations may have resonance peaks that are as much as 20 dB higher than audible, musical low-frequency content in the record. When the arm is excited by very strong bass in the music or by warps in a record, arm resonance can cause intermodulation in the reproduced music. Under worst-case conditions, excessive pickup arm resonance can actually push the stylus out of the groove entirely.

There are two approaches to solving arm-resonance problems: reducing the mass of the arm to increase the arm's resonant frequency so that it is above audible range; or taking steps to damp out resonance peaks to below audibility. A pickup arm recently introduced by JVC and incorporated in their *model QL-Y5F* turntable shown in Fig. 1 attempts to damp resonance with purely electronic systems. Tracking force and anti-skating force are also applied completely electronically. The new pickup arm is called an *Electro-Dynamic (E-D) Servo* arm and is aptly named, since two fully electronic servo systems control all

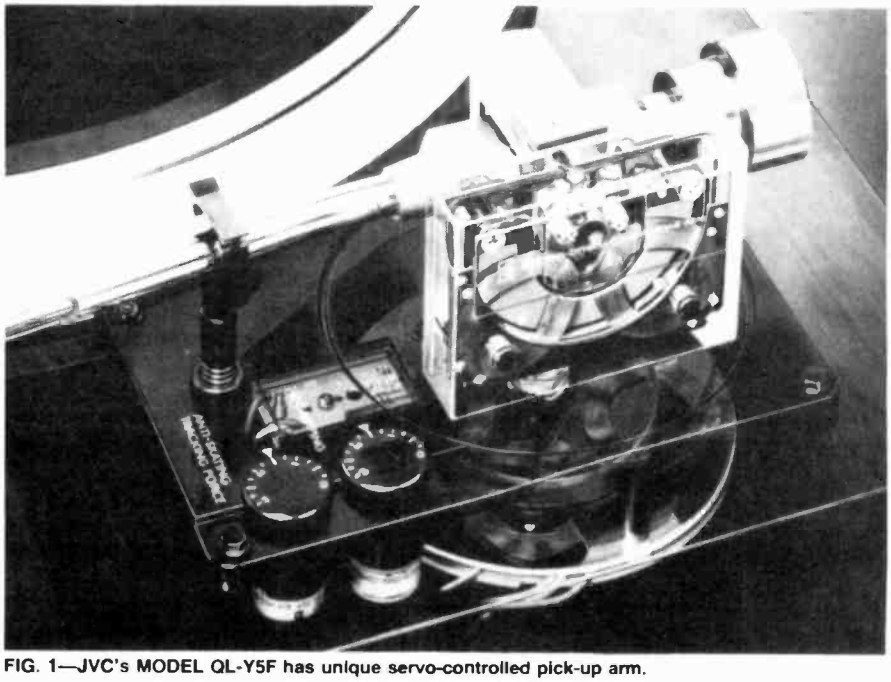


FIG. 1—JVC's MODEL QL-Y5F has unique servo-controlled pick-up arm.

horizontal and vertical motions of the arm from instant to instant while the arm tracks a record groove.

Two coreless linear motors generate the horizontal and vertical torques that move the arm. Each torque is controlled by its own independent servo system. Of the two most popular balancing systems used in pickup arms, dynamic and static, the dynamic type does a better job of keeping the stylus in close contact with the walls of the record grooves. But conversely, the spring that is used in most dynamically balanced arms, hinders, rather than helps, the arm to move smoothly as the stylus it carries tracks complex undulations in the grooves. The result is stylus movement that is not totally free. Another important factor to consider is the applied anti-skating force. It is often mechanically applied and presents another source of friction and, in consequence, another cause of impeded stylus motion.

JVC's E-D Servo pickup arm is a dynamically balanced type that does not have the drawbacks you would normally expect. It has no spring to apply tracking force, nor does it have a second spring or magnet to apply skating force. Instead, it uses a balancing system in which torques, generated by the interaction of a built-in coil with a permanent magnet (actually two magnet-coil combinations, for horizontal and vertical torque generation) do the

JVC MODEL QL-Y5F.

job without any mechanical contact with the moving arm itself. What is essentially a statically balanced arm remains free of any mechanical linkage, and, therefore, has high sensitivity. An exploded view of the major elements of the new E-D arm is shown in Fig. 2.

If a conventional pickup arm is accelerated upwards by the warp of a record being tracked, its tendency is to rise even after the warp-area has flattened out, until gravity brings it back into contact with the record's surface. In the past, oil-damped arms have been used to attempt to correct that situation. In JVC's E-D Arm, when record warp starts to lift the arm, it generates a voltage in the vertical velocity-detection coil. This voltage is passed along to the vertical arm-drive circuit where it is converted into current, is amplified, and fed to the vertical arm-drive coil. The coil develops a magnetic field that moves a magnet in the opposite direction to that of the initial force—in this case, downward. Since the entire process is electronic, it occurs in a matter of nanoseconds, before mis-tracking can occur. Incidentally, once static balance has been set for the arm/cartridge combination, variable tracking force is applied electronically, by a constant current, in much the same manner.

Lateral motion of the arm and cartridge is also under continuous electronic control by a similar system. Sudden physical shocks, whether mechanically or acoustically coupled to the turntable system are effectively "damped," as are excessive lateral arm excursions caused by records with center-holes that are not properly centered. The two separate horizontal and vertical servo systems work together to cancel all spurious arm movements, whether they are vertical, horizontal, or, as most often, a combination of both. And just as a constant current maintains downward tracking force vertically, anti-skating compensation is applied by the horizontal drive coil, also with a constant current. Despite the seeming complexity of the servo systems, adjusting the E-D Servo arm is actually as simple, if not simpler, than adjusting a conventional arm. Once the cartridge has been mounted and the counterweight has been set for zero-balance, the user merely turns both the Q-DAMPING and ANTI-SKATING/TRACKING FORCE dials to the value, in grams, recommended by the cartridge manufacturer.

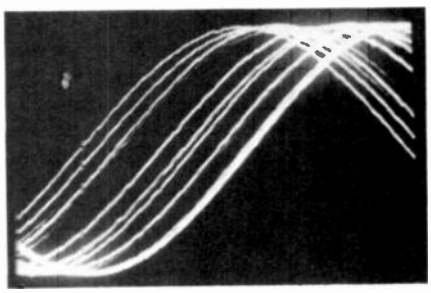


FIG. 3—SUBSONIC ARM RESONANCE distorts audible test tone.

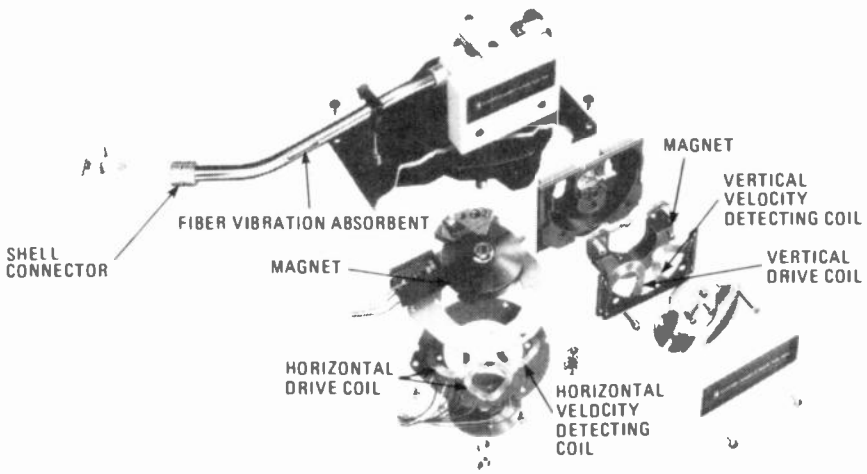


FIG. 2—SERVO-CONTROLLED PICK-UP ARM has velocity detecting and drive coils that are used to vary both the horizontal and vertical damping characteristics.

The two separate linear motors that generate horizontal and vertical rotary torques are mounted so that those torques are created around the same axis as that of the pickup arm's rotary shaft. This is done so that no force is generated to try to shift the position of the rotary shaft, and prevents any reduction in arm sensitivity caused by eccentric application of additional friction components.

Operation of the more usual automated functions of the arm such as horizontal travel, up/down cueing, lead-in, lead-out and return functions

are also completely electronic and the arm does not contact any part of the cabinet at any time. It is even possible to adjust arm parameters during play, since tracking and anti-skating forces as well as resonance damping are all adjusted with continuously variable controls located at the base of the pickup arm.

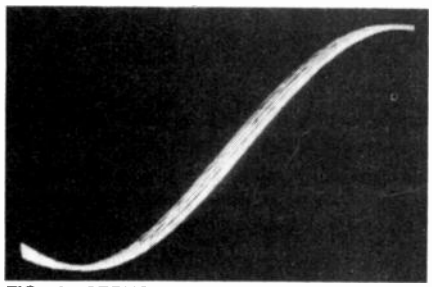


FIG. 4—SERVO-CONTROLLED PICK-UP ARM reduces arm resonance. Audible test tone distortion is also reduced as compared to Fig. 3.

To illustrate the effect of arm resonance, we found a heavily warped record (not at all difficult to do, incidentally) that had served us well as a test record before it was inadvertantly exposed to sunlight and hopelessly warped. Using a conventional pickup arm with a known resonance in the region of 8 to 10 Hz with a specific cartridge, that resonance was easily caused intermodulation at the higher audible frequencies on the test record. By synchronizing our oscilloscope so that it "locks" just one cycle of the desired test tone contained in the record, we see, in Fig. 3, how the subsonic warp or resonance frequency interacts with the desired audible-test frequency to generate distortion.

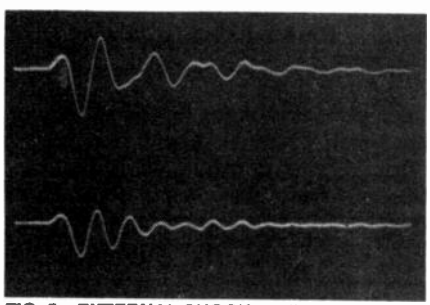


FIG. 5—EXTERNAL SHOCK applied to turntable cabinet is accented by arm resonance. Upper trace shows effect of external shock on conventional pick-up arm, while lower trace shows effect on servo-controlled arm.

The same warped record was then played using the new JVC Electro-Dynamic Servo pickup arm equipped with the same cartridge. The Q-Damping (or Resonance Damping) control was adjusted until virtually all of the effects of resonance disappeared from the scope presentation, as shown in the scope photo of Fig. 4.

Uncontrolled resonance in a pickup arm can also accentuate the effect that an external shock applied to the turntable cabinet can have on reproduced music. The upper trace of Fig. 5 shows the output waveform of a well-known cartridge after an external shock is applied to a turntable cabinet. The lower trace shows the output waveform produced by the same cartridge mounted in the E-D arm and adjusted properly for resonance control.

According to JVC, even signal-to-noise is improved by proper control of arm resonance. Since an unmodulated record groove contains wideband, random noise frequencies, it is reasoned that some of that noise energy will excite the resonant frequency region of the arm/cartridge combination and if such resonance is undamped or uncontrolled, overall noise amplitude will actually be

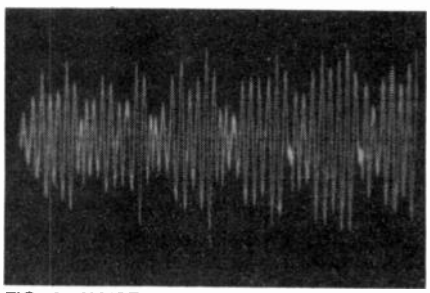


FIG. 6—NOISE WAVEFORM generated by unmodulated record groove that is traced with a conventional pick-up arm.

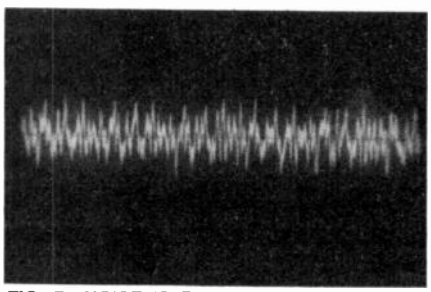


FIG. 7—NOISE IS REDUCED as compared to Fig. 6 when unmodulated groove is traced by new servo-controlled pick-up arm.

greater than it would be had the arm been properly damped and its resonance suppressed. To prove that last point, JVC supplied us scope photos of waveforms of noise generated when an unmodulated groove is traced with a pick-up-arm whose resonance is uncontrolled (Fig. 6) and, for comparison, the waveform of noise generated when an unmodulated groove is traced with their new E-D arm (Fig. 7).

Although the phonograph record is now more than 100 years old, and we have come a long, long way from Edison's tin foil cylinders and steel phonograph "needles," there still seems to be no end to the innovative improvements that continue to be developed to aid in its reproduction and accuracy of playback. Probably the only development that will bring to an end this quest for perfection will be the standardization and popularization of a digital disc format. But since such standardization still seems to be years away, every new advance in analog record reproduction is a welcome one. **R-E**

COMMUNI

ROBERT B. GROVE

NO OTHER COUNTRY IN THE WORLD HAS a government that smiles more leniently on its eavesdropping citizens than does our own. Many countries ban radio listening altogether, while nearly all others regulate it to varying degrees.

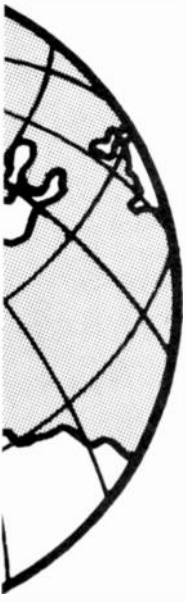
Listening and the law

While we Americans are free to listen to anything, we are prohibited from discussing what we overhear (unless the transmission is specifically intended for public consumption). Additionally, we may not use what we overhear for personal gain. Those laws are expressed by the 1934 Communications Act, section 605. The act is presently undergoing massive rewriting by Congress.

Obviously, many manufacturers, both domestic and abroad, are aware of the insatiable appetite that Americans have for "listening in." New shortwave receivers from offshore manufacturers like Sony, Panasonic, Radio Shack, Yaesu, and Kenwood-Trio, compete with Drake, McKay, Dymek, Heathkit, and other American manufacturers.

Some companies—notably Electra (Bearcat), and Regency—specialize in scanning receivers for the VHF/UHF enthusiast.

As a result, worldwide radio communications are being overheard at an unprecedented rate by unauthorized and uninvited listeners. Some agencies are becoming quite sensitive about the intrusion of their privacy. Treasury and Justice Department officials are openly opposed to scanner monitoring. Their hostility is not without cause: an alarming number of scanners have been



TUNING IN ON WORLWIDE SW STATIONS

In radio circles, eavesdropping is a way of life. If you want to find out for yourself what's happening on the air, this guide will provide a number of worthwhile pointers.

confiscated from suspects arrested during criminal investigations. The scanners had been used ostensibly to monitor law-enforcement channels to elude capture. On the other hand, many law-enforcement agencies welcome the public inspection of their communications to stimulate involvement.

The vast majority of scanner listeners are simply fascinated by the idea of intercepting a communication not intended for them to hear. It is a form of voyeurism, whether we admit it or not. And it's fun! (See Table I.)

About scanners

Although crystal-controlled scanners are still with us for inexpensive monitoring of small numbers of frequencies, programmable scanners are growing rapidly in popularity. They are where the action is.

The "Big Three" in programmables are: Electra (Bearcat), Regency, and Radio Shack (Realistic). For the inveterate tinkerer, nothing can surpass the hours of fascination playing with a programmable scanning receiver. Those radios are available for VHF/UHF-FM monitoring, VHF-AM aircraft listening, or a combination of those functions. New products and innovative features are closely-guarded secrets with manufacturers. Industrial espionage is a real threat in this hotly-contested race for first place in consumer scanner marketing.

Modern scanner design

Most modern scanners have outstanding sensitivity. They provide metropolitan coverage while using only their small whip antennas. In fact, manufacturers prefer that their customers not use outside antennas. Often, the increased signal strengths aggravate problems of intermodulation, images, and other symptoms typical of front-end overload.

A frequent criticism heard from users is, "Why don't manufacturers listen to us? We want increased frequency coverage, S-meters, reduction of images and spurious signals, and increased search rates." Well, perhaps the tide is turning. I have just returned from a very productive meeting with a top manufacturer of scanners where I served as a consultant. Many suggestions were carefully considered. There should be improvements in the months ahead!

Perhaps the most important development in recent scanners is the BC-220 from Electra. It combines VHF-AM aircraft monitoring with the usual complement of three-band FM coverage. More important, the dual-mode detector (AM and FM) qualifies the receiver as an excellent mainframe to be used with external frequency converters for those stalwart listeners who want to extend their frequency ranges. Thus, the military UHF-AM aircraft band (225–400 MHz) could be covered, as well as the new 806-866 MHz FM land mobile band.

TABLE 1—SELECTED VHF-FM MONITORING FREQUENCIES

Freq. MHz.	Service
43.58	Paging, nationwide.
47.42	American Red Cross network.
146.94	Most popular 2-meter ham frequency.
148.15	Civil Air Patrol.
150.00	Military navigational satellite.
152.54	Mobile telephone.
156.80	Ship calling and distress.
157.05	U.S. Coast Guard vessels.
163.20	U.S. Marshals, nationwide.
165.375	Secret Service.
462-975	Emergency Medical Team dispatch (larger cities)

BEARCAT 220 from the Electra Co.

A number of manufacturers produce high-quality frequency converters, including VHF Engineering, Vanguard, JANEL, and Hamtronics.

VHF/UHF ban

In the U.S., the most popular bands

REALISTIC DX-300 from Radio Shack

scan in the FM ranges are: VHF-low band (30–50 MHz); VHF-high band (150–175 MHz), and UHF (450–512 MHz). Probably 99% of the land mobile services operate their communications within those ranges.

VHF-low band is occupied primarily by users who need wide geographical coverage. Hilly or mountainous terrain is less destructive on signals within this band. Sheriffs' departments, utility companies, and military users populate that portion of the spectrum.

VHF-high band is the most densely-packed portion of the land mobile spectrum. Fortunately, it is not as vulnerable to skip interference as low band; otherwise most of the high-band frequencies would sound like CB channel 19! The popular two-meter ham band with its myriad repeaters is

PANASONIC MODEL RF-2900

found just below the high-band frequencies. The band of 144-148 MHz is allocated to the amateur services, and most programmable scanners cover at least a portion of that range. Federal government agencies are allocated the frequencies above 162 MHz.

UHF is used primarily in metropolitan areas. It provides some relief from VHF congestion. Short antennas and less co-channel interference are incentives for many UHF users.

Frequency lists for VHF/UHF

Several companies produce periodic lists of frequencies for scanner buffs. Many of those lists are categorized by geographical region for maximum consumer convenience. Electra provides a frequency service. Dial 1-317-894-1230 to request a free frequency list for your area. It provides an excellent starting point to begin listening with your new scanner.

For the serious scanner user, one organization is outstanding for its service to members: The Radio Communications Monitoring Association (RCMA) with headquarters in Anaheim, California. Their monthly newsletter is packed with pertinent information for scanner enthusiasts. Frequency lists, new equipment reports, technical topics, and question-and-answer columns are meticulously prepared for each issue. New members are welcome. Write to RCMA (P.O.B. 4563, Anaheim, CA 92803) for a free sample copy of their excellent bulletin, and membership information.

YAESU MODEL FRG-7000

A very sensitive topic among scanner listeners is that of federal law-enforcement frequencies. Generally, those channels are considerably removed from the portion of the spectrum reserved for non-government law-enforcement operations. Some of those ranges are not tuneable with programmable scanners. An interesting book by Tom Kneitel is his *Top Secret Registry of U.S. Government Radio Frequencies*. ($4.95 from CRB Research, P.O. Box 56, Commack, NY 11725). It covers the frequency range 25–470 MHz, and gives an idea of who is on which frequencies in the VHF/UHF spectrum. Several pages of operating and listening hints are included.

One major source of police, fire, and local government frequencies is the *Police Call Directory*, published by Gene Hughes. It is available through Radio Shack outlets. It may be ordered

PANASONIC MODEL RF-4900

from Hollin's Radio Data, P.O. Box 35002, Los Angeles, CA 90035.

Shortwave reception

Below 30 MHz, everything is different: receivers, antennas, signal propagation, and even services. Shortwave listeners ("SWL's") often stay up into the wee hours of the morning to catch rare "DX" as distant stations are called in the vernacular (see Table 2). It is here that we may intercept "Air Force One" with its presidential communications—spies with their cryptic broadcasts—pirate broadcasting stations at hidden locations—Coast Guard rescue missions—intercontinental telephone conversations—aircraft transmissions from worldwide countries as they cross the seas. The shortwave spectrum changes its signal-carrying characteristics from day to night. As a general rule, above 10 MHz is daylight use. Below 10 MHz is best heard at night.

Although many listeners are fascinated by everything they hear on the shortwave bands, most SWL's are polarized into one of two groups: Broadcast listeners (those who enjoy logging distant international broadcasting stations like BBC and Radio Moscow), and Utility DX'ers (two-way communications interception).

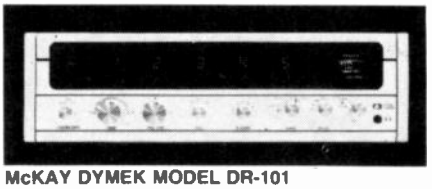
There is great challenge in both areas. Third world countries with their weak, temporary transmitters are elusive targets for the broadcast hunters. Military maneuvers and diplomatic communications are fascinating fare for the

HEATHKIT MODEL SW-717

"Ute" fans. Yes, the shortwave spectrum is a whirlwind of intrigue.

Many hobbyists are rediscovering the excitement of shortwave listening, an enthusiasm that seemed to fade a few years ago. Time-honored companies like Hallicrafters, National, Hammarlund, Gonset, and RME fell by the wayside. Diversified companies like Heathkit, Collins, Radio Shack, and Drake survived the threat of extinction.

Certainly, the increase in Japanese competition contributed to the demise of those former giants. Many manufacturers have seized the opportunity to use off-shore manufacturing to their own advantage. We have finally grown to accept off-shore goods as a way of life. Much of that equipment has turned



McKAY DYMEK MODEL DR-101

out to be of consistently high quality—but some of it is not.

Choosing a receiver

If you are planning to buy a general-coverage receiver, there are several key factors worth considering before you buy.

TABLE 2—SELECTED SHORTWAVE MONITORING FREQUENCIES

Freq. kHz	Mode	Service
3060	AM	Spies? Try this frequency on the hour, evenings.
3090	AM	Same as above, 15 minutes after the hour.
6175	AM	British Broadcasting Corporation, early evening.
6522	SSB	Commercial boats, Mississippi River system.
6715	SSB	Andrews AFB; Air Force One communciations.
6723	SSB	U.S. Navy primary calling channel.
6753	SSB	Tactical Air Command, air-to-ground calling channel.
8959	SSB	Transoceanic commercial airlines.
9505	AM	Radio Moscow.
10390	RTTY	INTERPOL (You'll need a teleprinter for this one!).
10780	SSB	Cape Kennedy/Patrick AFB air-to-ground.
11243	SSB	Strategic Air Command "Alfa One" primary calling channel.
11740	AM	Voice of America.
13272	AM	Wide-area aeronautical weather broadcasts.
14894	SSB	Northern Air Defense Command (NORAD) network.

1. Frequency Stability: Tune in a stable signal at the upper frequency range of the receiver. Switch the BFO on. Does the pitch drift continuously over a period of merely a few seconds? Tap the cabinet. Does the signal waver in pitch? If the answer to both questions is "yes", then the receiver has both thermal and mechanical drift. Unless you are a glutton for punishment, forget that receiver!

2. Image rejection: All receivers suffer in varying degrees from a malady called images. It is the direct result of superheterodyne circuitry, used in nearly 100% of all receivers made today. The symptom is receiving the same signal in more than one place on the dial, usually displaced by twice the IF frequency. For example, if the receiver IF is 455 kHz, then you might hear 5000-kHz WWV time signals also on 5910 kHz. (5000 kHz + 2 × 455 kHz = 5910 kHz). That affliction is reducible—for a price!

3. Frequency-readout accuracy: There is a strong trend toward digital frequency displays. That is good. Even competitively-priced receivers can now afford a low-cost digital readout. Check the readout accuracy by tuning in a few stations of known frequencies (such as WWV time signals on 5, 10, 15 and 20 MHz), and reading the display. Some receivers can be calibrated easily for improved accuracy.

4. Selectivity: With an ever-growing demand for radio-spectrum space, radio-spectrum users find themselves crowded closer and closer together. Your receiver's responsibility is to separate them. Better receivers have switchable selectivity. Broad selectivity is used when audio quality is more important than interference rejection. But for weak-signal, crowded-band conditions, there is no substitute for sharp selectivity. To check your prospective receiver for selectivity, tune through the 6 to 12-MHz portion of the shortwave spectrum at night. Try to narrow in on individual signals. Single-signal reception in that crowded portion of the HF spectrum at night is the mark of a good receiver!

Those four characteristics—stability, image rejection, readout accuracy, and selectivity—are the most important considerations in buying a receiver for today's demanding needs. Other considerations—noise limiter, fine-tuning dial, S-meter, internal speaker—are usually included, and do not warrant special attention here.

Conspicuously absent is a check for sensitivity. Most modern solid-state receivers have adequate sensitivity. If you are in doubt, try the following simple test: At night, listen to the 6 to 12-MHz portion of the dial with no antenna connected. Preferably, short-circuit the antenna connection to the chassis ground terminal. Few, if any, signals should be heard. Now, (with the antenna terminal unshorted) connect a short length (a few feet) of wire to the antenna terminal. A barrage of very strong signals should be received throughout that range.

TABLE 3
MANUFACTURERS

For more information, circle the corresponding numbers on the Free Information Card inside the back cover.

R. L. Drake Company
540 Richard St.
Miamisburg, OH 45342
CIRCLE NO. 90

Electra Co., Div. of Masco Corp.
300 East County Line Rd.
Cumberland, IN 46229
CIRCLE NO. 91

Heath Company
Benton Harbor, MI 49022
CIRCLE NO. 92

McKay Dymek Co.
111 South College Ave.
Claremont, CA 91711
CIRCLE NO. 93

Panasonic Company
One Panasonic Way
Secaucus, NJ 07094
CIRCLE NO. 94

Radio-Shack, Div. of Tandy Corp.
2617 West Seventh St.
Fort Worth, TX 76107
CIRCLE NO. 95

Regency Electronics, Inc.
7707 Records St.
Indianapolis, IN 46226
CIRCLE NO. 96

Sony Corp. of America
9 West 57th St.
New York, NY 10019
CIRCLE NO. 97

Trio-Kenwood Communications, Inc.
1111 West Walnut
Compton, CA 90220
CIRCLE NO. 98

Yaesu Electronics Corp.
15954 Downey Ave.
Paramount, CA 90723
CIRCLE NO. 99

Antennas for shortwave

Selecting an antenna is reasonably straightforward for shortwave listeners. It should be 25 to 75 feet long, as high as possible, clear of obstructions such as buildings and trees, and as straight as practical without sharply doubling back on itself.

If you live in a tightly-regulated apartment building, adequate reception is still possible by running the antenna wire around the outer edge of the ceiling. A ground helps reduce electrical noise, but is not absolutely mandatory.

Frequency sources for the SWL

The newcomer is often faced with a dilemma: He has a fine receiving setup, but how can he find out where to listen? Fortunately, several excellent publications are available for the shortwave listener. The venerable Confidential Frequency List, Volume 4, is now available from Gilfer Associates for $6.95. (P.O. Box 239, Park Ridge, N.J. 07656). Gilfer is also a good source for the World Radio and Television Handbook ($14.95), an exhaustive directory of broadcasting stations worldwide.

Steve Handler has just released his World Radio Communications Guide for $5.95. (Handler Enterprises, P.O. Box 48, Deerfield, IL 60015). It lists a wide range of frequencies from shortwave through UHF.

Getting into monitoring does not have to be prohibitively expensive. Crystal scanners are available for less than $100 new. Programmables start at about $250. Shortwave receivers of reasonable quality generally start in the $300 range. Of course the upper limit is considerably higher. Watch for advertised specials. **R-E**

Step-by-step TV IF Align

Aligning a TV IF amplifier isn't much of a chore as it sounds. With the equipment on hand, just follow the alignment instructions. Here are some helpful hints.

JACK DARR
SERVICE EDITOR

ONE THING YOU *MUST* HAVE BEFORE starting any TV IF alignment job is the *alignment instructions*. Why? For one thing, to show you *where* the different tuned circuits *are*, and what frequencies they should be aligned to! This will vary widely from set to set, even in sets of the same make. You have to *know* where things are; you can't just guess at it.

The manufacturer's service data should give you full alignment instructions. All *Sams Photofact Folders* have them. Pictorial diagrams or layouts of the chassis are necessary, to show you where each adjustment is. They also show you where various traps are, and to what frequencies they must be aligned. So, be sure you have this information first; study it and locate each adjustment.

Many sets have solid metal bottom-shields over the IF stages. Holes are provided in them so you can get alignment tools into the coils. It's often a good idea to look the IF stages up, and write their identification on the shield in pencil!

You'll need to locate the various hookup points, too. The video detector output is often provided with a metal "lance" or strip so that you can connect to it. The sweep signal must be fed into the input of the IF. That is on the *tuner*, since the mixer is actually the first IF amplifier, and its output transformer is the 1st IF transformer, also on the tuner. It is sometimes called the "mixer grid test point."

In transistor tuners, an alignment connection is usually provided for that, too. It will be shown in the alignment instructions; look it up. If it isn't, you can often clip the sweep generator's output lead to some insulated part near the mixer transistor and radiate the sweep signal into the mixer.

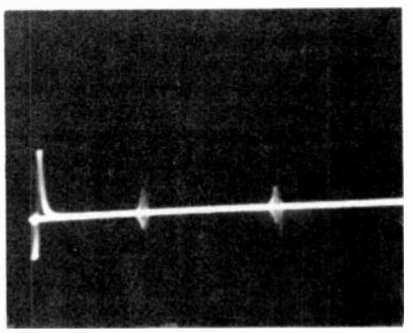


FIG. 1—SCOPE TRACE WITH TV OFF. The 45.75 MHz marker is at the right; the 41.25 at left. Sweep curve will come up between them

Sweep generators.

Sweep generators are generally built into a single cabinet that contains the sweep, markers, and marker adder. Many of the sweep generators also have bias supplies. The scope's vertical and horizontal sweeps are driven from the marker adder through separate leads.

If you leave the scope hooked up, you can often set up a TV for alignment by connecting only two leads! One is the sweep output, which goes to the mixer test point; the other is the "trace input," which is connected to the video detector output of the set. That is the marker-adder input from the set. Scope trace height can be adjusted by the TRACE AMPLITUDE control on the marker-adder. The scope's horizontal sweep, blanking, and phasing; can also be controlled by the marker-adder. By the way, the scope must be set to EXTERNAL HORIZONTAL SWEEP position, that will leave you with only a dot on the scope screen unless the sweep generator is turned on! The actual horizontal sweep is coming from the sweep-generator.

Adjusting the sweep centering

With this type of instrument, you can set up the markers and adjust the sweep-center and sweepwidth, even with the TV set turned *off*. The markers can be turned on, and they will show up on the scope trace. To locate the right place, turn on the 45.75 MHz and 41.25 MHz pix and sound markers. Next, adjust the SWEEP CENTER control until those are spaced about right on the scope. The SWEEP WIDTH will control their distance apart. Fig. 1 shows how that should look.

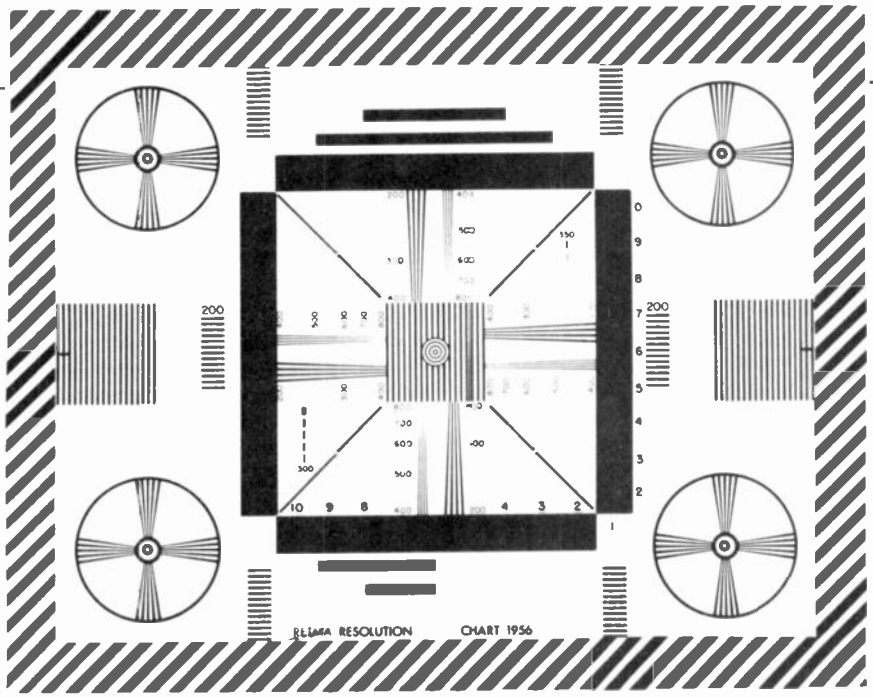
Now you're ready to go. Turn up the SWEEP OUTPUT amplitude control of the generator until you see the curve on the screen. Bias can be adjusted at this time. Check the alignment instructions and connect the bias leads to the points indicated. Set the voltage by hooking a multimeter to the bias points, and adjust for the value specified.

Killing the TV horizontal sweep

Most alignment instructions call for disabling the horizontal sweep of the TV set, to prevent radiating harmonics into the curve, which would cause beats. Figure 2 shows a curve with such beats; that is a color bandpass curve. The wiggles on the curve came from the horizontal output.

To kill the horizontal sweep, pull the horizontal output tube. Do not simply take the plate-cap off; that may damage

ment



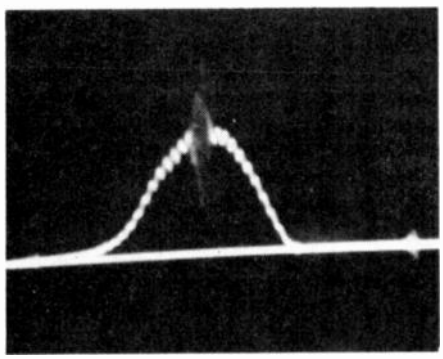


FIG. 2—HORIZONTAL OUTPUT STAGE is making the beats on the sweep curve.

the output tube. *Never* pull the horizontal *oscillator* tube alone; that will ruin the horizontal output tube in about 30 seconds. If the set is a series-filament-type and you can't pull the tube, disconnect the horizontal output tube's cathode lead from ground. In solid-state sets you can often pull the horizontal-output stage fuse or disconnect the DC supply.

The actual alignment job

Now you're ready! Turn up the gain on the scope and sweep-generator untill you see a curve about 2 to 3 inches high on the screen. (Many alignment instructions specify an output from the video detector of 2.0 volts P-P. You can calibrate your scope for that if you want to.)

You have the picture and sound carriers marked. Check the position of those markers: They should be at the places shown in Fig. 3. Check the overall *shape* of the curve. It should look a lot like this one. The pix marker (45.75) should be halfway up the right side and the 41.25 sound marker must be in the trap-notch at the left, just where the curve touches the baseline.

Reversing sweep direction

You *may* find that the curve is reversed; 45.75 marker on the left, etc. Actually, that makes no difference at all as long as you know which is which. However, if you want to "make it look like the one in the book," flip the TRACE REVERSE switch found on many sweep-generators. If yours doesn't have one, pull the sweep-generator AC plug, turn it over, and put it back. That will do it. Many set-markers (and all Sams *Photofact Folders*) show alignment curves with the pix carrier on the right.

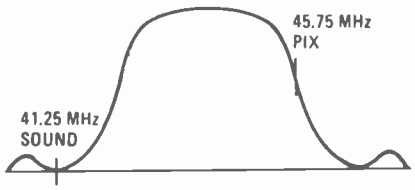


FIG. 3—HOW THE INITIAL CURVE should look; only pix and sound markers are on.

Not enough marker height?

If you have a fine curve but the markers are tiny pips, hard to see, you have too much RF output from the sweep-generator. Turn the RF SWEEP output down and bring the scope vertical gain up to put the curve back to its original size. You'll see the markers get bigger. For a normal curve, with the scope set at 2.0 volts P-P for about a 2-inch-high pattern, you'll have plenty of marker gain; you'll find that there is a MARKER SIZE control on practically all sweep-generators.

Figure 4 shows a curve that you might see on the initial setup. The 45.75 MHz marker is on the right, 41.25 MHz marker on the left in the trap-notch. However, the 42.17 MHz color marker just above it is much too far down; also, the vital "color-slope" of the curve has a wrinkle in it! There's also a peak above the video carrier that shouldn't be there. Now we're ready to start straightening this out.

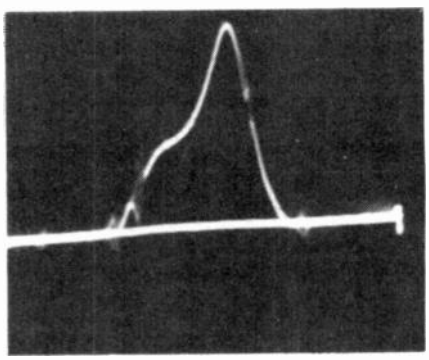


FIG. 4—FIRST CURVE ON SCOPE: Not too bad for a start; not too good, either!

The first step

You'll find that the first step in all alignment procedures is the trap alignment Since those do a lot to shape the curve, you can see why. They determine the slope of both sides of the curve and take out unwanted signals.

Set the 41.25 MHz sound marker first. It must always sit in the notch (in fact, it *makes* the notch!) at the left side of the curve. You'll often find two trap coils and an adjustable resistor used for this. The resistor is connected across one of the trap coils and is called a "Q-spoiler"; it flattens the response of the trap to just the amount needed.

There will usually be one trap in the IF input and one in the output. The Q-spoiler resistor may be at either end. In either case, watch the 41.25 MHz marker and adjust all of those until the marker is set exactly in the right place, just where the left side of the curve touches the baseline, and the curve is as steep as possible on that side.

On the other side of the curve, the 47.25 MHz adjacent channel sound marker (ADJ SND) is in the same position, just at the point where the slope of the curve touches the baseline. One more: The 39.25 MHz adjacent-channel picture will be seen to the left of the 41.25 MHz sound marker, on the baseline.

The worst trouble you can get into with incorrect trap adjustments is when they "get into the curve." To see what that does, deliberately detune the 41.25 MHz trap so that it moves to the right—into the curve. You'll see that side of the curve flatten out very badly. To find out what that will do to your picture, turn on the three color markers: 42.17, 41.67, and 42.67 MHz. That shows you the response of the IF to the important *color* signals.

Now turn the trap over into the curve and watch the three color markers. Figure 5 shows you what this could look like. What kind of symptom would that cause? No color, or very bad color.

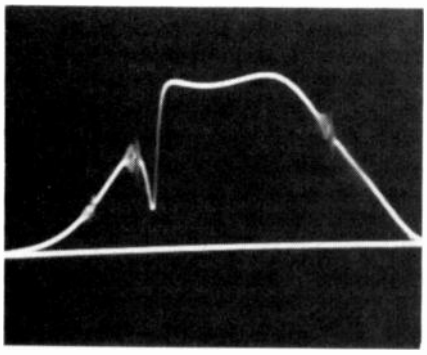


FIG. 5—WHAT YOU CAN SEE WHEN a trap is intentionally tuned into the curve.

Note that the color signals have now been almost obliterated by the trap! A marginal condition on this—where the trap is not quite in the middle of the color bandpass, but too close—can cause the "I can't tune the color in" symptom. The color will appear as you fine-tune, but will drop out.

Order of alignment

Now, (finally!) we're about ready to start on the alignment of the tuned circuits. Don't try to take shortcuts here; do the trap adjustments, and all of the other preparatory steps, *first*. After that, the actual alignment is a breeze.

While you'll find variations, the typical order of alignment for the various stages and their frequencies will be something like this:

The 1st IF transformer, on the tuner: tuned near 45.75 MHz, it affects the right side of the curve and the position of the pix carrier on this slope.

The 2nd and 3rd IF coils: peaked near the center of the band, about 43-44 MHz, they affect the tilt, bandwidth, and the top of the curve in general.

Last IF transformer, before the video detector: normally about 42 MHz; it affects the slope of the left side of the curve and determines the position of the color carrier on that side.

For the first step, rough in all the adjustments, starting at the 1st IF and working back toward the video detector. Get the curve as close as possible; go by the position of the 45.75 pix marker and 42.17 color marker on the slopes. Those should be at about 50% up on the curve and exactly opposite each other.

Now *look* at the curve. Are the sides as straight as possible? Are the pix and color markers at 50% up and are they at the same height? If so, fine. Now turn on the two color-bandpass markers and check the color-slope of the curve—the left side. But sure that it is straight and that *all three* markers are "up" on the slope. If the 41.25 MHz trap is set too close to the curve, it can pull down the lower bandpass marker, 41.67 MHz, until it's down on the baseline. That cuts off one sideband of the color signal and can give you some very strange pictures indeed! The 41.67 MHz marker should be up on the curve as far as you can get it—which won't be too far; it must *not* be on the baseline!

Figure 6 shows a typical IF curve after alignment: 41.25 MHz marker on the baseline at left, 42.17 MHz color marker up the left slope, 45.75 MHz pix marker up the right slope, and 47.25 MHz adjacent sound marker on the baseline at right (Color band-limit markers off.) Note the dip in the center. That is not unusual; in fact, for this set, the alignment instructions specify "not more than 15%" dip. It is due to a little overcoupling of the middle IF transformers, to get a better bandwidth. Others will show a round-top "haystack" IF curve or a very small dip. Check the alignment instructions for your set to see what the finished curve should look like.

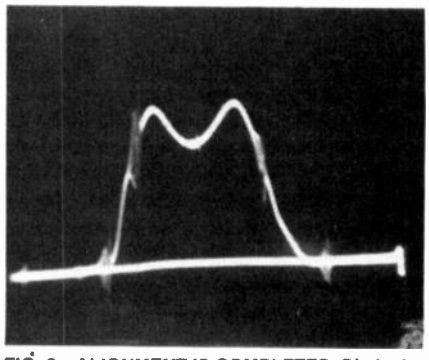


FIG. 6—ALIGNMENT IS COMPLETED. Dip in the center is normal in this receiver.

When making those adjustments, remember what I said a while back. Tune for *shape, not amplitude!* Those stages are designed to give the proper amplitude; the tubes (or transistors) *will* have enough gain, but they must have the correct bandpass (meaning, curve shape). In olden days, many "technicians" used to "tune up the IF's" to get a blacker picture! They usually did so without test equipment—and wound up in a mess. Actually, the picture strength or amplitude is not determined by the amplitude of the curve but by the picture carrier's *position* on it! Not too long ago, I had good color but weak video in one set. Hooking up the sweep generator, I found the video carrier down to about 15% off the baseline! One "twitch" of the input IF adjustment brought it up to its proper place and I had all the video I wanted! That is a good example of the type of problem that can be so simply solved with sweep-alignment tests.

The preceding has dealt with color TV IF alignment, which is more critical than black-and-white. Alignment in black-and-white sets is pretty simple. You simply align for a symmetrical curve with the picture carrier about halfway up on the right side. The 41.25 MHz sound marker can be used to set the left side of the curve and, if you want to, a 44.0 MHz marker used to locate the center of the peak. Those will usually have the haystack curve we mentioned before. **R-E**

"Wow! This month's centerfold in **Radio-Electronics** *is the new IPM digital computer, and what a beautiful memory it has!"*

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Electra

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hobby corner

A quick and easy way to make one-of-a-kind printed circuit boards.

EARL "DOC" SAVAGE, K4SDS, HOBBY EDITOR

YOU NEED NOT HAVE BEEN READING THESE pages very long to know that I firmly believe in doing things the easiest possible way. When it comes to building up a circuit on a board, we all know that a dedicated printed-circuit board is the easiest way to go.

In spite of that, I have recommended using a wiring pencil and a plain board when a pre-etched board is unavailable and you need only one or two copies. To my way of thinking, all that drawing and etching is too much trouble for a couple of boards. Well, times do change and so must I when the best of both worlds is available.

Now you can make a dedicated PC board without etching! All it takes is *E-Z Circuit* materials by Bishop Graphics (P. O. Box 5007RE, Westlake Village, CA 91359). Actually, the *E-Z Circuit* line includes materials for several systems. I'll tell you about the others later, but this month we'll concentrate on *instant* PC boards (well, almost instant). By the way, it is I and not Bishop who call these boards "instant."

This system consists of epoxy-glass boards, plain or drilled, plus pressure-sensitive PC board *copper* patterns. There are all types of sockets (DIPS, SIPS, transistor), strips (distribution, terminal, conductor) and insertion-connector fingers for plug-in boards—all of those in various sizes and configurations. That array of patterns is completed by a selection of donut pads and tapes for laying down traces.

What? Sounds familiar? Careful now; don't miss the main point. Those patterns are not for making artwork—they are *copper*. When you have pressed them down on a board, you are ready to mount the circuit components, solder them in place and turn on the power! *That* is what I call instant PC boards.

There is even pressure-sensitive insulating tape. You can build a "bridge" right on the board by putting insulating tape across copper traces and then putting a copper trace on top of that. Now there is no need to solder in a jumper later. (*And* you don't have to be so careful trying to get a jumperless design in the beginning.)

The whole process of making a PC board is quite as simple as it sounds. Take a look at Figs. 1 and 2; then tell me whether you would rather make your board the *E-Z Circuit* way or use the darkroom/etchant route.

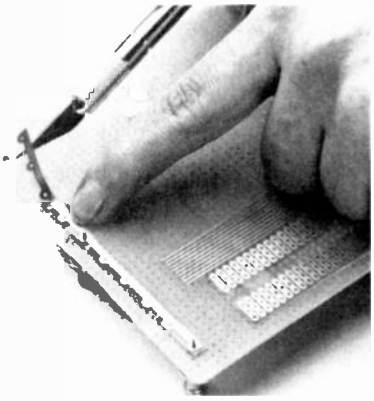

FIG. 1

The various patterns are available in small-quantity packages so you can get just what you need. The same is true of other parts of this PC-board system: IC sockets, individual wire-wrap or solder pins for discrete components, insertion tool and base, wire and wrap tool, alignment pins and so on.

Having used this *E-Z Circuit* system, I can report that it is quick, easy, and reliable. The patterns are full 1-oz copper. It is the best way I have found to make one- or two-of-a-kind PC boards—anything from the smallest to a 21- by 43-cm computer board.

If you are as I am, you sometimes make mistakes. The patterns, traces, and so on can be lifted and re-positioned if you do it carefully soon after putting them down. Even later, after the adhesive has set, you can still lift circuit parts to correct errors or make circuit modifications, but those parts cannot be re-used.

An added bonus is that this *E-Z Circuit* material can be used to repair damaged commercial or homebrew PC boards and/or modify such an existing board. Clean up the damaged traces, etc. and put down new adhesive parts. The ability to modify any board can salvage an otherwise useless one. For these reasons alone, you should keep some of that instant-board material on hand.

Bishop has a fine combination manual and catalog—identified as *EZ-102*. It can be ordered directly from Bishop at the above

continued on page 68

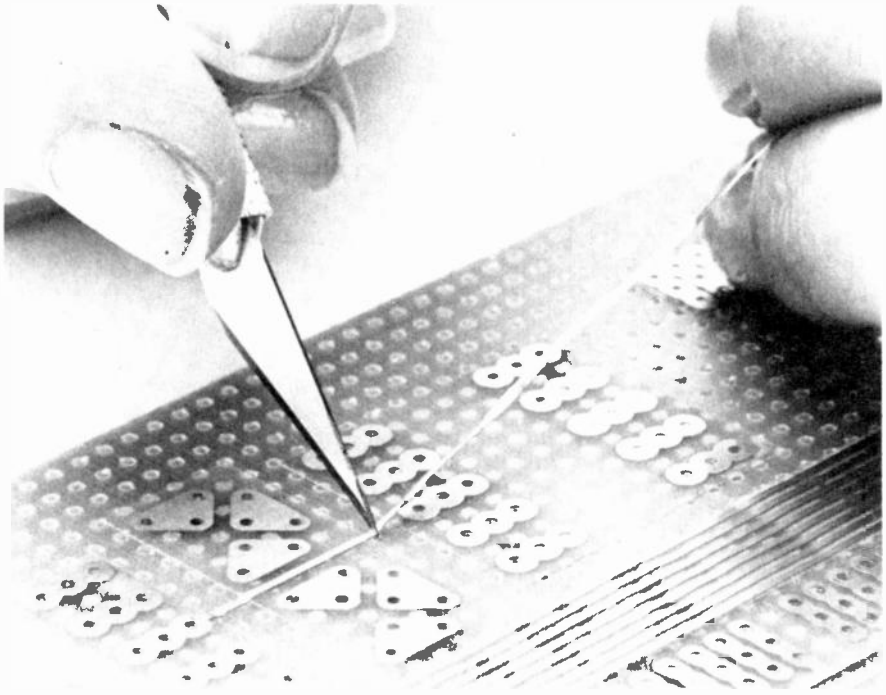

FIG. 2

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7. PORTABILITY: All models are delivered with a 115 VAC adapter, a 12 VDC cord with plug and may be equipped with an optional ni-cad rechargeable battery pack installed within its case. The optional Ni-Cad pack may be recharged with 12 VDC or the AC adapter provided.

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10. CERTIFIED CALIBRATION: All models meet FCC specs for frequency measurement and provided with each model is a certificate of NBS traceable calibration.

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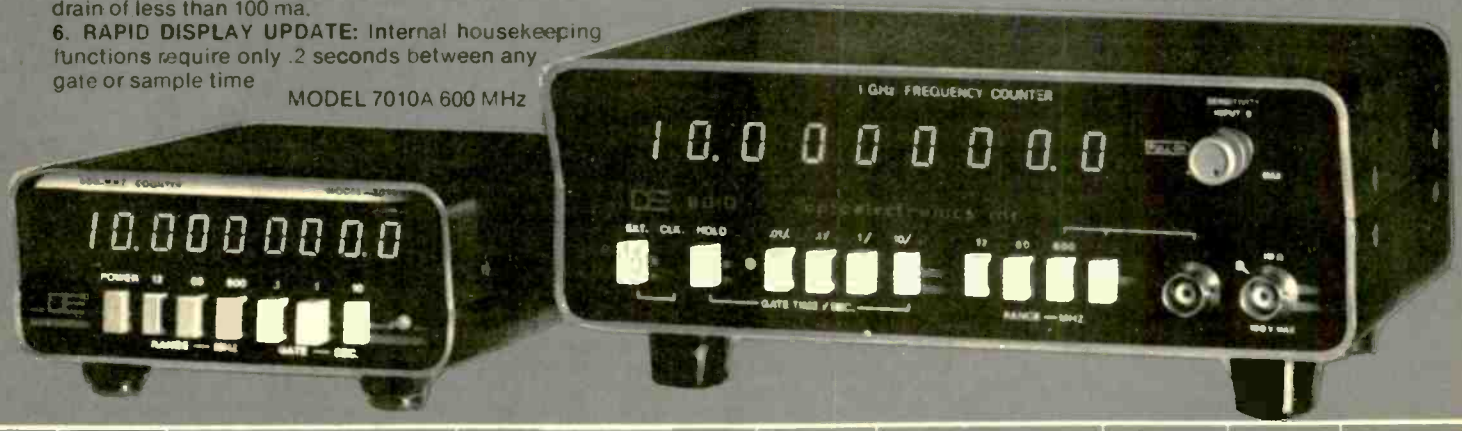
12. PRICE: Whether you choose a series 7010 600 MHz counter or a series 8013 1.3 GHz instrument it will compete at twice its price for comparable quality and performance.

MODEL 7010A 600 MHz

MODEL 8010A/8013 1.1 GHz/1.3 GHz



MODEL	RANGE (From 10 Hz)	10 MHz TIME BASE			AVG SENSITIVITY		GATE TIMES	RESOLUTION			EXT. CLOCK INPUT/OUTPUT	SENSITIVITY CONTROL	NI-CAD BATTERY PAC
		STABILITY	AGING	DESIGN	10 Hz to 500 MHz	500 MHz to 1.1 GHz		12 MHz	60 MHz	Max. Freq.			
7010A	600 MHz	± 1 PPM	<1 PPM/YR	TCXO*	15 mV	N/A	(3) 1, 1, 10 sec	1 Hz	1 Hz	10 Hz (600 MHz)	YES OPTIONAL	NO	YES OPTIONAL
7010 1A		± 0.1 PPM											
8010A	1.1 GHz	± 1 PPM	<1 PPM/YR	TCXO*	15 mV	30 mV	(4) .01, 1, 1, 10 sec	1 Hz	1 Hz	10 Hz (1.1 GHz)	YES STANDARD	YES	YES OPTIONAL
8010 1A		± 0.1 PPM											
8010 05A		± .05 PPM		OCXO**									
8013.1	1.3 GHz	± 0.1 PPM	1 PPM/YR	TCXO*	15 mV	30 mV	(4) .01, 1, 1, 10 sec	1 Hz	1 Hz	10 Hz (1.3 GHz)	YES STANDARD	YES	YES OPTIONAL
8013 05		± .05 PPM		OCXO**									

*TCXO = Temperature Compensated Xtal Oscillator **OCXO = Proportional Oven Controlled Xtal Oscillator

SERIES 7010A

#7010A	600 MHz Counter - 1 PPM TCXO	$199.95
#7010.1A	600 MHz Counter - 0.1 PPM TCXO	$249.95
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#EC-70	External Clock Input/Output	$35.00
#CC-70	Carry Case - Padded Black Vinyl	$9.95

SERIES 8010A/8013

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#8010-1A	1.1 GHz Counter - 0.1 PPM TCXO	$450.00
#8010 05A	1.3 GHz Counter - .05 PPM Oven	$499.00
#8013.1	1.3 GHz Counter - 0.1 PPM TCXO	$550.00
#8013 05	1.3 GHz Counter - .05 PPM Oven	$599.00
OPTIONS		
#Ni-Cad-801	Ni-Cad Battery Pack & Charging Circuitry Installed Inside Unit	$49.95
#CC-80	Carry Case - Padded Black Vinyl	$ 9.95

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#P-101	Probe, Lo-Pass Audio Usage	$16.95
#P-102	Probe, Hi-Z General Purpose	$16.95
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HOBBY CORNER

continued from page 66

address for $1.50 postpaid in the US and Canada.

Semiconductor guide

Radio Shack has announced the release of the 1980 edition of the *Archer Semiconductor Replacement Guide*. This handsome new guide is even more elaborate than the old edition. It lists cross references/substitutions for more than 100,000 devices.

This book has data and pinouts for IC's, diodes, LED's, SCR's, and so on. In addition, there is other useful information pertaining to such matters as handling and testing.

It's a real money-saver—with just a couple of substitutions, you could save more than the cost of the Guide ($1.99). You should have it (or something like it) near your workbench. You can obtain your copy at your local Radio Shack store.

Another mystery

Don Francois of Manchester, MO has sent another light mystery. Unlike the puzzle of a few months ago, however, that rather sneakily made use of several hidden subminiature components as well as other bits of subterfuge, this new mystery circuit is guaranteed to have *no* hidden parts. Examine the two circuits in Figs. 3 and 4.

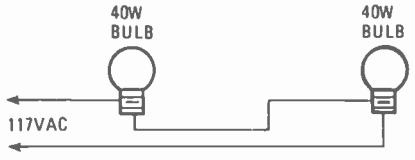

FIG. 3

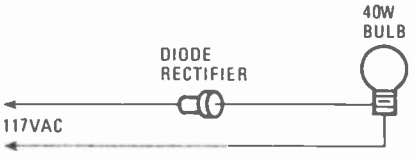

FIG. 4

Don found that the measured voltage across all three bulbs was the same. He measured equal current in both circuits. You would expect the three bulbs to be of equal brightness but that was not so. The bulb brightness in one circuit was much greater than in the other.

Now, on the surface that is exceedingly strange. However, some thought should lead you to the answer to this seeming anomaly. (If you can guess which circuit is brighter, you should be on the right track.)

WARNING: If you build those circuits to check the data, there is exposed 117 VAC. Take great care not to come into contact with that AC voltage.

If you can figure out what is *really* happening in those circuits, let me know. **R-E**

new products

More information on new products is available. Use the Free Information Card inside the back cover.

HAND-HELD DIGITAL THERMOMETER, *model 940,* accurately measures temperature from −65°C to 150°C and displays the reading to 0.1° resolution on a large LCD module. The rugged, "palmsize" device comes complete with: 9-volt battery, removable probe and cable assembly, detailed instruction manual, two-year warranty,

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and certificate of traceability to NBS standards. It will operate for up to 200 hours from a standard alkaline battery. Push-button controls allow convenient display conversion from degrees C to degrees F. The instrument, complete with probe assembly, has a retail price of $189.—**Data Precision Corporation** Division of Analogic Corporation, Electronics Avenue, Danvers, MA 01923.

CAPACITANCE-MEASURING ADAPTOR, *C-Probe II,* attaches directly to the input connector of any standard frequency-counter and allows a direct readout of the capacitor's value from 0.1 pF to 10,000 μF. The basic accuracy of the *C-Probe II*'s two capacitance ranges are 0.25% (pF

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range) and 0.5% (μF range). The ×1 and ×10 resolution button provides for 1 or 0.1 pF resolution (pF range) and 0.001 or 0.0001 μF resolution (μF range). Ten-turn precision controls are used for pF and μF range calibration and for cancellation of stray or lead capacitance to 50 pF. Circuitry is all-CMOS, crystal control is used, and battery life is 100 hours. The *C-Probe II* lists for $69.95.—**International Instrumentation, Inc.,** Box 3751, Thousand Oaks, CA 91359.

DISTORTION-MEASURING SET, *model 3500,* represents a breakthrough in performance/size/cost ratio. It combines the performance and features of large, expensive lab instruments in a compact, case small enough to fit into an attache case. The Amber *3500* is a high-performance distortion-and-noise-measuring set incorporating

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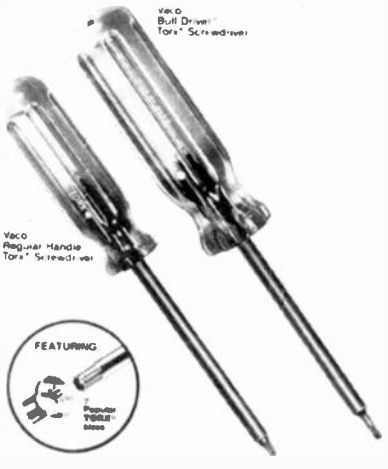
an ultra-low-distortion sinewave oscillator, total harmonic-distortion analyzer, wideband and weighted true RMS-level meter, and narrowband tunable filter. It will measure signal level, frequency response, weighted noise, narrowband noise, crosstalk, and total harmonic distortion. It may be operated from line current or from an optional battery pack. The price of the *3500* is $1,600.—**Amber Electro Design, Inc.,** 4810 Jean Talon West, Montreal, Canada H4P 2N5.

TORX SCREWDRIVERS offers an expanded line including three new sizes of screwdrivers with the *Bull Driver* handle in sizes T8, T10 and T27, and a line of seven regular drivers with a *comfordome* handle in Torx sizes T8, T10, T15, T20, T25, T27 and T30. The line of insert bits includes a new size, T27, along with five other sizes. Also offered is a bit card *No. 70432,* which contains four



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replacement bits in four sizes. Each screwdriver has a blade-size diameter of ¼". The length of the *Bull Driver* is 8½" and the length of the regular driver is 7½".—**Vaco Products Co.,** 1510 Skokie Blvd., Northbrook, IL 60062. **R-E**

communications corner

A remote-controlled coax switch from Heath allows you to switch bands easily. **HERB FRIEDMAN,** COMMUNICATIONS EDITOR

I RECENTLY CAME ACROSS A STACK OF magazines from the late 1940's, and the most impressive thing about that era—from a communications-derived viewpoint—was how much land we lived on. Most antenna feature and construction articles involved what would be at least an acre of land, or a backyard stretching out behind the house far enough for an 80-meter doublet, or even a rhombic for 40 or 20 meters.

Today, we're lucky to have our house on a 40 × 100 lot, and few are the neighbors who would permit an antenna to cross their property. For the cliff-dweller in a hi-rise apartment building, the backyard might extend as far as the next window, or the edge of a postage-stamp-size terrace. At best, a modern *antenna farm* might be no larger than what we can erect on a single mast.

Another loss for many amateurs, at least judging by the magazines of some 30 years back, was the tuned feeders. It was not unusual for a ham to use a single antenna for "all bands," using open-wire resonant feedlines and an antenna-tuning device to force system operation on several bands. Again, the key to multi-banding required lots of elbow room because the flat-top—the wire antenna itself without the feeders—often exceeded 100 feet. Today, we not only don't have the room, we probably couldn't turn up the insulators needed to make open-wire feeders. (I can even remember commercially-manufactured open-wire feeders used for TV antenna installations in the early 1950's.)

The general rule today seems to be: "Go up rather than out." It's not unusual to see a single mast or tower supporting a tri-band 10-15-20 meter beam, with a 6- and/or 2-meter beam above, and maybe the mast supporting an inverted-V for 40 and 80 meters, or a long-wire or doublet for 160 meters. And hanging down from this assemblage of sky-hooks is a rat's nest of coaxial transmission lines, most of which must be reconnected when the operator changes bands. To go from, say, 80 meters to 10 meters, the operator removes the 80-meter transmission line from the transceiver's output jack and connects the 10-meter line. Etc., etc., etc.

And this brings us to one of this month's topics, the Heathkit SA-1480 remote-controlled coaxial switch.

The remote-controlled coax switch is a simple idea; it's the actual construction that takes a bit of hardware. The main assembly is a 5-outlet motor-driven coax switch that mounts on the antenna mast. A short length of coax connects from the switch to each antenna. Running back from the switch to a remote controller in the shack is a single coax line and a multi-conductor control cable. To change antennas the operator simply dials in the desired one on the controller. The controller sends current down the proper pair of wires to cause the motor-driven coax switch to connect the transmission line from the shack to the correct antenna. All coax outputs except the selected one are maintained at ground. If desired, the controller can be set to ground all five coax outputs.

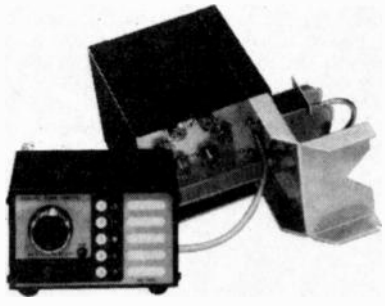

FIG. 1

The coax switch is weatherproof and comes with extensive hardware for mast mounting. The controller has a power switch and a selector knob. Five LED's indicate the selected antenna. (See Fig. 1.) A sixth LED indicates when all coax switch outputs are grounded.

Because the control voltage from the controller is 30 volts DC, the multi-conductor connecting cable can be ordinary vinyl-jacketed stranded wire such as you might use for an intercom. The transmission line can be any 50-72 ohm coax that can be terminated with a standard UHF connector. The operating range of the coax switch is DC to 150 MHz. Below 30 MHz, maximum VSWR is rated for a worst-case of 1.05:1. From 30 to 150 MHz, the worst-case VSWR is 1.2:1. The rated power loss at 100 MHz is less than 0.2 dB. In plain terms, that means that if you feed in 105 watts you'll get out *at least* 100 watts (at 100 MHz). Loss is even less at lower frequencies, slightly greater at higher frequencies.

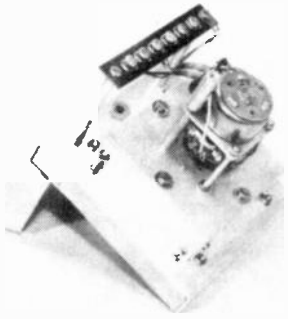

FIG. 2

If you look carefully at Fig. 2, you can't find the actual coaxial connections. That is because they are fully shielded in the small compartment in front of the switch motor. And that is what makes for a somewhat extensive mechanical assembly. The coax jacks are arranged in a circle and the switch wafer, which will eventually wind up inside a shield, is actually positioned on the jacks. The drive shaft from the switch motor passes through the shield and into the wafer. It's quite an assembly; it really has to be seen in order to be appreciated.

One switch wafer is external to the shield, and can be seen under the switch motor in the photograph. It serves as the mechanism that stops the motor in the correct position relative to the selected coaxial output.

Direction indicator

Our second item this month is for those who want a more accurate indication of beam heading than can usually be obtained from a rotator's indicator. For those who have sufficiently accurate indicators, it provides a digital readout of the beam's compass heading.

The device is the Monitor *DX-3* retrofit digital-readout system for *Ham II, Ham III* and *Ham IV* rotators. Priced at $39.95, the device has three seven-segment LED digital devices that indicate compass heading to 360°. It installs in

continued on page 72

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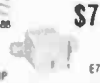
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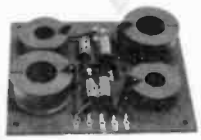

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COMMUNICATIONS CORNER

continued from page 70

the above-mentioned rotators without cabinet modifications, and takes just three wire-connections. According to the manufacturer, it is adaptable to other rotator systems though no other information was given. The circuit

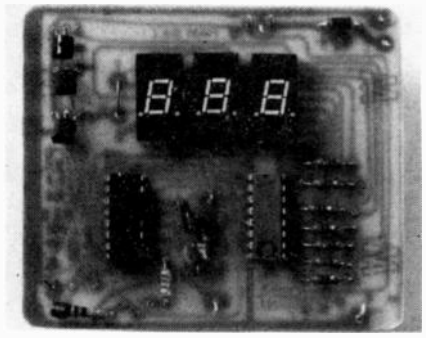

FIG. 3

board of the *DX-3* is shown in Fig. 3. For additional information write to: Monitor, Box 55, Agincourt, Ont., Canada M1S 3B4.

CB antenna

Our final topic this month is a CB antenna—one with a real difference, at least in mechanical mounting. The fact is, the *Super Scorpion* antenna by Antenna Specialists Co. has one of the most fascinating mounting systems yet seen on CB gear. The antenna itself is a trunk-lip or roof-mounting base-loaded 60-inch whip. Built into the base is a small lever that controls both electrical

FIG. 4

and mechanical connections. (See Fig. 4.) Position the antenna over its mounting location, flip the lever clockwise, and the antenna locks in place and secures the electrical connection. Flipping the lever counterclockwise releases both the electrical and mechanical connection. It's a lot more reliable than many magnetic mount antennas (at the very least it won't fly off at high speeds), and a lot easier to remove than the average trunk-lip mounted antenna. Just don't walk away from your car for too long with the antenna in place. That lever is what's called by lawyers "an attractive nuisance"—at least that's what they'll claim if you try to prosecute some young hoodlum caught trying to steal the antenna. **R-E**

two-piece tip? It's the front end of a *Big Red* ballpoint pen, but with two holes pre-drilled for the mini-LED's. The small piece must be cut with a knife or razor blade, as shown in Fig. 6, so the shoulder length is no longer than 3/32 inch to allow room for the PC board. Scrape or file the plating from the top of the metal pin. Strip the insulation from the end of a 2 inch length of wire and wrap it around the top of the metal pin. Solder the wire to the pin and firmly press the wire-pin assembly into the plastic probe-tip until it is solidly seated. The pin should extend at least 1/4 inch beyond the front of the tip. Using a quick-setting glue on the outside of the probe-tip, cement it into the nosepiece to complete the probe-tip assembly.

Now insert the LED end of the PC board assembly into the probe-tip assembly so the LED's pop up into the two holes. A small amount of quick-setting glue at the bottom of the LED's *before* they are inserted into the probe-tip assembly could be used. A small stick could hold the LED's in position as the glue dried. It is easier, however, to just wedge some soft material like foam rubber under the front of the PC board to keep the LED's pushed up into the holes in the tip assembly.

Cut and strip the end of the wire from the probe tip and solder it into the hole between the junction at the near end of D1 and D2. Red and black wires about 2 feet long should be twisted together. Strip the insulation from both ends of both wires. Solder one end of the black wire to the PC board hole (ground or B−) next to pin 1 of the 555. Solder the red wire at the same end of the twisted-pair to the free end of D3, clipping off any excess lead wire after soldering. Make a simple knot in the twisted-pair about 3 inches behind the end of the PC board to act as a strain relief.

Slide the tubular probe body over the wires and PC board and down to the probe-tip assembly shoulder, cementing if desired. Using an icepick, knife, or other such tool, make a hole in the soft plastic end cap and push the twisted wires through the hole. Slide the cap over the end of the probe body. Slide the colored insulators on the free ends of the long wires (red on red, black on black, of course) and solder on the small alligator clips. Slide the insulators over the clips and your probe is complete.

Using the probe

A 6- or 9-volt battery can be used for testing. Connect the red clip to positive voltage and the black tip to minus. The upper LED (furthest from the tip) should light. Now touch the probe tip to the minus side of the battery (the black clip). The upper LED should go out and the lower LED should light. If the probe fails that test, check the polarities and orientation of the 555, diodes and LED's. Also be sure you haven't connected the probe clips to the wrong battery terminals!

In normal use, connect the red and black probe clips to the positive and ground, respectively, of the circuit under test. The probe will operate from a source voltage of 3.5 to 15 volts, making it usable for virtually all common digital families. Do not exceed 15 volts to power the probe or at the probe tip.

By touching each pin of a logic IC with the probe tip you can determine if that pin is at a logic low level, or changing. A slow change is very obvious since the probe LED's seem to jump back and forth. A rapid state change—a high-frequency pulse train—will make it appear that both LED's are on at the same time. If one LED is noticeably brighter than another, that means that the duty cycles (the ratio of time ON to total cycle time) are unequal. A noticeably brighter logic high indication, for example, means that the duty cycle for the logic high level is somewhat over 70%. (Since the LED's, R1 and R2 are not identical, equal brightness does not necessarily mean a 50% duty cycle).

Although this probe will not indicate pulses in the nanosecond range, pulse durations as short as a few milliseconds are apparent. The $10 Digital Logic Probe won't substitute for a laboratory oscilloscope, but you'll find it handy and easy to use in all but hi-speed critical digital circuits. **R-E**

service clinic

Tricks for catching the touchy intermittent.

JACK DARR, SERVICE EDITOR

THERE'S ONE PARTICULARLY VIRULENT type of intermittent that has been with us for a long time, and will be for longer: the "touchy" one. The circuit cuts out; then, touch a test probe to the circuit anywhere, and Pow! . . . the set starts working again and may work for weeks. It won't cut out on your bench, but just as soon as you take it home, out it goes again! That can be a time-waster. (I have a flair for understatements.)

However, there are a few tricks that can be used when you run into one of those. They've been worked out over a long period, so let's have a look at them. There are several things that'll make it easier.

Step one: Get all the data you can from the users. If they say "It quits; then if I turn it off and right on again, it'll play for a good while," look out. You have just gotten a touchy intermittent.

Step two: The usual cause of that is a very small transient. Somewhere in the circuitry there is a bad connection that is opening. Any transient causes a surge and that temporarily restores the connection and the set works. One of those transients occurs at turn-on. To avoid it, plug the set into a variable-voltage line transformer; adjust the line voltage to zero, switch the set on, and bring the line voltage up slowly and smoothly. If the problem shows up immediately, you're lucky. You can get some observations and verify what you found out from the user. That lets you locate the exact type of problem. No video but a raster, loss of sync, color, and so on. Don't start sticking in test-probes yet!

Step three: You will need some test readings to pin down the trouble. There are two ways. First, the scope. Do not touch the probe to the circuitry; hold the probe tip *near* various points and turn the vertical gain up; look for a normal signal, or the absence of one. The second way is to turn the set off again, by reducing the line voltage, and hooking all of the test equipment on hand to test points, while it's *off*. In that way, you can avoid the tiny transient caused by touching things. You can get some data on DC voltages and signals and find out where the signal stops.

Now, back off and take a look at the problem. The major cause of such things is an *open* circuit that interrupts the signal or supply voltage, or anything else that will make the set stop working. That, of course, is the kind that "just stops playing"—no smoke or smell. (If you find a hot one, the location of the parts that are overheating will give you a dandy clue.) From statistics, that kind of problem is caused by a *cold solder-joint* more frequently than by any other fault. The typical characteristics of that kind of defect exactly match what we're seeing. The joint opens up, but the "ends" are so close together that any disturbance causes them to make contact again.

So, get out the well-calibrated eyeball and a good, big, magnifying glass and check the area of the trouble. We're all familiar with the appearance of cold solder-joints. In most, the solder will be "fuzzy" or frosty-looking, instead of smooth and shiny. If the leads from the part come through the solder, check very closely for a hairline crack all the way around (see Fig. 1-a). Wiggle the lead slightly; if you see it move, there's one of them. (Like rattlesnakes, those sometimes come in pairs; don't stop hunting yet!)

The exception to the above is the infamous "pocket joint" (see Fig. 1-b). On the underside, they look perfectly good; smooth, shiny, and so on. However, the lead from the part is sitting in a "pocket" inside the solder bubble! Check: pull lightly on the lead from the top; if it moves, there you are. Those can be a real wipe-out if you don't suspect them; they have been around since the very early days.

It is always possible to shotgun suspected areas. Melt and resolder *all* of the joints in the area where the trouble could be. Look out for joints where the solder comes off the instant the iron-tip touches it, leaving the lead sticking up through the eyelet. Chances are that it was a pocket joint. Nothing's perfect though; there *is* a hitch in this method. You may fix the set but not be certain about it. So, you're going to have to cook it for several days. Shotgunning, I think, should be a last resort. Try to get some kind of handle on the problem before you resort to that method.

Apply heat or cold to see if they affect the intermittent. Try tapping the PC board. *Don't* bang on it; tap very lightly and selectively so that you jar only one part at a time. The eraser end of a wooden pencil is a dandy tool for that. Also, try bending the PC board carefully up or down. That trick will often catch hairline cracks in PC conductors that could be causing the trouble. If that is suspected, or verified—but you can't manage to see the crack—run a bead of solder the whole length of the thing; that will bridge the gap whether you can see it or not.

In the old days, intermittently-open capacitors caused a lot of those problems. Later types don't seem to act up that way. Another good suspect is the resistors in the circuit. If they have been overheated enough, say by a shorted transistor that was replaced without catching the resistor, it may break in two in the middle. The ends still make contact until something—heat, cold, etc.—makes it move and open up. Fortunately for us the color-

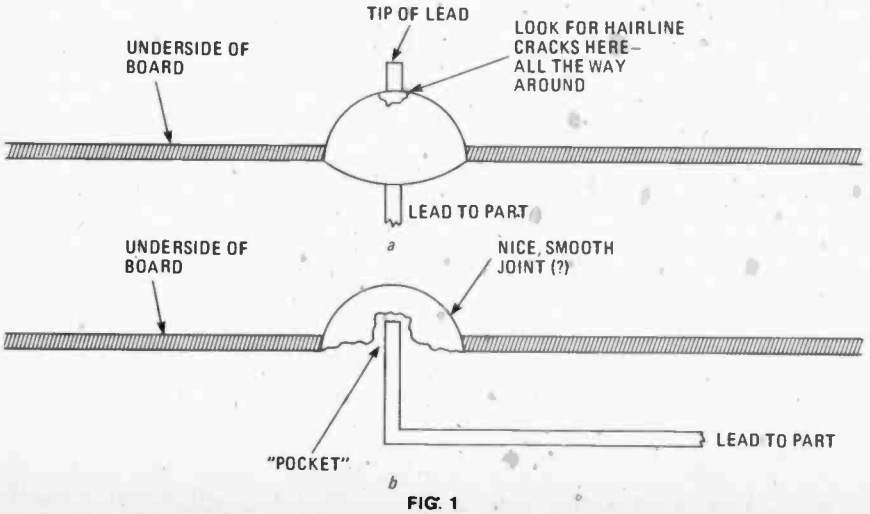

FIG. 1

code paint *usually* changes color when overheated. (Not always!) Look for any resistor that shows signs of being "off-color". A good check for those is to use an insulated prod with a "screwdriver" tip; put it under the body of the resistor and pry up gently. If the resistor is broken it'll come in two.

So, there is a partial list of the things that can cause that infuriating type of intermittent. Notice the careful use of the word "partial." I've been around this business too long not to know that there will always be more possibilities. Good luck and happy hunting! **R-E**

service questions

TRANSISTOR DATA

I need help. I can't find a Sams folder for this Quasar TS-931; several people tell me Sams doesn't have it. Also need sub for horizontal regulator transistor Q501. Have schematic, no parts list, and they show it as PNP; the one in it is an NPN. I'm lost!—C.R., Norfolk, VA.

This one *is* hard to locate in the Sams Index: Try looking under "AH-19TS931", in folder 1479-3. Quasar Service data is in CTV-7.

Q501 isn't a standard transistor. It's a Darlington amplifier, with an internal shunt diode. Quasar stock number is B1R/48S127512. Can't find a cross to this number in the Guides. You'll probably have to get an exact duplicate from Quasar. Get CTV-7 while you're at it. This is an NPN, but a stock transistor won't work; not enough gain.

HELPFUL HINTS

In the July 1979 issue, I saw a hint from Leon Caldwell on erratic sync in a General Electric CD chassis. He found R251 gone up in value. A General Electric note I got later says that they have found these R251's to be failure-prone and are recommending replacing the original carbon-film types with solid carbons. I've found that a 1 watt type works better. This applies to the CD,C2,L2, and LB chassis.

They also recommend checking capacitor C274,200 pF, 5kV, which is under the damper socket. If you find a 300 pF in here, change it to part No. EP22X15, which is a 200 pF. The bigger capacitor makes the feedback pulse higher, and results in overheating of R251.

Thanks a lot to W.A. Shingler, Shingler's Radio-TV, Lewistown PA.

MORE ON BRIGHTNESS SHADING

Obed Elland, Dennisport, MA says "The horizontal output transistor, Q508, often develops leakage in the Sony KV-1710 chassis. That causes shading at the top of a raster. We've also found that using substitute transistors can cause other odd problems".

Thanks very much, Obed. Useful thing to remember. Personally, I've never had too many problems with substitute transistors, as long as I paid careful attention to the type, voltage rating, etc. Practically all that I've used work very well. There is, of course, the occasional typographical error in the replacement guides. Usually it's so obvious that no correction is needed; sub has TO-3 case and the original is an RF amplifer, and so on!

BLEEDER RESISTOR HOT

In this Sony KV-1212U, I get very little high voltage (5 kV or so), no raster, and R813, the high-voltage bleeder resistor smokes. Thermistor gets hot and circuit breaker trips in 20 seconds. This resistor is in series with the high-voltage capacitor C902, 1000 pf, 25 kV. Capacitor shows no leakage on ohmmeter. What's going on?—L.K., Palm Bay, FL.

Well, this high-voltage capacitor isn't often used any more. Older sets all had them. Note that it's connected right across the high voltage. Resistor R813 (1K, 1 watt), for some unfathomable reason, is connected in the ground return of this capacitor.

As far as I can see, only one thing could make this resistor blow up and give you all of the other symptoms; the high-voltage filter capacitor is breaking down! This is the only place you could get enough current to blow up the resistor! I'd try replacing the capacitor and see what happens.

OSCILLATOR PROBLEM

Got this GE 15XB from another shop. They had (incorrectly) replaced the flyback to cure the high-voltage problems with no luck. I found an open collector shunt capacitor (C263) on the horizontal output transistor. That brought back the high-voltage but now the oscillator is far off frequency; too high. I've subbed all of the parts that should determine frequency with no luck! Incidentally; I read only about 100 pF on C263; it's a .0033. Thought paper capacitors did not change value, just opened. Why?—A.B., Rochester, NY.

Take the easy one first! From the very small capacitance you read, it is probably the capacitance from the wire spiral that should make contact with the foil-roll! Now for the hard part.

The oscillator circuit here is a Colpitts. Frequency-determining parts are the coil, C259 (.02 μF) and C257 (.0033 μF). Check to make *sure* that those two haven't been *reversed*. You may find that the previous "tech" did one of my favorite tricks—put them in backward. If I'm not mistaken, that *does* make the oscillator run high in frequency. Obviously, the feedback is there since the oscillator is running, but some of the "constants" must be far off. Sounds like that to me; check it. **R-E**

UNICORN-1

continued from page 41

to make sure that you have not omitted a step. It will be very frustrating if you are halfway through assembling the arm and discover that you have to take it all apart again to drill one small hole that you omitted earlier.

Arm movement

The upper-arm assembly includes a section of ¼-20 threaded rod which, when rotated by the elbow motor, allows the robot to flex its arm. The threaded rod, which passes through the threaded hole in the pivot slide bar, will move that bar one inch for every 20 revolutions it makes. Using the dimensions given, this will produce a maximum travel of 5.5 inches. A motor turning at 6600 revolutions per minute would be required to flex the elbow through 90° in four seconds.

The most readily available motor, however, turns at 10,000 RPM and would make that action too fast. If we add a one-inch diameter, 48-tooth gear to the threaded rod, and a ½-inch, 20-tooth gear to the motor, we reduce the effective speed of the motor by 50% and can achieve full elbow action in a bit under ten seconds. Figure 7 illustrates that arrangement. Note that the threaded rod has a collar secured to it by a set screw. The collar prevents the rod from being pulled upward by the motor.

Figure 8 shows a clamp joining the motor and the side rods of the upper arm. That clamp is made from a piece of 1/16 x 1-in. sheet aluminum flared to accept an 8-32 bolt which applies tension to hold the motor in place.

While the preceding may sound somewhat complex at first reading, it *can* be done and will yield a perfectly workable robot arm. You are encouraged to use surplus sheet metal, rods, and gears to keep costs down. For convenience sake, however, a list of components and their sources is shown in the parts list.

The next part of this series will describe the assembly of the manipulators and will cover the construction of the robot's end-effectors (hands). In addition, we will go into the electrical wiring of the manipulators.

Should you have a question about any part of this series, the author may be reached in care of **Radio-Electronics.** Please enclose a self-addressed, stamped envelope with your inquiry to insure a prompt reply. **R-E**

RACEWAY
continued from page 45

black-and-white are provided.

Adjustment and troubleshooting.

There are two PC board potentiometers that require adjustment; the audio level and hue. The hue control (R29) is adjusted for the best contrast. The audio output (R30) should be adjusted to provide the desired noise level.

If problems occur after assembly use the following check list:

1. Are all components in the proper location?
2. Is PC board wired correctly to the external components?
3. Is the power supply voltage correct?
4. Is a 3.58-MHz clock signal present at pin 9 of the AY-3-8603-1?
5. Is there audio output?
6. Is there a composite video signal? (See Fig. 3 for waveform.)

If a "no" answer is generated by any of those questions then repair that portion of the circuit. For example, if a normal image is displayed, but the players' cars are not present; then check pin 7 to see if a video signal is present. If it is not, then the IC is bad; if a signal *is* present check the summing resistors. **R-E**

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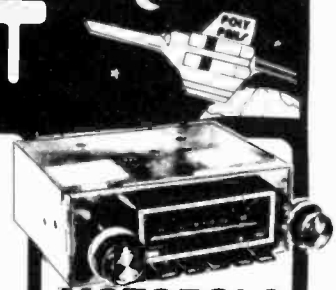

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- Redundant contact points
- YOUR CHOICE — TIN OR GOLD*
(*Minimum of 50 microinches gold inlay on gold sockets)
- TEXAS INSTRUMENTS QUALITY

TIN INLAY SOLDER TAIL

Part No.	Description	1	10	100
C8508	8 pin solder tail, tin	.10	.88	8.00
C8514	14 pin solder tail, tin	.17	1.53	14.00
C8516	16 pin solder tail, tin	.20	1.76	16.00
C8518	18 pin solder tail, tin	.22	1.98	18.00
C8520	20 pin solder tail, tin	.25	2.21	20.00
C8522	22 pin solder tail, tin	.27	2.43	22.00
C8524	24 pin solder tail, tin	.30	2.65	24.00
C8528	28 pin solder tail, tin	.38	3.31	[illegible]
C8540	40 pin solder tail, tin	[illegible]	[illegible]	[illegible]

GOLD INLAY SOLDER TAIL

Part No.	Description	1	10	100
C9508	8 pin solder tail, gold	.24	2.48	22.00
C9514	14 pin solder tail, gold	.32	2.81	25.00
C9516	16 pin solder tail, gold	.37	3.26	29.00
C9518	18 pin solder tail, gold	.42	3.72	33.00
C9520	20 pin solder tail, gold	.47	4.16	37.00
C9522	22 pin solder tail, gold	.50	4.50	40.00
C9524	24 pin solder tail, gold	.54	4.86	43.00
C9528	28 pin solder tail, gold	.63	5.63	50.00
C9540	40 pin solder tail, gold	.90	8.10	72.00

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(*Minimum .30 microinch gold inlay on gold sockets)
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TIN PLATED WIRE WRAP

Part No.	Description	1	10	100
C8108	8 pin wire wrap, tin	.30	2.92	26.00
C8114	14 pin wire wrap, tin	.38	3.70	36.00
C8116	16 pin wire wrap, tin	[illegible]	[illegible]	[illegible]
C8118	18 pin wire wrap, tin	.55	[illegible]	44.00
C8120	20 pin wire wrap, tin	.70	6.90	62.00
C8122	22 pin wire wrap, tin	.80	7.20	64.00
C8124	24 pin wire wrap, tin	.80	7.45	66.00
C8128	28 pin wire wrap, tin	1.05	9.45	84.00
C8140	40 pin wire wrap, tin	1.58	14.18	126.00

GOLD INLAY WIRE WRAP

Part No.	Description	1	10	100
C9108	8 pin wire wrap, gold	.49	4.35	41.10
C9114	14 pin wire wrap, gold	[illegible]	[illegible]	69.95
C9116	16 pin wire wrap, gold	[illegible]	[illegible]	77.15
C9118	18 pin wire wrap, gold	[illegible]	[illegible]	84.40
C9120	20 pin wire wrap, gold	1.28	11.25	111.00
C9122	22 pin wire wrap, gold	1.33	11.95	113.05
C9124	24 pin wire wrap, gold	[illegible]	12.35	115.40
C9128	28 pin wire wrap, gold	[illegible]	16.35	154.10
C9140	40 pin wire wrap, gold	2.50	22.20	210.90

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Solder Tab — Solder Eye — Wire Wrap

RELIABLE, COST-EFFICIENT CONTACT DESIGN

- 50 (Wire Wrap) to 30 (solder Tab) micro-inches gold inlay over a nickel diffusion barrier.
- Copper-nickel-tin CA 725 alloy.
- Bifurcated contact points.
- Preloaded, cantilever spring design.
- Contacts are user removable.

H4 SERIES .100" x .200" EDGEBOARD CONNECTORS

Contacts	Part No.	1	10	100	Part No.	1	10	100
10/20	C6-10	[illegible]	[illegible]	[illegible]	C5-10	[illegible]	[illegible]	[illegible]
15/30	C6-15	2.55	23.40	191.00	C5-15	2.37	21.70	178.00
17/34	C6-17	2.73	25.00	205.00	C5-17	2.52	23.10	189.00
18/36	C6-18	2.88	26.40	216.00	C5-18	2.61	23.90	196.00
20/40	C6-20	3.09	28.30	232.00	C5-20	2.76	25.30	207.00
22/44	C6-22	3.36	30.80	252.00	C5-22	2.97	27.20	223.00
25/50	C6-25	3.75	34.40	281.00	C5-25	3.27	30.00	245.00
28/56	C6-28	3.99	36.60	299.00	C5-28	3.54	32.50	266.00
30/60	C6-30	4.14	38.00	311.00	C5-30	3.75	34.40	281.00
31/62	C6-31	4.32	39.60	324.00	C5-31	3.84	35.20	288.00
35/70	C6-35	4.89	44.80	367.00	C5-35	4.20	38.50	315.00
36/72	C6-36	4.95	45.40	371.00	C5-36	4.32	39.60	324.00
40/80	C6-40	5.49	50.30	412.00	C5-40	4.71	43.20	353.00
43/86	C6-43	5.91	54.20	443.00	C5-43	4.98	45.70	374.00
49/98	C6-49	6.72	61.60	504.00	C5-49	5.58	51.20	419.00
50/100	C6-50	6.81	62.40	511.00	C5-50	5.64	51.70	423.00

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H4 SERIES .125" x .250" EDGEBOARD CONNECTORS

Contacts	Part No.	1	10	100	Part No.	1	10	100
10/20	C4-10	2.37	21.70	178.00	C3-10	[illegible]	[illegible]	[illegible]
15/30	C4-15	2.73	25.00	205.00	C3-15	2.46	22.60	185.00
18/36	C4-18	2.97	27.20	223.00	C3-18	2.67	24.50	200.00
20/40	C4-20	3.24	29.70	243.00	C3-20	2.85	26.10	214.00
22/44	C4-22	3.48	31.90	261.00	C3-22	3.00	27.50	225.00
25/50	C4-25	3.90	35.80	293.00	C3-25	3.39	31.10	254.00
28/56	C4-28	4.11	37.70	308.00	C3-28	3.69	33.80	277.00
30/60	C4-30	4.29	39.30	322.00	C3-30	3.81	34.90	286.00
31/62	C4-31	4.44	40.70	333.00	C3-31	4.05	37.10	304.00
35/70	C4-35	5.01	45.90	376.00	C3-35	4.50	41.30	338.00
36/72	C4-36	5.10	46.80	383.00	C3-36	4.56	41.80	342.00
40/80	C4-40	5.64	51.70	423.00	C3-40	5.04	46.20	378.00
44/88	C4-44	6.09	55.80	457.00	C3-44	5.49	50.30	412.00
50/100	C4-50	6.90	63.30	518.00	C3-50	6.18	56.70	464.00

H4 SERIES .156" x .200" EDGEBOARD CONNECTORS

Contacts	Part No.	1	10	100	Part No.	1	10	100
10/20	C1-10	2.49	22.80	187.00	C2-10	4.06	37.60	306.00
12/24	C1-12	2.64	24.20	198.00	C2-12	4.32	39.60	324.00
15/30	C1-15	2.94	27.00	221.00	C2-15	4.71	43.20	353.00
18/36	C1-18	3.18	29.20	239.00	C2-18	4.98	45.70	374.00
22/44	C1-22	3.54	32.50	266.00	C2-22	5.49	50.30	412.00
25/50	C1-25	3.84	35.20	288.00	C2-25	5.91	54.20	443.00
28/56	C1-28	4.29	39.30	322.00	C2-28	6.36	58.30	477.00

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RS125	Set of 5 each of the 73 standard 5% ¼ watt carbon film resistors in the series 1.0, 1.2, 1.5, 1.8, 2.2, etc. through 1.0 megohm (365 total pcs.)	$9.90
RS225	Set of 5 each of the 72 standard 5% ¼ watt carbon film resistors in the series 1.1, 1.3, 1.6, 2.0, 2.4, etc. through 910 kilohm (360 total pcs.)	$9.90

½ WATT RESISTORS ASSORTMENTS

RS150	Set of 5 each of the 73 standard 5% ½ watt carbon film resistors in the series 1.0, 1.2, 1.5, 1.8, 2.2, etc. through 1.0 megohm (365 total pcs.)	$9.90
RS250	Set of 5 each of the 72 standard 5% ½ watt carbon film resistors in the series 1.1, 1.3, 1.6, 2.0, 2.4, etc. through 910 kilohm (360 total pcs.)	$9.90

TIME-TEMPERATURE PROGRAMMABLE MODULE

USER PROGRAMMABLE FOR:

- 12 or 24 Hour Display
- °F and/or °C, as well as virtually any number of temperature sensors
- Fixed or flashing colon format
- 50/60 Hz line frequency operation

FEATURES

- Giant 0.7 inch - 4 digit LED display with red lens.
- PM, colon, degree and alarm "ON" LED indicators
- 6 display modes - temperature, time, seconds, alarm, sleep and lamp test
- Exclusive Digi-Key switching panel available to simplify hook-up
- Leading zero blanking
- Time is normal display mode, with temperature display at push of switch, provision for time-shared and display of temperatures in range of -40°C to 90°C
- multiple temperature sensors may be used
- power fail condition indicated by flashing
- addition of simple circuit will allow switching of small to medium AC loads
- optional switching panel to simplify hook-up

Catalog No.	Description	COST
MA1026M	MA1026 Clock Module (Assembled and Tested with data sheet)	$19.95
MA1026P	Digi-Key Switching Panel Kit for MA1026M (Includes P.C. Board, 12 low profile switches, wrappers, standoffs, hardware, components, two LM334 temperature sensors, two EOA32 trimpots, and instructions)	15.91
MA1026T	Special transformer for MA1026M suitable for most applications	2.95
MA1026B	Alarm buzzer for MA1026M	3.00
MA1026K	Includes MA1026M, P, T, and B	34.95
MA1026C	Conventional Switch Set for applications where MA1026P is not used. Includes one 501PB and ten 502PB switches and special wiring instructions	3.95
MA1026K	Includes MA1026M clock module, MA1026C conventional switch set, MA1026T special transformer, two LM334 temperature sensors, and two EOA32 trimpots	39.95

For each additional sensor unit, the following are suggested:

LM334	Temperature transducer for MA1026M module	$1.30
EOA32	300 ohm trimpot for LM334 transducer	.32
502PB	Normally open switch	.45

THE "PROGRAMMABLE" CLOCK MODULES

USER PROGRAMMABLE FOR:

- 12 or 24 hour display
- Fixed or flashing colon
- 50/60 Hz line frequency operation

NEW! Two Giant Sizes 0.7" and 0.84"

FEATURES:

- display brightness can be controlled by introduction of potentiometer
- will adapt for continuous time keeping with introduction of 5M potentiometer and 9V battery
- alarm requires adding buzzer — no intervening circuitry
- Your Choice — 0.7" or 0.84" red LED display
- low power consumption
- leading zero blanking
- optional switching panel to simplify hook-up

MA1023 — 0.7" HIGH DIGITS

MA1020 — 0.84" HIGH DIGITS

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- Ideal for Car, Van or Boat
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2-56 1/2 SCREW	1.39/C
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4-40 1/2 SCREW	.99/C
6-32 1/4 SCREW	.99/C
6-32 1/2 SCREW	.99/C
8-32 3/8 SCREW	[illegible]
8-32 5/8 SCREW	[illegible]
2-56 HEX NUT	[illegible]
4-40 HEX NUT	[illegible]
6-32 HEX NUT	[illegible]
8-32 HEX NUT	.75/C
NO. 2 LOCKWASHER	1.25/C
NO. 4 LOCKWASHER	1.00/C
NO. 6 LOCKWASHER	1.00/C
NO. 8 LOCKWASHER	1.00/C

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2N3906	.20	1.79	16.25	146.25
2N4124	.21	1.93	17.50	157.50
2N4126	.22	2.01	18.25	164.25
2N4401	.21	1.93	17.50	157.50
2N4403	.21	1.93	17.50	157.50
2N4410	.30	2.70	24.38	219.38
2N5087	.24	2.20	20.00	180.00
2N5089	.24	2.20	20.00	180.00
2N5210	.27	2.48	22.50	202.50
2N5457	.54	4.86	43.88	394.88
92PU01A	.38	3.42	30.88	277.88
92PU10	.38	3.42	30.88	277.88
92PU45A	.41	3.69	33.32	299.88
92PU51A	.38	3.42	30.88	277.88
MJ2955	1.47	13.48	122.50	1102.25
MJE172	.74	6.66	60.13	541.13
MJE182	.72	6.48	58.50	526.50
MJE3439	.56	4.80	40.00	360.00
MJE344	.68	6.12	55.25	497.25
MJE370	.89	8.01	72.32	650.82
MJE371	1.10	9.90	89.38	804.38
MJE520	.86	7.74	69.88	628.88
MJE521	.86	7.74	69.88	628.88
MJE703	1.13	10.17	91.82	826.31
MJE712	.74	6.66	60.13	541.13
MJE722	.74	6.66	60.13	541.13
MJE803	1.01	9.09	82.07	738.57
MPF102	.54	4.95	45.00	405.00
MPS2222A	.21	1.93	17.50	157.50
MPS2369A	.24	2.20	20.00	180.00
MPS2907A	.24	2.20	20.00	180.00
MPS3392	.23	2.07	18.75	169.00
MPS3393	.21	1.93	17.50	157.50
MPS3394	.24	2.20	20.00	180.00
MPS3395	.24	2.20	20.00	180.00
MPS3563	.21	1.93	17.50	157.50
MPS3565	.21	1.93	17.50	157.50
MPS3638A	.21	1.93	17.50	157.50
MPS3641	.21	1.93	17.50	157.50
MPS3643	.21	1.93	17.50	157.50
MPS918	.22	1.98	17.88	160.88
MPS930	.21	1.93	17.50	157.50
MPSA13	.27	2.48	22.50	202.50
TIP112	.98	8.40	70.00	630.00
TIP117	1.12	10.08	91.00	819.00
TIP120	1.17	10.73	97.50	877.50
TIP122	1.54	13.20	110.00	990.00
TIP127	1.54	13.20	110.00	990.00
TIP132	2.32	20.88	188.50	1696.50
TIP135	2.32	20.88	188.50	1696.50
TIP29C	.81	6.90	57.50	517.50
TIP30C	.81	6.90	57.50	517.50
TIP31C	.98	8.40	70.00	630.00
TIP32C	1.02	8.70	72.50	652.50
TIP61C	.81	6.90	57.50	517.50
TIP62C	.81	6.90	57.50	517.50

PANASONIC ELECTROLYTIC CAPACITORS

Value	Axial 1	Axial 10	Axial 100	Radial 1	Radial 10	Radial 100
.47/50V	.13	1.08	8.94	.18	1.54	12.83
1/50V	.13	1.08	8.94	.18	1.54	12.83
2.2/50V	.13	1.08	8.94	.18	1.54	12.83
3.3/50V	.14	1.15	9.52	.18	1.54	12.83
4.7/35V	.14	1.18	9.78	.18	1.54	12.83
4.7/50V	.14	1.18	9.78	.21	1.78	14.76
10/16V	.13	1.08	8.94	.18	1.54	12.83
10/25V	.14	1.15	9.52	.18	1.54	12.83
10/35V	.14	1.19	9.90	.21	1.78	14.79
10/50V	.16	1.35	11.20	.24	2.00	16.65
22/16V	.14	1.15	9.52	.21	1.74	14.48
22/25V	.15	1.22	10.17	.22	1.83	15.21
22/35V	.19	1.60	13.30	.24	2.00	16.65
22/50V	.22	1.83	15.19	.28	2.35	19.53
33/16V	.14	1.19	9.90	.21	1.78	14.76
33/25V	.17	1.38	11.50	.24	2.00	16.65
33/35V	.21	1.78	14.80	.28	2.35	19.53
33/50V	.23	1.90	15.77	.32	2.70	22.43
47/10V	.14	1.19	9.90	.21	1.78	14.78
47/16V	.16	1.36	11.32	.24	2.00	16.65
47/25V	.21	1.73	14.42	.28	2.35	19.53
47/35V	.23	1.90	15.77	.33	2.78	23.15
47/50V	.24	2.05	17.03	.36	3.04	25.33
100/10V	.17	1.39	11.58	.24	2.00	16.65
100/16V	.21	1.78	14.80	.28	2.35	19.53
100/25V	.23	1.90	15.77	.33	2.78	23.15
100/35V	.24	2.06	17.10	.43	3.65	30.40
100/50V	.36	3.07	25.62	.45	3.79	31.54
220/10V	.23	1.92	15.95	.29	2.46	20.48
220/16V	.23	1.92	15.95	.33	2.78	23.15
220/25V	.23	1.92	15.95	.44	3.75	31.24
220/35V	.40	3.42	28.45	.51	4.34	36.16
220/50V	.52	4.45	37.08	.61	5.18	43.15
330/6V	.23	1.92	15.95	.29	2.46	20.48
330/10V	.24	2.06	17.10	.33	2.78	23.15
330/16V	.35	2.97	24.69	.44	3.72	30.96
330/25V	.40	3.42	28.45	.50	4.26	35.46
330/35V	.52	4.45	37.08	.57	4.85	40.40
330/50V	.83	7.06	58.78	.92	7.87	65.55
470/6V	.23	1.97	16.34	.33	2.78	23.15
470/10V	.35	2.93	24.69	.44	3.72	30.96
470/16V	.38	3.19	26.58	.50	4.22	35.14
470/25V	.50	4.21	35.08	.58	4.95	41.24
470/35V	.64	5.42	45.13	.65	5.51	45.89
470/50V	.92	7.84	65.33	.92	7.87	65.55
1000/6V	.36	3.08	25.62	.49	4.20	35.00
1000/10V	.40	3.42	28.45	.54	4.64	38.61
1000/16V	.50	4.21	35.08	.59	5.10	42.45
1000/25V	.83	7.06	58.78	.84	7.19	59.84
1000/35V	.92	7.84	65.32	.98	8.38	69.80
2200/6V	.54	4.55	37.95	.60	5.13	42.75
2200/10V	.70	5.93	49.42	.77	6.64	55.20
2200/16V	.87	7.44	62.10	.92	7.85	65.39
2200/25V	1.17	10.01	83.47	1.16	9.92	82.62
3300/6V	.75	6.38	53.10	.81	6.94	57.83
3300/10V	.90	7.71	64.22	.99	8.45	70.38
3300/16V	1.17	10.01	83.47	1.16	9.92	82.62
3300/25V	1.66	14.17	118.03	1.61	13.78	114.76
4700/6V	.97	7.95	66.20	1.04	8.89	74.07
4700/10V	1.13	9.68	80.62	1.28	10.95	91.18
4700/16V	1.57	13.43	111.87	1.56	13.41	111.68
6800/6V	1.13	9.68	80.62	1.27	10.87	90.58
6800/10V	1.54	13.13	109.40	1.55	13.27	110.51
6800/16V	—	—	—	1.98	17.00	141.63
10,000/6V	1.54	13.13	109.40	1.54	13.10	109.76
10,000/10V	—	—	—	1.98	17.00	141.63

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PANASONIC POLYESTER CAPACITORS

Panasonic Trimmer Potentiometers

Part No.	Part No.	Resistance	1	10	100	1000
Q1A22	Q0A22	200	.40	3.70	26.00	200.00
Q1A52	Q0A52	500	.40	3.70	26.00	200.00
Q1A13	Q0A13	1K	.40	3.70	26.00	200.00
Q1A23	Q0A23	2K	.40	3.70	26.00	200.00
Q1A53	Q0A53	5K	.40	3.70	26.00	200.00
Q1A14	Q0A14	10K	.40	3.70	26.00	200.00
Q1A24	Q0A24	20K	.40	3.70	26.00	200.00
Q1A54	Q0A54	50K	.40	3.70	26.00	200.00
Q1A15	Q0A15	100K	.40	3.70	26.00	200.00
Q1A25	Q0A25	200K	.40	3.70	26.00	200.00
Q1A55	Q0A55	500K	.40	3.70	26.00	200.00
Q1A16	Q0A16	1M	.40	3.70	26.00	200.00
Q1A26	Q0A26	2M	.40	3.70	26.00	200.00

PANASONIC TRIMMER POTENTIOMETERS

5/16" (8 mm) DIA. PRESET VARIABLE RESISTORS

Lay Down	Stand Up	Resist.	1	10	100	1000
E4A22	E0A22	200	.32	2.40	21.00	160.00
E4A52	E0A52	500	.32	2.40	21.00	160.00
E4A13	E0A13	1K	.32	2.40	21.00	160.00
E4A23	E0A23	2K	.32	2.40	21.00	160.00
E4A53	E0A53	5K	.32	2.40	21.00	160.00
E4A14	E0A14	10K	.32	2.40	21.00	160.00
E4A24	E0A24	20K	.32	2.40	21.00	160.00
E4A54	E0A54	50K	.32	2.40	21.00	160.00
E4A15	E0A15	100K	.32	2.40	21.00	160.00
E4A25	E0A25	200K	.32	2.40	21.00	160.00
E4A55	E0A55	500K	.32	2.40	21.00	160.00
E4A16	E0A16	1M	.32	2.40	21.00	160.00
E4A26	E0A26	2M	.32	2.40	21.00	160.00

PLESSEY MINIBOX METALLIZED POLYESTER CAPACITORS

PANASONIC METALLIZED POLYESTER CAPACITORS

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1N5227B	3.6V	1N5243B	13V
1N5228B	3.9V	1N5244B	14V
1N5229B	4.3V	1N5245B	15V
1N5230B	4.7V	1N5246B	16V
1N5231B	5.1V	1N5247B	17V
1N5232B	5.6V	1N5248B	18V
1N5233B	6.0V	1N5249B	19V
1N5234B	6.2V	1N5250B	20V
1N5235B	6.8V	1N5251B	22V
1N5236B	7.5V	1N5252B	24V
1N5237B	8.2V	1N5253B	25V
1N5238B	8.7V	1N5254B	27V
1N5239B	9.1V	1N5255B	28V
1N5240B	10V	1N5256B	30V
1N5241B	11V	1N5257B	33V

SILICON DIODES

	10	100
1N4001	[illegible]	[illegible]
1N4002	.80	7.00
1N4003	.80	7.50
1N4004	.80	7.90
1N4005	1.00	9.00
1N4006	1.00	9.00
1N4007	1.00	9.00
1N4148	.50	[illegible]

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SPST	.22	2.00/10	18.00/C
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DPDT	.22	2.00/10	19.00/C

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4013	276-2413	1.19
4017	276-2417	1.99
4027	276-2427	1.19
4511	276-2447	1.99
4049	276-2449	.99
4050	276-2450	.99
4066	276-2466	1.59

TTL

7400	276-1801	.69
7402	276-1811	.79
7404	276-1802	.79
7408	276-1822	.79
7447	276-1805	1.19
7448	276-1816	1.29
7473	276-1803	.79
7474	276-1818	.99
7475	276-1806	1.09
7476	276-1813	.89
7490	276-1808	1.09
7492	276-1819	1.19
74154	276-1834	1.49
74192	276-1831	1.59
74193	276-1820	1.49

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- ***Fast and Easy to Use***
- ***Helps Prevent Damage***

Just rock IC on pin straightener and tool ejects it, ready for socket or board insertion. Extractor handles all 8 to 24-pin devices. Both tools easily grounded. **276-1574** **6.95**

Compact Lever Switches

Low As **2.69 SPST**

Rated 6A @ 125VAC

Tapered lever for easy grip. Solder lugs. With mtg. hardware.

SPST. 275-257 ..... **2.69**
DPDT. 275-259 ..... **3.19**

NEW Submini 6-Volt Lamps

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- ***5" Leads***
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Super small red incandescents for model railroads, dials, meters. 60 mA @ 6V. **272-1144** .... **6 for 99¢**

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Low As **2.59 SPDT**

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- ***Solder Lugs***

½"-long tapered metal lever.

SPDT. 275-635 ..... **2.59**
DPDT. 275-636 ..... **2.89**

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6AU6A	4.19
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6GH8A	3.89
6GM6	5.29
6GY6/6GX6	4.89
6HM5/6HA5	4.89
6HZ6	4.19
6JC6	6.69

Tube Type	Each
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12AV6	4.59
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SN7402N	.22	SN74126N	.44
SN7403N	.22	SN74128N	.59
SN7404N	.22	SN74132N	.69
SN7405N	.23	SN74136N	.95
SN7406N	.23	SN74139N	.95
SN7407N	.23	SN74141N	.69
SN7408N	.26	SN74142N	2.95
SN7409N	.23	SN74143N	2.95
SN7410N	.22	SN74144N	2.95
SN7411N	.29	SN74145N	.82
SN7412N	.29	SN74147N	1.95
SN7413N	.39	SN74148N	1.20
SN7414N	.59	SN74150N	.99
SN7416N	.29	SN74151N	.87
SN7417N	.29	SN74152N	.87
SN7420N	.22	SN74153N	.87
SN7421N	.35	SN74154N	1.19
SN7422N	.29	SN74155N	.82
SN7423N	.29	SN74156N	.89
SN7425N	.29	SN74157N	.69
SN7426N	.29	SN74158N	1.65
SN7427N	.29	SN74160N	.95
SN7429N	.45	SN74161N	.95
SN7430N	.23	SN74162N	.89
SN7432N	.29	SN74163N	.87
SN7437N	.29	SN74164N	.97
SN7438N	.29	SN74165N	.97
SN7439N	.29	SN74166N	1.20
SN7440N	.24	SN74167N	1.95
SN7441N	.79	SN74170N	1.69
SN7442N	.87	SN74172N	5.95
SN7443N	.79	SN74173N	.79
SN7444N	.79	SN74174N	.89
SN7445N	.79	SN74175N	.89
SN7446N	.79	SN74176N	.85
SN7447N	.59	SN74177N	.85
SN7448N	.79	SN74179N	1.80
SN7450N	.23	SN74180N	.75
SN7451N	.23	SN74181N	1.75
SN7453N	.23	SN74182N	.75
SN7454N	.23	SN74184N	1.95
SN7459N	.29	SN74185N	1.95
SN7460N	.23	SN74186N	9.95
SN7470N	.39	SN74188N	3.90
SN7472N	.34	SN74190N	1.15
SN7473N	.38	SN74191N	1.15
SN7474N	.36	SN74192N	.85
SN7475N	.38	SN74193N	.85
SN7476N	.36	SN74194N	.85
SN7479N	4.60	SN74195N	.85
SN7480N	.59	SN74196N	.85
SN7481N	1.10	SN74197N	.85
SN7482N	1.10	SN74198N	1.39
SN7483N	.85	SN74199N	1.39
SN7485N	.65	SN74221N	1.39
SN7486N	.39	SN74251N	.95
SN7489N	1.75	SN74273N	1.05
SN7490N	.39	SN74279N	.89
SN7491N	.65	SN74283N	2.15
SN7492N	.52	SN74284N	3.90
SN7493N	.49	SN74285N	3.90
SN7494N	.72	SN74290N	1.25
SN7495N	.85	SN74298N	.95
SN7496N	.72	SN74365N	.68
SN7497N	3.10	SN74366N	.68
SN74100N	.99	SN74367N	.79
SN74107N	.32	SN74368N	.79
SN74109N	.53	SN74390N	1.90
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CD4001	.29	CD4094	2.95
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CD4006	1.39	CD4099	2.25
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CD4011	.29	MC14415	8.95
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CD4014	1.39	CD4502	1.65
CD4015	1.39	CD4503	.69
CD4016	.59	CD4505	8.95
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CD4018	1.19	CD4507	.95
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CD4020	1.19	CD4510	1.39
CD4021	1.49	CD4511	1.39
CD4022	1.29	CD4512	1.39
CD4023	.38	CD4515	3.95
CD4024	.79	CD4516	1.69
CD4025	.38	CD4518	1.39
CD4027	.79	CD4520	1.39
CD4028	.99	CD4555	4.95
CD4029	1.29	CD4556	.99
CD4030	.69	CD4566	2.25
CD4031	3.25	74C00	.39
CD4032	2.15	74C02	.39
CD4034	3.25	74C04	.39
CD4035	1.19	74C08	.49
CD4037	1.95	74C10	.49
CD4040	1.29	74C14	1.65
CD4041	1.25	74C20	.39
CD4042	.99	74C30	.39
CD4043	.99	74C32	.99
CD4044	.99	74C42	1.85
CD4046	2.25	74C48	2.39
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CD4056	2.95	74C151	2.49
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CD4060	1.39	74C157	2.10
CD4066	.89	74C160	2.39
CD4069	.35	74C161	2.30
CD4070	.89	74C163	2.39
CD4071	.35	74C164	2.39
CD4072	.35	74C173	2.69
CD4073	.35	74C174	2.75
CD4075	.35	74C175	2.75
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CD4078	.35	74C195	2.39
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CD4085	1.95	MM80C95	1.50
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74LS00N	.35	74LS164N	1.19
74LS01N	.28	74LS165N	.89
74LS02N	.28	74LS166N	2.48
74LS03N	.28	74LS168N	1.89
74LS04N	.39	74LS169N	1.89
74LS05N	.28	74LS170N	1.99
74LS08N	.39	74LS173N	.89
74LS09N	.39	74LS174N	.99
74LS10N	.28	74LS175N	.99
74LS11N	.39	74LS181N	2.20
74LS12N	.39	74LS190N	1.15
74LS13N	.47	74LS191N	1.15
74LS14N	1.25	74LS192N	.98
74LS15N	.39	74LS193N	.98
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74LS21N	.38	74LS195N	.95
74LS22N	.38	74LS196N	.89
74LS26N	.39	74LS197N	.89
74LS27N	.39	74LS221N	1.49
74LS28N	.39	74LS240N	2.99
74LS30N	.26	74LS241N	2.49
74LS32N	.38	74LS242N	2.29
74LS37N	.79	74LS243N	2.29
74LS38N	.39	74LS244N	2.95
74LS40N	.26	74LS245N	8.95
74LS42N	.79	74LS247N	1.10
74LS47N	.79	74LS248N	1.10
74LS48N	.79	74LS249N	1.69
74LS51N	.26	74LS251N	1.79
74LS54N	.35	74LS253N	.98
74LS55N	.35	74LS257N	.98
74LS73N	.45	74LS258N	.98
74LS74N	.59	74LS259N	2.95
74LS75N	.68	74LS260N	.69
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74LS78N	.65	74LS266N	.59
74LS83AN	.99	74LS273N	1.75
74LS85N	1.19	74LS275N	4.40
74LS86N	.45	74LS279N	.59
74LS90N	.75	74LS283N	1.10
74LS92N	.75	74LS290N	1.29
74LS93N	.75	74LS293N	1.95
74LS95N	.88	74LS295N	1.10
74LS96N	.98	74LS298N	1.29
74LS107N	.45	74LS324N	1.75
74LS109N	.45	74LS347N	1.95
74LS112N	.49	74LS348N	1.95
74LS113N	.49	74LS352N	1.65
74LS114N	.55	74LS353N	1.65
74LS122N	.55	74LS363N	1.49
74LS123N	1.19	74LS365N	.99
74LS124N	1.35	74LS366N	.99
74LS125N	.89	74LS367N	.99
74LS126N	.89	74LS368N	.99
74LS132N	.79	74LS373N	2.75
74LS136N	.59	74LS374N	2.75
74LS138N	.89	74LS375N	.89
74LS139N	.89	74LS377N	1.95
74LS145N	1.25	74LS385N	1.95
74LS148N	1.49	74LS386N	.65
74LS151N	.79	74LS390N	1.95
74LS153N	.79	74LS393N	1.95
74LS154N	2.49	74LS395N	1.70
74LS155N	1.19	74LS399N	2.95
74LS156N	.99	74LS424N	2.95
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LM739N	1.15	SN75453N	.49
LM741CN/H	.33	SN75454N	.49
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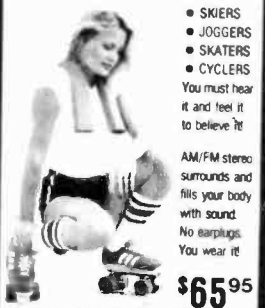

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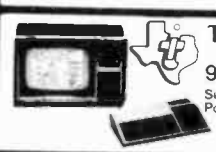

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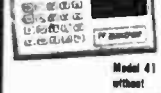

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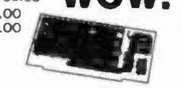

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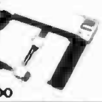

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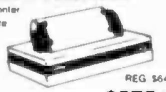

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WE NOW STOCK A FULL LINE OF THESE HARD TO FIND CELLS WHICH CONVERT LIGHT DIRECTLY INTO ELECTRICITY. EACH CELL GENERATES APPROXIMATELY .45 VOLT AND GENERATES CURRENT AS SHOWN BELOW. CONNECT CELLS IN SERIES FOR MORE VOLTAGE AND CONNECT CELLS IN PARALLEL FOR MORE CURRENT. MANY OTHER TYPES ARE LISTED IN OUR CATALOG!

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2" 1/4 CELL	100MA	C24154	$1.75
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PEE WEE BOXER FAN

IMC #PWS 2107FL
115 VAC 36 CFM
3 1/8"x3 1/8"x1 1/8"
7-Blade Fan

NEW $13.50 each

8,000 mfd. 15VDC
Axial electrolytte

Large Capacity - Small package
3-7/8" long x 1-1/16" diameter

$1.50 each

DUAL 50K SLIDE POT
linear taper $1.50 each

3 inch long 2¼ inch slide
knobs for slide pots 20¢ each

50K SLIDE POT 75¢ Each
Knobs for Slide Pots 20¢ each
audio taper

● 3-1/2 inch long ● 2-3/4 inch slide

REED RELAYS
9-15 VOLT D.C.
NORMALLY OPENED
CONTACTS: 1 amp max. switch — 2 amp max. carry
BODY SIZE: approx. 1 inch long ¼ inch high

S.P.S.T. 1500 ohm coil $1.15 each
D.P.S.T. 1200 ohm coil $1.30 each
3.P.S.T. 750 ohm coil $1.50 each

ALCO HEAVY DUTY MINIATURE SIZE TOGGLE

- Rated: 10 amps @ 120 vac
- Contacts: solid silver S.P.D.T.
- Body Size: 9/16" dia. cylindrical body ¾" high

$1.50 each specify handle style

Miniature Flat Lever ¼-40 Bushing — SPCT-1100-AA
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HOUSE MARKED DARLINGTON TRANSISTOR
SPECIFY NPN OR PNP
5 AMPS 65 WATTS
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SIMILAR TO: TIP 121NPN TIP 126 PNP
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$1.75 each
8¾" long. 1-1/8" dia.

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TIN SOLDERTAIL .156"x.200"
LARGE QUANTITIES AVAILABLE
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LONG PLAY 10 HOUR TAPE RECORDER

Top quality AC-DC cassette recorder, modified to provide 5 continuous hours of recording and playback of true fidelity, distortion-free sound on each side of cassette for a total of 10 hours. Unit has many special built-in features. TDK D-C180 cassette supplied.

ONLY $125.00*

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Record incoming and outgoing calls automatically with this all solid state unit connected to your telephone jack and tape recorder. Starts recording when phone is lifted. Stops when you hang up, making a permanent record. Easily installed. No monthly charges.

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Solid state. Self contained. Excellent adjustable sensitivity. Voices or other sounds activate and control recorder. Uses recorder mike or remote mike.

2¼ x 1¾ x ¾" $24.95*

Phone call Adapter $24.50*, VOX $24.95*, (* plus $1.00 ea. shipping & handling), 10 hr. Recorder $125.00* (* plus $4.00 shipping & handling). California residents add tax. Mail Order, VISA, M/C, cod's okay, quantity discounts available. Money back guar. Free data.

AMC SALES, Dept. 19 9335 Lubec St., Box 928
Downey, CA 90241, Phone (213) 869-8519

CIRCLE 5 ON FREE INFORMATION CARD

APPLE EXPANSION KIT 16K

Memory add-on with instructions

$47.50

LOGIC PROBE KIT

$17.95

I.C. MASTER

NEW "1980" $49

CIRUIT SPECIALS

74LS240	2.25
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74LS243	2.25
74LS244	2.25
74LS373	2.55
74LS374	2.55
74S138	3.95

8212 I/O PORT $2.95

8216 BUS DRIVER $2.95

2708 1024x8 EPROM $7.95

SOROC TECHNOLOGY, INC.

IQ120 $699.00

DUST COVERS

Apple Disk	3.75
Apple Keyboard	8.75
TRS-80 Keyboard	7.75
TRS-80 Recorder	3.75
TRS-80 Single Disk	3.75
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TRS-80 Model Keyboard	7.75
Pet Disk	7.75
Pet Terminal/Comp	15.75
Northstar Computer	11.75
Soroc Terminal	10.75

2716 16K EPROM $19.50
450ns single +5V

8038C VCO Waveform Gen. w/sine $2.65

2114L 1024x4 Static RAM $4.50
450 ns

video 100

$129.00

Leedex Corp.

12" BLACK & WHITE LOW COST VIDEO MONITOR

TRS 80

16K Memory Add-On

$49.95 KIT

with jumpers and instructions

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8038	VCO Waveform Gen.	2.55
4116	16kx1 Dyn RAM (300ns)	6.00
4116	16kx1 DYN RAM (200ns)	7.00
2114L	1kx4 Static RAM (450ns)	4.75
2114L	1kx4 Static RAM (250ns)	5.50

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** PHANTOM LINE CAPABILITY
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** LED INDICATORS FOR BOARD/BANK
** SOLDER MASK ON BOTH SIDES OF BOARD

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TERMS: Satisfaction guaranteed or money refunded. COD add $1.50. Minimum order $6.00. Orders under $10.00 add $.75. Add 5% for postage, insurance, handling. Overseas add 15%. NY residents add 7% tax.

MINI KITS - YOU HAVE SEEN THESE BEFORE NOW HERE ARE OLD FAVORITE AND NEW ONES TOO. GREAT FOR THAT AFTERNOON HOBBY.

FM MINI MIKE

A super high performance FM wireless mike kit! Transmits a stable signal up to 300 yards with exceptional audio quality by means of its built in electret mike. Kit includes case, mike, on-off switch, antenna, battery and super instructions. This is the finest unit available.

FM-3 Kit $14.95
FM-3 Wired and Tested 19.95

Color Organ

See music come alive! 3 different lights flicker with music. One light each for, high, mid-range and lows. Each individually adjustable and drives up to 300 W. runs on 110 VAC.

Complete kit, ML-1 $8.95

Video Modulator Kit

Converts any TV to video monitor. Super stable, tunable over ch. 4-6. Runs on 5-15V, accepts std. video signal. Best unit on the market! Complete kit, VD-1 $7.95

Led Blinky Kit

A great attention getter which alternately flashes 2 jumbo LEDs. Use for name badges, buttons, warning panel lights, anything! Runs on 3 to 15 volts. Complete kit, BL-1 $2.95

Super Sleuth

A super sensitive amplifier which will pick up a pin drop at 15 feet! Great for monitoring baby's room or as general purpose amplifier. Full 2 W rms output, runs on 6 to 15 volts, uses 8-45 ohm speaker. Complete kit, BN-9 $5.95

CPO-1

Runs on 3-12 Vdc 1 wall out, 1 KHZ good for CPO, Alarm, Audio Oscillator. Complete kit $2.95

FM Wireless Mike Kit

Transmits up to 300' to any FM broadcast radio, uses any type of mike. Runs on 3 to 9V. Type FM-2 has added sensitive mike preamp stage.

FM-1 kit $3.95 FM-2 kit $4.95

Whisper Light Kit

An interesting kit, small mike picks up sounds and converts them to light. The louder the sound, the brighter the light. Includes mike, controls up to 300 W, runs on 110 VAC. Complete kit, WL-1 $6.95

Tone Decoder

A complete tone decoder on a single PC board. Features: 400-5000 Hz adjustable range via 20 turn pot, voltage regulation, 567 IC. Useful for touch-tone burst detection, FSK, etc. Can also be used as a stable tone encoder. Runs on 5 to 12 volts. Complete kit, TD-1 $5.95

Universal Timer Kit

Provides the basic parts and PC board required to provide a source of precision timing and pulse generation. Uses 555 timer IC and includes a range of parts for most timing needs.

UT-5 Kit $5.95

Mad Blaster Kit

Produces LOUD ear shattering and attention getting siren like sound. Can supply up to 15 watts of obnoxious audio. Runs on 6-15 VDC

MB-1 Kit $4.95

Siren Kit

Produces upward and downward wail characteristic of a police siren. 5 W peak audio output, runs on 3-15 volts, uses 3-45 ohm speaker.

Complete kit, SM-3 $2.95

60 Hz Time Base

Runs on 5-15 VDC. Low current (2.5ma). 1 min/month accuracy. TB-7 Kit $5.90
TB-7 Assy $9.95

CLOCK KITS

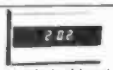
Your old favorites are here again. Over 7,000 Sold to Date. Be one of the gang and order yours today!

Try your hand at building the finest looking clock on the market. Its satin finish anodized aluminum case looks great anywhere, while six .4" LED digits provide a highly readable display. This is a complete kit, no extras needed, and it only takes 1-2 hours to assemble. Your choice of case colors: silver, gold, black (specify).

Clock kit, 12/24 hour, DC-5 $24.95
Clock with 10 min. ID timer, 12/24 hour, DC-10 $29.95
Alarm clock, 12 hour only, DC-8 $29.95
12V DC car clock, DC-7 $29.95

For wired and tested clocks add $10.00 to kit price. Specify 12 or 24 hr. format

Car Clock



The UN-KIT, only 5 solder connections

Here's a super looking, rugged and accurate auto clock, which is a snap to build and install. Clock movement is completely assembled — you only solder 3 wires and 2 switches, takes about 15 minutes! Display is bright green with automatic brightness control photocell — assures you of a highly readable display, day or night. Comes in a satin finish anodized aluminum case which can be attached 5 different ways using 2 sided tape. Choice of silver, black or gold case (specify).

DC-3 kit, 12 hour format $22.95
DC-3 wired and tested $29.95

Calendar Alarm Clock

The clock that's got it all: 6-.5" LEDs, 12/24 hour, snooze, 24 hour alarm, 4 year calendar, battery backup, and lots more. The super 7001 chip is used. Size: 5x4x2 inches. Complete kit, less case (not available)

DC-9 $34.95

Under Dash Car Clock

12/24 hour clock in a beautiful plastic case features 6 jumbo RED LEDS, high accuracy (.001%), easy 3 wire hookup, display blanks with ignition, and super instructions. Optional dimmer automatically adjusts display to ambient light level.

DC-11 clock with mtg. bracket $27.95 kit
DM-1 dimmer adapter $2.50
Add $10.00 Assy. and Test

Video Terminal

A completely self-contained, stand alone video terminal card. Requires only an ASCII keyboard and TV set to become a complete terminal unit. Features are: single 5V supply, XTAL controlled sync and baud rates (to 9600), complete computer and keyboard control of cursor. Parity error control and display. Accepts and generates serial ASCII plus parallel keyboard input. The 6416 is 64 char. by 16 lines with scrolling, upper and lower case (optional) and has RS-232 and 20ma loop interfaces on board. Kits include sockets and complete documentation.

RE 6416, terminal card kit (add $60.00 for wired unit) $189.95
Lower Case option $13.95
Power Supply $14.95
RF Modulator kit $7.95

PARTS PARADE

IC SPECIALS

LINEAR

301	$ .35
324	$1.50
380	$1.50
555	$ .45
556	$1.00
565	$1.00
566	$1.00
567	$1.25
741	10/$2.00
1458	$ .50
3900	$ .50
3914	$2.95
8038	$2.95

CMOS

4011	.50
4013	.50
4046	$1.85
4049	.50
4059	$8.00
4511	$2.00
4518	$1.38
5639	$1.75

TTL

74S00	$ .40
7447	$ .65
7475	$ .50
7490	$ .50
74196	$1.35

SPECIAL

11C90	$15.00
10116	$ 1.25
7208	$17.50
7207A	$ 5.50
7216D	$21.00
7107C	$12.50
5314	$ 2.95
5375AB/G	$ 2.95
7001	$ 6.50

FERRITE BEADS

With info and specs 15/$1.00
6 Hole Balun Beads 5/$1.00

READOUTS

FND 359 .4" C.C.	$1.00
FND 507/510 .5" C.A.	1.00
MAN 72/HP7730 .33" C.A.	1.00
HP 7651 .43" C.A.	2.00

TRANSISTORS

2N3904 NPN	15/$1.00
2N3906 PNP	15/$1.00
2N4403 PNP	15/$1.00
2N4410 NPN	15/$1.00
2N4916 FET	4/$1.00
2N5401 PNP	5/$1.00
2N6028	4/$1.00
2N3771 NPN Silicon	$1.50
2N5179 UHF NPN	3/$2.00
Power Tab NPN 40W	3/$1.00
Power Tab PNP 40W	3/1.00
MPF 102/2N5484	$.50
NPN 3904 Type	50/$2.50
PNP 3906 Type	50/$2.50
2N3055	$.80
2N2646 UJT	3/$2.00

Sockets

8 Pin	10/$2.00
14 Pin	10/$2.00
16 Pin	10/$2.00
24 Pin	4/$2.00
28 Pin	4/$2.00
40 Pin	3/$2.00

Diodes

5.1 V Zener	20/$1.00
1N914 Type	50/$1.00
1KV 2Amp	8/$1.00
100V 1Amp	15/$1.00

25 AMP 100V Bridge **$1.50 each**

Mini-Bridge 50V 1 AMP **2 for $1.00**

Resistor Ass't

Assortment of Popular values - ¼ watt. Cut lead for PC mounting, ½" center, ½" leads, bag of 300 or more. $1.50

Switches

Mini toggle SPDT $1.00
Red Pushbuttons N.O. 3/$1.00

Earphones

3" leads, 8 ohm, good for small tone speakers, alarm clocks, etc. **8 for $1.00**

Mini Speaker

Approx 2½" diam. Round type for radios, mike etc. **3 for $2.00**

Solid State Buzzers

small buzzer 450 Hz, 86 dB, sound output on 5-12 vdc at 10-30 mA, TTL compatible $1.50

Slug Tuned Coils

Small 3/16" Hex Slugs turned coil. 3 turns. **10/$1.00**

AC Outlet

Panel Mount with Leads **4/$1.00**

CAPACITORS

TANTALUM Dipped Epoxy
1.5 µF 25V 3/$1.00
1.8 µF 25V 3/$1.00
.22 µF 25V 3/$1.00

ALUMINUM Electrolytic
1000 uF 16V Radial $.50
500 uF 20V Axial $.50
150 uF 16V Axial 5/$1.00
10 uF 15V Radial 10/$1.00

DISK CERAMIC
01 16V disk 20/$1.00
1 16V 15/$1.00
.001 16V 20/$1.00
100 pF 20/$1.00
.047 16V 20/$1.00

DC-DC Converter

-5 vdc input prod. -9 vdc @ 30ma
-9 vdc produces -15 vdc @ 35ma $1.25

Ceramic IF Filters

Mini ceramic filters 7 KHz B. W. 455KHz **$1.50 ea.**

25K 20 Turn Trim Pot $1.00
1K 20 Turn Trim Pot $ .50

Trimmer Caps

Sprague - 3-40 pf Stable Polypropylene **.50 ea.**

Crystal Microphone

Small 1" diameter ¼" thick crystal mike cartridge $.75

Mini RG-174 Coax

10 ft. for $1.00

Coax Connector

Chassis mount BNC type $1.00

9 Volt Battery Clips

Nice quality clips 5 for $1.00
¾" Rubber Grommets 10 for $1.00

Parts Bag

Asst. of chokes, disc caps, tant. resistors, transistors, diodes, MICA caps etc.
sm. bag (100 pc) $1.00 lg. bag (300 pc) $2.50

Connectors

6 pin type gold contacts for mA-1003 car clock module price .75 ea.

Leds - your choice, please specify
Mini Red, Jumbo Red, High Intensity Red, Illuminator Red 8/$1
Mini Yellow, Jumbo Yellow, Jumbo Green 6/$1

Varactors

Motorola MV 2209 30 PF Nominal cap 20-80 PF - Tunable range - .50 each or 3/$1.00

Crystals

3.579545 MHZ	$1.50
10.00000 MHZ	$5.00
5.248800 MHZ	$5.00

AC Adapters

Good for clocks, nicad chargers, all 110 VAC plug one end

8.5 vdc @ 20 mA	$1.00
16. vac @ 160mA	$2.50
12. vac @ 250mA	$3.00

Audio Prescaler

Make high resolution audio measurments, great for musical instrument tuning, PL tones, etc. Multiplies audio UP in frequency, selectable x10 or x100, gives .01 HZ resolution with 1 sec. gate time! High sensitivity of 25 mv, 1 meg input z and built-in filtering gives great performance. Runs on 9V battery, all CMOS.

PS-2 kit $29.95
PS-2 wired $39.95

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 mtr PWR AMP

Simple Class C power amp features 8 times power gain. 1 W in for 8 out, 2 W in for 15 out, 4W In for 30 out. Max output of 35 W, incredible value, complete with all parts, less case and T-R relay.

PA-1, 30 W pwr amp kit $22.95
TR-1, RF sensed T-R relay kit 6.95

MRF-238 transistor as used in PA-1 8-10db gain 150 mhz $11.95

RF actuated relay senses RF (1W) and closes DPDT relay. For RF sensed T-R relay TR-1 Kit $6.95

Power Supply Kit

Complete triple regulated power supply provides variable 6 to 18 volts at 200 ma and +5 at 1 Amp. Excellent load regulation, good filtering and small size. Less transformers, requires 6.3 V @ 1 A and 24 VCT.

Complete kit, PS-3LT $6.95

OP-AMP Special

BI-FET LF 13741 - Direct pin for pin 741 compatible, but 500,000 MEG input z, super low 50 pa input current, low power drain.

50 for only $9.00 10 for $2.00

Regulators

78MG	$1.25	7812	$1.00
79MG	$1.25	7815	$1.00
723	$.50	7905	$1.25
309K	$1.15	7912	$1.25
7805	$1.00	7915	$1.25

Shrink Tubing Nubs

Nice precut pces of shrink size: 1" x ¼" shrink to ⅛". Great for splices. 50/$1.00

Mini TO-92 Heat Sinks

Thermalloy Brand 5 for $1.00
To-220 Heat Sinks 3 for $1.00

Opto Isolators - 4N28 type $.50 ea.
Opto Reflectors - Photo diode + LED $1.00 ea.

Molex Pins

Molex already precut in length of 7. Perfect for 14 pin sockets. 20 strips for $1.00

COS Photocells

Resistance varies with light, 250 ohms to over 3 meg 3 for $1.00

7400 TTL

SN7400N	.20	SN7470N	.29	SN74160N	.89
SN7401N	.20	SN7472N	.29	SN74161N	.89
SN7402N	.20	SN7473N	.35	SN74162N	1.95
SN7403N	.20	SN7474N	.35	SN74163N	.89
SN7404N	.25	SN7475N	.49	SN74164N	.89
SN7405N	.20	SN7476N	.35	SN74165N	.89
SN7406N	.29	SN7479N	5.00	SN74166N	1.25
SN7407N	.29	SN7480N	.50	SN74167N	1.95
SN7408N	.20	SN7482N	.99	SN74170N	1.59
SN7409N	.20	SN7483N	.69	SN74172N	6.00
SN7410N	.18	SN7485N	.89	SN74173N	1.25
SN7411N	.25	SN7486N	.35	SN74174N	1.00
SN7412N	.25	SN7489N	1.75	SN74175N	1.00
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SN7420N	.20	SN7494N	.65	SN74181N	1.95
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SN7422N	.39	SN7496N	.65	SN74184N	1.95
SN7423N	.25	SN7497N	3.00	SN74185N	1.95
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SN7426N	.29	SN74107N	.35	SN74188N	3.95
SN7427N	.25	SN74109N	.59	SN74190N	1.25
SN7429N	.39	SN74116N	1.95	SN74191N	1.25
SN7430N	.20	SN74121N	.35	SN74192N	.79
SN7432N	.25	SN74122N	.39	SN74193N	.79
SN7437N	.25	SN74123N	.59	SN74194N	.89
SN7438N	.40	SN74125N	.49	SN74195N	.69
SN7439N	.25	SN74126N	.49	SN74196N	.89
SN7440N	.20	SN74132N	.75	SN74197N	.89
SN7441N	.89	SN74136N	.75	SN74198N	1.49
SN7442N	.59	SN74141N	.79	SN74199N	1.49
SN7443N	.75	SN74142N	2.95	SN74S200	4.95
SN7444N	.75	SN74143N	2.95	SN74251N	.99
SN7445N	.75	SN74144N	2.95	SN74279N	.79
SN7446N	.69	SN74145N	.79	SN74283N	2.25
SN7447N	.59	SN74147N	1.95	SN74284N	3.95
SN7448N	.79	SN74148N	1.29	SN74285N	3.95
SN7450N	.20	SN74150N	1.25	SN74365N	.69
SN7451N	.20	SN74151N	.59	SN74366N	.69
SN7453N	.20	SN74152N	.59	SN74367N	.69
SN7454N	.20	SN74153N	.59	SN74368N	.69
SN7459A	.25	SN74154N	1.50	SN74390N	1.95
SN7460N	.20	SN74155N	.79	SN74393N	1.95
		SN74156N	.79		
		SN74157N	.65		

CMOS

CD4000	.39	CD4028	.89	CD4070	.55
CD4001	.39	CD4029	1.49	CD4071	.49
CD4002	.39	CD4030	.49	CD4072	.49
CD4006	1.19	CD4035	.99	CD4076	1.39
CD4007	.25	CD4040	1.49	CD4081	.39
CD4009	.49	CD4041	1.49	CD4082	.39
CD4010	.49	CD4042	.99	CD4093	.99
CD4011	.39	CD4043	.89	CD4098	1.19
CD4012	.25	CD4044	.89	MC14409	14.95
CD4013	.49	CD4046	1.79	MC14410	14.95
CD4014	1.39	CD4047	2.50	MC14411	14.95
CD4015	1.19	CD4048	1.35	MC14419	4.95
CD4016	.59	CD4049	.49	MC14433	13.95
CD4017	1.19	CD4050	.69	MC14506	.75
CD4018	.99	CD4051	1.19	MC14507	.99
CD4019	.49	CD4053	1.19	MC14562	11.95
CD4020	1.19	CD4056	2.95	MC14583	2.49
CD4021	1.39	CD4059	9.95	CD4508	3.95
CD4022	1.19	CD4060	1.49	CD4510	1.39
CD4023	.25	CD4066	.79	CD4511	1.29
CD4024	.79	CD4068	.39	CD4515	2.95
CD4025	.23	CD4069	.45	CD4518	1.29
CD4026	2.95			CD4520	1.29
CD4027	.69			CD4566	2.25

74C00

74C00	.39	74C85	2.49	74C163	2.49
74C02	.39	74C90	1.95	74C164	2.49
74C04	.45	74C93	1.95	74C173	2.60
74C08	.49	74C95	1.95	74C192	2.49
74C10	.39	74C107	1.25	74C193	2.49
74C14	1.95	74C151	2.90	74C195	2.49
74C20	.39	74C154	3.00	74C922	7.95
74C30	.39	74C157	2.15	74C923	6.25
74C42	1.95	74C160	2.49	74C925	8.95
74C48	2.49	74C161	2.49	74C926	8.95
74C73	.89			80C95	1.50
74C74	.89			80C97	1.50

LINEAR

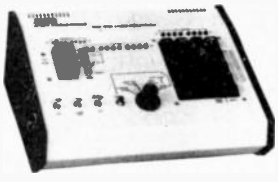
78MG	1.75	LM340K-18	1.35	LM710N	.79
LM106H	.99	LM340K-24	1.35	LM711N	.39
LM300H	.80	LM340T-5	1.25	LM723N/H	.55
LM301CN/H	.35	LM340T-6	1.25	LM733N	1.00
LM302H	.75	LM340T-8	1.25	LM739N	1.19
LM304H	1.00	LM340T-12	1.25	LM741CN/H	.35
LM305H	.60	LM340T-15	1.25	LM741-14N	.39
LM307CN/H	.35	LM340T-18	1.25	LM747N/H	.79
LM308CN/H	1.00	LM340T-24	1.25	LM748N/H	.39
LM309H	1.10	LM358N	1.00	LM1310N	1.95
LM309K	1.25	LM370N	1.95	LM1458CN/H	.59
LM310CN	1.95	LM373N	3.25	MC1488N	1.95
LM311N/H	.90	LM377N	4.00	MC1489N	1.95
LM312H	1.95	LM380N	1.25	LM1496N	.95
LM317K	6.50	LM380CN	.99	LM1556V	1.75
LM318CN/H	1.50	LM381N	1.79	MC1741SCP	3.00
LM319N	1.30	LM382N	1.79	LM2111N	1.95
LM320K-5	1.35	NE501N	8.00	LM2901N	2.95
LM320K-5.2	1.35	NE510A	6.00	LM3053N	1.50
LM320K-12	1.25	NE529A	4.95	LM3065N	1.49
LM320K-15	1.35	NE531H/V	3.95	LM3900N(3401)	.59
LM320K-18	1.35	NE536T	6.00	LM3905N	1.49
LM320K-24	1.35	NE540	6.00	LM3909N	1.25
LM320T-5	1.25	NE544N	4.95	MC5558V	.59
LM320T-5.2	1.25	NE550N	1.30	8038B	4.95
LM320T-8	1.25	NE555V	.39	LM75450N	.49
LM320T-12	1.25	NE556N	.99	75451CN	.39
LM320T-15	1.25	NE560B	5.00	75452CN	.39
LM320T-18	1.25	NE562B	5.00	75453CN	.39
LM320T-24	1.25	NE565N/H	1.25	75454CN	.39
LM323K-5	5.95	NE566CN	1.75	75491CN	.79
LM324N	1.49	NE567V/H	.99	75492CN	.89
LM339N	.99	NE570N	4.95	75493N	.89
LM340K-5	1.35	LM703CN/H	.69	75494CN	.89
LM340K-6	1.35	LM709N/H	.29	RC4136	1.25
LM340K-8	1.35			RC4151	3.95
LM340K-12	1.35			RC4194	4.95
LM340K-15	1.35			RC4195	4.49

74LS00TTL

74LS00	.35	74LS51	.29	74LS139	1.05
74LS01	.35	74LS54	.29	74LS151	1.05
74LS02	.35	74LS55	.29	74LS155	1.05
74LS03	.35	74LS73	.54	74LS157	1.05
74LS04	.42	74LS74	.54	74LS160	1.15
74LS05	.42	74LS75	.71	74LS161	1.39
74LS08	.35	74LS76	.54	74LS162	1.25
74LS09	.42	74LS78	.49	74LS163	1.39
74LS10	.35	74LS83	1.05	74LS164	1.50
74LS11	.75	74LS85	1.50	74LS175	1.25
74LS13	.59	74LS86	.54	74LS181	2.49
74LS14	1.25	74LS90	.71	74LS190	1.39
74LS15	.35	74LS92	.90	74LS191	1.39
74LS20	.35	74LS93	.90	74LS192	1.39
74LS21	.35	74LS95	.99	74LS193	1.39
74LS22	.35	74LS96	1.15	74LS194	1.39
74LS26	.35	74LS107	.54	74LS195	1.39
74LS27	.35	74LS109	.54	74LS253	1.25
74LS28	.35	74LS112	.54	74LS257	1.05
74LS30	.35	74LS123	1.50	74LS258	1.75
74LS32	.42	74LS125	1.05	74LS260	.83
74LS37	.45	74LS132	.99	74LS279	.90
74LS40	.35	74LS136	.59	74LS367	.75
74LS42	1.05	74LS138	1.05	74LS368	.75
74LS47	1.05			74LS670	2.49

JE608 PROGRAMMER

2704/2708 EPROM PROGRAMMER



- 3 separate Display Registers. 8 LED's for Hex Key entries, 16 LED's (2" 2") for Address Register and 8 LED's for Data Memory Register. The Data Memory Register displays the content of the RAMs from the EPROM Chip.
- Development of microprocessor systems by means of a ribbon cable from the programmer panel test socket to the EPROM socket on the microprocessor board.
- Rapid checking verification of programmed data changes.
- User may move data from a master to RAM's or write into RAM's with keyboard entries.
- Allows manual stepping manipulation (up and down) at any address location.
- Stand-alone EPROM Programmer consisting of: A 16-key Hexadecimal Keyboard assembly, Programmer Board assembly with 4 power supplies and a LED/Test Socket Panel Board assembly. The Test Socket is zero force insertion type. Power requirements: 115VAC, 60Hz, 8W
- Compact desk top enclosure: Color-coordinated designer's case with light tan panels and anodized end panels in mocha brown. Size: 3¾"H x 11"W x 9¾"D. Weight: 5 lbs.

The JE608 EPROM Programmer is a completely self contained unit which is independent of computer control and requires no additional systems for its operations. The EPROM can be programmed from the Hexadecimal Keyboard or from a pre-programmed EPROM. The JE608 Programmer can emulate a programmed EPROM by the use of its internal RAM circuits. This will allow the user to test or pretest a program, for a system, prior to programming a chip. Any changes in the program can be entered directly into the memory circuits with the Hexadecimal Keyboard so that rewriting the entire program will not be necessary. The JE608 Programmer contains a Programmer/Board with 25 IC's and including power supplies of −5V, +5V, +12V and +26V. The Hexadecimal Keyboard and LED/Test Socket Panel Board are separate assemblies within the system.

JE608 KIT $399.95
JE608 Assembled and Tested $499.95

DISCRETE LEDS

XC556R	.200"	red	5/$1	MV50	.085"	red	6/$1	XC111R	.190"	red	5/$1
XC556G	.200"	green	4/$1	XC209R	.125"	red	5/$1	XC111G	.190"	green	4/$1
XC556Y	.200"	yellow	4/$1	XC209G	.125"	green	4/$1	XC111Y	.190"	yellow	4/$1
XC556C	.200"	clear	4/$1	XC209Y	.125"	yellow	4/$1	XC111C	.190"	clear	4/$1
XC22R	.200"	red	5/$1	XC526R	.185"	red	5/$1				
XC22G	.200"	green	4/$1	XC526G	.185"	green	4/$1				
XC22Y	.200"	yellow	4/$1	XC526Y	.185"	yellow	4/$1				
MV10B	.170"	red	4/$1	XC526C	.185"	clear	4/$1				

INFRA-RED LED
¼"x¼"x1/16" flat 5/$1

DISPLAY LEDS

TYPE	POLARITY	HT	PRICE	TYPE	POLARITY	HT	PRICE
MAN 1	Common Anode-red	.270	2.95	MAN 6730	Common Anode-red ± 1	.560	.99
MAN 2	5 x 7 Dot Matrix-red	.300	4.95	MAN 6740	Common Cathode-red-D.D.	.560	.99
MAN 3	Common Cathode-red	.125	.25	MAN 6750	Common Cathode-red ± 1	.560	.99
MAN 4	Common Cathode-red	.187	1.95	MAN 6760	Common Anode-red	.560	.99
MAN 7G	Common Anode-green	.300	1.25	MAN 6780	Common Cathode-red	.560	.99
MAN 7Y	Common Anode-yellow	.300	.99	DL701	Common Anode-red ± 1	.300	.99
MAN 72	Common Anode-red	.300	.75	DL704	Common Cathode-red	.300	.99
MAN 74	Common Cathode-red	.300	1.25	DL707	Common Anode-red	.300	.99
MAN 82	Common Anode-yellow	.300	.49	DL728	Common Cathode-red	.500	1.49
MAN 84	Common Cathode-yellow	.300	.99	DL741	Common Anode-red	.600	1.25
MAN 3620	Common Anode-orange	.300	.49	DL746	Common Anode-red ± 1	.630	1.49
MAN 3630	Common Anode-orange ± 1	.300	.99	DL747	Common Anode-red	.600	1.49
MAN 3640	Common Cathode-orange	.300	.99	DL749	Common Cathode-red ± 1	.630	1.49
MAN 4610	Common Anode-orange	.300	.99	DL750	Common Cathode-red	.600	1.49
MAN 4640	Common Cathode-orange	.400	.99	DL338	Common Cathode-red	.110	.35
MAN 4710	Common Anode-red	.400	.99	FND70	Common Cathode	.250	.69
MAN 4730	Common Anode-red ± 1	.400	.99	FND358	Common Cathode ± 1	.357	.99
MAN 4740	Common Cathode-red	.400	.99	FND359	Common Cathode	.357	.75
MAN 4810	Common Anode-yellow	.400	.99	FND503	Common Cathode(FND500)	.500	.99
MAN 4840	Common Cathode-yellow	.400	.99	FND507	Common Anode (FND510)	.500	.99
MAN 6610	Common Anode-orange-D.D.	.560	.99	5082-7730	Common Anode-red	.300	.99
MAN 6630	Common Anode-orange ± 1	.560	.99	HDSP-3400	Common Anode-red	.800	1.50
MAN 6640	Common Cathode-orange-D.D.	.560	.99	HDSP-3403	Common Cathode red	.800	1.50
MAN 6650	Common Cathode-orange ± 1	.560	.99	5082-7300	4 x 7 sgl Digit-RHDP	.600	19.95
MAN 6660	Common Anode-orange	.560	.99	5082-7302	4 x 7 Sgl Digit-LHDP	.600	19.95
MAN 6680	Common Cathode-orange	.560	.99	5082-7304	Overrange character (± 1)	.600	15.00
MAN 6710	Common Anode-red-D.D.	.560	.99	5082-7340	4 x 7 Sgl Digit-Hexadecimal	.600	22.50

RCA LINEAR

CA3013T	2.15	CA3082N	2.00
CA2023T	3.25	CA3083N	1.60
CA3035T	2.48	CA3086N	.85
CA3039T	1.35	CA3089N	3.75
CA3046N	1.30	CA3130T	1.39
CA3059N	3.25	CA3140T	1.25
CA3060N	3.25	CA3160T	1.25
CA3080T	1.25	CA3401N	.59
CA3081N	2.00	CA3600N	3.50

CALCULATOR CHIPS/DRIVERS

MM5725	$2.95
MM5738	2.95
DM8864	2.00
DM8865	1.00
DM8887	.75
DM8889	.75
9374 7-seg. LED driver	1.50
MM5309	4.95

CLOCK CHIPS

MM5309	4.95
MM5311	4.95
MM5312	4.95
MM5314	4.95
MM5316	6.95
MM5318	9.95
MM5369	2.95
MM5387/1998A	4.95
CT 7001	6.95

MOTOROLA

MC1408L7	4.95
MC1408L8	5.75
MC1439L	2.95
MC3022P	2.95
MC3061P	3.50
MC4016(74416)	7.50
MC4024P	3.95
MC4040P	6.95
MC4044P	4.50

LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100
8 pin LP	.17	.16	.15
14 pin LP	.20	.19	.18
16 pin LP	.22	.21	.20
18 pin LP	.29	.28	.27
20 pin LP	.34	.32	.30
22 pin LP	.37	.36	.35
24 pin LP	.38	.37	.36
28 pin LP	.45	.44	.43
36 pin LP	.60	.59	.58
40 pin LP	.63	.62	.61

SOLDERTAIL STANDARD (TIN)

	1-24	25-49	50-100
14 pin ST	.27	.25	.24
16 pin ST	.30	.27	.25
18 pin ST	.35	.32	.30
24 pin ST	.49	.45	.42
28 pin ST	.99	.90	.81
36 pin ST	1.39	1.26	1.15
40 pin ST	1.59	1.45	1.30

SOLDERTAIL (GOLD) STANDARD

	1-24	25-49	50-100
8 pin SG	.39	.35	.31
14 pin SG	.49	.45	.41
16 pin SG	.54	.49	.44
18 pin SG	.59	.53	.48
24 pin SG	.79	.75	.69
28 pin SG	1.10	1.00	.90
36 pin SG	1.65	1.40	1.26
40 pin SG	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

	1-24	25-49	50-100
8 pin WW	.59	.54	.49
10 pin WW	.69	.63	.58
14 pin WW	.79	.73	.67
16 pin WW	.85	.77	.70
18 pin WW	.99	.90	.81
20 pin WW	1.19	1.08	.99
22 pin WW	1.49	1.35	1.23
24 pin WW	1.39	1.26	1.14
28 pin WW	1.69	1.53	1.38
36 pin WW	2.19	1.99	1.79
40 pin WW	2.29	2.09	1.89

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ASST. 1	5 ea	10 OHM	12 OHM	15 OHM	18 OHM	22 OHM		
		27 OHM	33 OHM	39 OHM	47 OHM	56 OHM	50 PCS	$1.75
ASST. 2	5 ea	68 OHM	82 OHM	100 OHM	120 OHM	150 OHM		
		180 OHM	220 OHM	270 OHM	330 OHM	390 OHM	50 PCS	1.75
ASST. 3	5 ea	470 OHM	560 OHM	680 OHM	820 OHM	1K		
		1.2K	1.5K	1.8K	2.2K	2.7K	50 PCS	1.75
ASST. 4	5 ea	3.3K	3.9K	4.7K	5.6K	6.8K		
		8.2K	10K	12K	15K	18K	50 PCS	1.75
ASST. 5	5 ea	22K	27K	33K	39K	47K		
		56K	68K	82K	100K	120K	50 PCS	1.75
ASST. 6	5 ea	150K	180K	220K	270K	330K		
		390K	470K	560K	680K	820K	50 PCS	1.75
ASST. 7	5 ea	1M	1.2M	1.5M	1.8M	2.2M		
		2.7M	3.3M	3.9M	4.7M	5.6M	50 PCS	1.75

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TL494CN	Switching Regulator	4.49
TL496CP	Single Switching Regulator	1.75
11C90	Divide 10/11 Prescaler	19.95
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XR215	4.40			XR2556	3.20
XR320	1.55			XR2567	2.99
XR-L555	1.50	XR2206KB	19.95	XR3403	1.25
XR555	.39	XR1800	3.20	XR4136	1.25
XR556	.99	XR2206	4.40	XR4151	3.95
XR567CP	.99	XR2207	3.85	XR4194	1.45
XR567CT	1.25	XR2208	5.20	XR4202	3.60
XR1310P	1.95	XR2209	1.75	XR4212	2.05
XR1468CN	3.85	XR2211	5.25	XR4558	.75
XR1488	1.95	XR2212	4.35	XR4739	1.15
XR1489	1.95	XR2240	3.45	XR4741	1.47

DIODES

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
				1N4002	100 PIV	1 AMP	12/1.00
				1N4003	200 PIV	1 AMP	12/1.00
1N746	3.3	400m	4/1.00	1N4004	400 PIV	1 AMP	12/1.00
1N751	5.1	400m	4/1.00	1N4005	600 PIV	1 AMP	10/1.00
1N752	5.6	400m	4/1.00	1N4006	800 PIV	1 AMP	10/1.00
1N753	6.2	400m	4/1.00	1N4007	1000 PIV	1 AMP	10/1.00
1N754	6.8	400m	4/1.00	1N3600	50	200m	6/1.00
1N757	9.0	400m	4/1.00	1N4148	75	10m	15/1.00
1N759	12.0	400m	4/1.00	1N4154	35	10m	12/1.00
1N959	8.2	400m	4/1.00	1N4733	5.1	1w	.28
1N965	15	400m	4/1.00	1N4734	5.6	1w	.28
1N5232	5.6	500m	.28	1N4735	6.2	1w	.28
1N5234	6.2	500m	.28	1N4736	6.8	1w	.28
1N5235	6.8	500m	.28	1N4738	8.2	1w	.28
1N5236	7.5	500m	.28	1N4742	12	1w	.28
1N5242	12	500m	.28	1N4744	15	1w	.28
1N5245	15	500m	.28	1N1183	50 PIV	35 AMP	1.60
1N456	25	40m	6/1.00	1N1184	100 PIV	35 AMP	1.70
1N458	150	7m	6/1.00	1N1185	150 PIV	35 AMP	1.70
1N485A	180	10m	5/1.00	1N1186	200 PIV	35 AMP	1.80
1N4001	50 PIV	1 AMP	12/1.00	1N1188	400 PIV	35 AMP	3.00

SCR AND FW BRIDGE RECTIFIERS

C36D	15A @ 400V	SCR(2N1849)	$1.95
C38M	35A @ 600V	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

C106B1	.50			2N3904	4/1.00
MPSA05	.30	2N3055	.99	2N3905	4/1.00
MPSA06	5/1.00	MJE3055	1.00	2N3906	4/1.00
TIS97	6/1.00	2N3392	5/1.00	2N4013	3/1.00
TIS98	6/1.00	2N3398	5/1.00	2N4123	6/1.00
40409	1.75	PN3567	3/1.00	PN4249	4/1.00
40410	1.75	PN3568	4/1.00	PN4250	4/1.00
40673	1.75	PN3569	4/1.00	2N4400	4/1.00
2N918	4/1.00	MPS3638A	5/1.00	2N4401	4/1.00
2N2219A	2/1.00	MPS3702	5/1.00	2N4402	4/1.00
2N2221A	4/1.00	2N3704	5/1.00	2N4403	4/1.00
2N2222A	5/1.00	MPS3704	5/1.00	2N4409	5/1.00
PN2222 Plastic	7/1.00	2N3705	5/1.00	2N5086	4/1.00
2N2369A	4/1.00	MPS3705	5/1.00	2N5087	4/1.00
MPS2369	5/1.00	2N3706	5/1.00	2N5088	4/1.00
2N2484	4/1.00	MPS3706	5/1.00	2N5089	4/1.00
2N2906	4/1.00	2N3707	5/1.00	2N5129	5/1.00
2N2907	5/1.00	2N3711	5/1.00	PN5134	5/1.00
		2N3724A	.65	PN5138	5/1.00
2N2925	5/1.00	2N3725A	1.00	2N5139	5/1.00
MJE2955	1.25	2N3772	2.25	2N5210	5/1.00
2N3053	2/1.00	2N3823	1.00	2N5449	3/1.00
		2N3903	5/1.00	2N5951	3/1.00

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

	1-9	10-99	100+		1-9	10-99	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	.08
.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	.39	.31	.25	1.5/35V	.41	.33	.25
.15/35V	.39	.31	.25	2.2/35V	.51	.41	.33
.22/35V	.39	.31	.25	3.3/25V	.53	.43	.34
.33/35V	.39	.31	.25	4.7/25V	.63	.51	.41
.47/35V	.39	.31	.25	6.8/25V	.79	.63	.50
.68/35V	.39	.31	.25	15/25V	1.39	1.12	.89
1.0/35V	.39	.31	.25	22/6V	.79	.63	.50

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	.14	.12	.09	1.0/16V	.15	.13	.10
4.7/25V	.15	.13	.10	1.0/25V	.16	.14	.11
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	.25

CIRCLE 23 ON FREE INFORMATION CARD

ULTRAVIOLET INTENSITY METER

new

by BLAK-RAY

TWO MODELS: LONG WAVE AND SHORT WAVE

Meter consists of a sensor cell attached to a compact (3" x 3¼" x 3") metering unit. Can be hand-held or placed directly on surface for measuring. Can be used remotely, while connected to a meter housing by a 4-foot extension cord. Two models available – one for long wave and one for short wave ultraviolet. Readings are in microwatts per square centimeter. Weight: 1 lb.

Completely assembled (includes sensor cell, reduction screen, extension cord, contrast filter and certification report.)

J-221 LONG WAVE (300nm-400nm) **$242.00**

J-225 SHORT WAVE (200nm-280nm) **$260.00**

CSC CONTINENTAL SPECIALTIES

Proto Clips

14-PIN CLIP	PC-14	$ 4.50
16-PIN CLIP	PC-16	$ 4.75
24-PIN CLIP	PC-24	$10.00
40-PIN CLIP	PC-40	$16.00

Proto Boards

PB-6	$17.95
PB-100	19.95
PB-101	22.95
PB-102	26.95
PB-103	44.95
PB-104	55.95
PB-203	99.95
PB-203A	155.00
PB-203A-Kit	131.00

Jumbo 6-Digit Clock Kit

- Four .630"ht. and two .300"ht. common anode displays
- Uses MM5314 clock chip
- Switches for hours, minutes and hold functions
- Hours easily viewable to 30 feet
- Simulated walnut case
- 115 VAC operation
- 12 or 24 hour operation
- Includes all components, case and wall transformer
- Size: 6¾ x 3¾ x 1¾

JE747 ..... **$29.95**

- Bright .300 ht. comm. cathode display
- Uses MM5314 clock chip
- Switches for hours, minutes and hold modes
- Hrs. easily viewable to 20 ft.
- Simulated walnut case
- 115 VAC operation
- 12 or 24 hr. operation
- Incl. all components, case & wall transformer
- Size: 6¾" x 3-1/8" x 1¾"

JE701

6-Digit Clock Kit **$19.95**

Regulated Power Supply

Uses LM309K. Heat sink provided. PC board construction. Provides a solid 1 amp @ 5 volts. Can supply up to ±5V, ±9V and ±12V with JE205 Adapter. Includes components, hardware and instructions. Size: 3½" x 5" x 2"H

JE200 ..... **$14.95**

ADAPTER BOARD —Adapts to JE200— ±5V, ±9V and ±12V

DC/DC converter with +5V input. Toriodal hi-speed switching XMFR. Short circuit protection. PC board construction. Piggy-back to JE 200 board. Size: 3½" x 2" x 9/16"H

JE205 ..... **$12.95**

MICROPROCESSOR COMPONENTS

8080A/8080A SUPPORT DEVICES		
8080A	CPU	$ 7.95
8212	8-Bit Input/Output	3.25
8214,	Priority Interrupt Control	5.95
8216	Bi-Directional Bus Driver	3.49
8224	Clock Generator/Driver	3.95
8226	Bus Driver	3.49
8228	System Controller/Bus Driver	4.95
8238	System Controller	5.95
8251	Prog. Comm. I/O (USART)	7.95
8253	Prog. Interval Timer	14.95
8255	Prog. Periph. I/O (PPI)	9.95
8257	Prog. DMA Control	19.95
8259	Prog. Interrupt Control	19.95
6800/6800 SUPPORT DEVICES		
MC6800	MPU	$14.95
MC6802CP	MPU with Clock and Ram	24.95
MC6810API	128X8 Static Ram	5.95
MC6821	Periph. Inter. Adapt (MC6820)	7.49
MC6828	Priority Interrupt Controller	12.95
MC6830L8	1024X8 Bit ROM (MC68A30-8)	14.95
MC6850	Asynchronous Comm. Adapter	7.95
MC6852	Synchronous Serial Data Adapt.	9.95
MC6860	0-600 bps Digital MODEM	12.95
MC6862	2400 bps Modulator	14.95
MC6880A	Quad 3-State Bus Trans. (MC8726)	2.25
MICROPROCESSOR CHIPS—MISCELLANEOUS		
Z80(780C)	CPU	$13.95
Z80A(780-1)	CPU	15.95
CDP1802	CPU	19.95
2650	MPU	19.95
6502	CPU	11.95
8035	8-Bit MPU w/clock, RAM, 1/0 lines	19.95
P8085	CPU	19.95
TMS9900JL	16-Bit MPU w/hardware, multiply & divide	49.95
SHIFT REGISTERS		
MM500H	Dual 25 Bit Dynamic	$.50
MM503H	Dual 50 Bit Dynamic	.50
MM504H	Dual 16 Bit Static	.50
MM506H	Dual 100 Bit Static	.50
MM510H	Dual 64 Bit Accumulator	.50
MM5016H	500/512 Bit Dynamic	.89
2504†	1024 Dynamic	3.95
2518	Hex 32 Bit Static	4.95
2522	Dual 132 Bit Static	2.95
2524	512 Static	.99
2525	1024 Dynamic	2.95
2527	Dual 256 Bit Static	2.95
2528	Dual 250 Static	4.00
2529	Dual 240 Bit Static	4.00
2532	Quad 80 Bit Static	2.95
3341	Fifo	6.95
74LS670	4X4 Register File (TriState)	2.49
UART'S		
A-Y-5-1013	30K BAUD	5.95

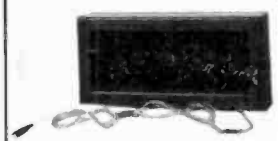
MICROPROCESSOR MANUALS		
M-Z80	User Manual	$7.50
M-CDP1802	User Manual	7.50
M-2650	User Manual	5.00
ROM'S		
2513(2140)	Character Generator(upper case)	$9.95
2513(3021)	Character Generator(lower case)	9.95
2516	Character Generator	10.95
MM5230N	2048-Bit Read Only Memory	1.95
RAM'S		
1101	256X1 Static	$1.49
1103	1024X1 Dynamic	.99
2101(8101)	256X4 Static	3.95
2102	1024X1 Static	1.75
21L02	1024X1 Static	1.95
2111(8111)	256X4 Static	3.95
2112	256X4 Static MOS	4.95
2114	1024X4 Static 450ns	7.95
2114L	1024X4 Static 450ns low power	10.95
2114-3	1024X4 Static 300ns	10.95
2114L-3	1024X4 Static 300ns low power	11.95
5101	256X4 Static	7.95
5280/2107	4096X1 Dynamic	4.95
7489	16X4 Static	1.75
74S200	256X1 Static Tristate	4.95
93421	256X1 Static	2.95
UPD414 (MK4027)	4K Dynamic 16 pin	4.95
UPD416 (MK4116)	16K Dynamic 16 pin 250ns	7.95
TMS4044 45NL	4K Static	14.95
TMS4045	1024X4 Static	14.95
2117	16,384X1 Dynamic 350ns (house marked)	9.95
MM5262	2KX1 Dynamic	4/1.00
PROM'S		
1702A	2048 FAMOS	$5.95
2716(INTEL	16K* EPROM	59.95
TMS2516	16K* EPROM	24.95
(2716)	*Requires single +5V power supply	
TMS2532	4KX8 EPROM	89.95
2708	8K EPROM	10.95
2716 T.I	16K** EPROM	29.95
	**Requires 3 voltages, —5V, +5V, +12V	
5203	2048 FAMOS	14.95
6301-1(7611)	1024 Tristate Bipolar	3.49
6330-1(7602)	256 Open C Bipolar	2.95
82S23	32X8 Open Collector	3.95
82S115	4096 Bipolar	19.95
82S123	32X8 Tristate	3.95
74186	512 TTL Open Collector	9.95
74188	256 TTL Open Collector	3.95
74S287	1024 Static	2.95

Function Generator Kit

Provides 3 basic waveforms: sine, triangle and square wave. Freq. range from 1 Hz to 100K Hz. Output amplitude from 0 volts to over 6 volts (peak to peak). Uses a 12V supply or a ±6V split supply. Includes chip, P.C. Board, components & instructions.

JE2206B **$19.95**

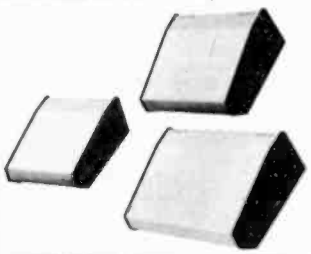
DIGITAL THERMOMETER KIT



- Dual sensors—switching control for indoor/outdoor or dual monitoring
- Continuous LED .8" ht. display
- Range: -40°F to 199°F / -40°C to 100°C
- Accuracy: ±1° nominal
- Set for Fahrenheit or Celsius reading
- Sim. walnut case - AC wall adapter incl.
- Size: 3-1/4"H x 6-5/8"W x 1-3/8"D

JE300 ..... **$39.95**

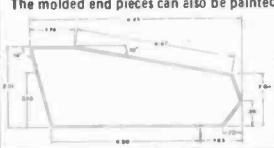
DESIGNERS' SERIES Blank Desk-Top Electronic Enclosures



- High strength epoxy molded end pieces in mocha brown finish.
- Sliding rear/bottom panel for service and component accessibility.
- Top / bottom panels .080 thk alum. Alodine type 1200 finish (gold tint color) for best paint adhesion after modification.
- Vented top and bottom panels for cooling efficiency.
- Rigid construction provides unlimited applications.

CONSTRUCTION:

The "DTE" Blank Desk Top Electronic Enclosures are designed to blend and complement today's modern computer equipment and can be used in both industrial and home. The end pieces are precision molded with an internal slot (all around) to accept both top and bottom panels. The panels are then fastened to ¼" thick tabs inside the end pieces to provide maximum rigidity to the enclosure. For ease of equipment servicing, the rear/bottom panel slides back on slotted tracks while the rest of the enclosure remains intact. Different panel widths may be used while maintaining a common profile outline. The molded end pieces can also be painted to match any panel color scheme.



Enclosure Model No.	Panel Width	PRICE
DTE-8	8.00"	$29.95
DTE-11	10.65"	$32.95
DTE-14	14.00"	$34.95

$10.00 Min. Order — U.S. Funds Only
Calif. Residents Add 6% Sales Tax
Postage — Add 5% plus $1 Insurance (if desired)

Spec Sheets — 25¢
1980 Catalog Available — Send 41¢ stamp

FREE 1980 CATALOG

Jameco ELECTRONICS

PHONE ORDERS WELCOME (415) 592-8097

MAIL ORDER ELECTRONICS — WORLDWIDE
1355 SHOREWAY ROAD, BELMONT, CA 94002
PRICES SUBJECT TO CHANGE

8/80

The Incredible "Pennywhistle 103"

$139.95 Kit Only

The Pennywhistle 103 is capable of recording data to and from audio tape without critical speed requirements for the recorder and it is able to communicate directly with another modem and terminal for telephone "hamming" and communications. In addition, it is free of critical adjustments and is built with non-precision, readily available parts.

Data Transmission Method	Frequency-Shift Keying, full-duplex (half-duplex selectable)
Maximum Data Rate	300 Baud.
Data Format	Asynchronous Serial (return to mark level required between each character).
Receive Channel Frequencies	2025 Hz for space, 2225 Hz for mark
Transmit Channel Frequencies	Switch selectable: Low (normal) = 1070 space, 1270 mark; High = 025 space, 2225 mark.
Receive Sensitivity	-46 dbm accoustically coupled.
Transmit Level	-15 dbm nominal. Adjustable from -6 dbm to -20 dbm.
Receive Frequency Tolerance	Frequency reference automatically adjusts to allow for operation between 1800 Hz and 2400 Hz.
Digital Data Interface	EIA RS-232C or 20 mA current loop (receiver is optoisolated and non-polar).
Power Requirements	120 VAC, single phase, 10 Watts.
Physical	All components mount on a single 5" by 9" printed circuit board. All components included.

Requires a VOM, Audio Oscillator, Frequency Counter and/or Oscilloscope to align.

TRS-80 16K Conversion Kit

Expand your 4K TRS-80 System to 16K.
Kit comes complete with:
- 8 each UPD416-1 (16K Dynamic Rams) 250NS
- Documentation for conversion

TRS-16K **$59.95**

JE610 ASCII Encoded Keyboard Kit

The JE610 ASCII Keyboard Kit can be interfaced into most any computer system. The kit comes complete with an industrial grade keyboard switch assembly (62-keys), IC's, sockets, connector, electronic components and a double-sided printed wiring board. The keyboard assembly requires +5V @ 150mA and -12V @ 10mA for operation. Features: 60 keys generate the full 128 characters, upper and lower case ASCII set. Fully buffered. Two user-define keys provided for custom applications. Caps lock for upper-case-only alpha characters. Utilizes a 2376 (40-pin) encoder read-only memory chip. Outputs directly compatible with TTL/DTL or MOS logic arrays. Easy interfacing with a 16-pin dip or 18-pin edge connector.

JE610 (Case not included) **$79.95**

Desk-Top Enclosure for JE610 ASCII Encoded Keyboard Kit

Compact desk-top enclosure: Color-coordinated designer's case with light tan aluminum panels and molded end pieces in mocha brown. Includes mounting hardware. Size: 3½"H x 14½"W x 8¾"D.

DTE-AK $49.95

SPECIAL: JE610/DTE-AK PURCHASED TOGETHER (Value $129.90) $124.95

JE600 Hexadecimal Encoder Kit

FULL 8-BIT LATCHED OUTPUT
19-KEY KEYBOARD

The JE600 Encoder Keyboard Kit provides two separate hexadecimal digits produced from sequential key entries to allow direct programming for 8-bit microprocessor or 8-bit memory circuits. Three additional keys are provided for user operations with one having a bistable output available. The outputs are latched and monitored with 9 LED readouts. Also included is a key entry strobe. Features: Full 8-bit latched output for microprocessor use. Three user-define keys with one being bistable operation. Debounce circuit provided for all 19 keys. 9 LED readouts to verify entries. Easy interfacing with standard 16-pin IC connector. Only +5VDC required for operation.

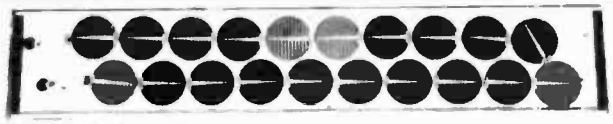
JE600 (Case not included) **$59.95**

Desk-Top Enclosure for JE600 Hexadecimal Keyboard Kit

Compact desk-top enclosure: Color-coordinated designer's case with light tan aluminum panels and molded end pieces in mocha brown. Includes mounting hardware. Size: 3½"H x 8¼"W x 8¾"D.

DTE-HK $44.95

SPECIAL: JE600/DTE-HK PURCHASED TOGETHER (Value $104.90) $99.95



Electricity from the sun.
5 Volt panel ¼ amp $50 2.5 Volt panel ½ amp $40
GIANT 3½ inch cell, delivers 1 amp $8.50
Above cell with special motor & prop, runs in sun $10.25

Computer video monitor chassis 9 inch, 12 volt used $40
Computer video monitor chassis 12 inch, new $50
Hy Gain CB chassis, trunk mount $9.00

Govt surplus walky talky, used cond. 47-55.4 mc range. Ant. $5 each extra. With data.

$25 ea 2 for $45

AN/PRC-6

SEE IN THE DARKNESS
IR viewer, portable, new with choice of one lens...close up, telephoto or gen. purpose. Requires 6 volt DC btry. $250

Parallel ASCII-II Keyboard
Unused $50.00
Red LED's large ..... 10/$1.00

Shipping extra on all merchandise

Meshna Inc., PO Box 62, E. Lynn, Mass. 01904

CIRCLE 4 ON FREE INFORMATION CARD

INTERNATIONAL ELECTRONICS UNLIMITED

.4" ORANGE LED DISPLAY, 7 segment RHD
MAN4610 - common anode
MAN4640 - common cathode
$1.19ea, 10/$7.95, 25/$17.50, 100/$65.00

.4" ORANGE overflow ±1
MAN4630 - common anode
$.89ea, 10/$5.95

.3" RED LED DISPLAY, 7 segment RHD
XAN72(MAN72 equiv) common anode
$.99ea, 10/$7.95, 25/$17.50, 100/$65.00

JUMBO RED LED .20" diffused — 10/$1.00, 25/$2.00
SUBMIN RED LED .125" diffused — 100/$7.50
JUMBO GREEN LED .20" diffused — 7/$1.00, 25/$2.85
SUBMIN GREEN LED .125" diffused — 100/$9.75

Rohm — METAL FILM RESISTORS

		ea	pk-10	pk-25	pk-100
R-OHM RB60FY (RN60) ±1% 50ppm/°C 1/4w MIL-R-10509 250V/70°C .138" dia X .355" long (body) ALL STANDARD DECADE VALUES FROM 10ohm to 475K	1-999	.25	1.50	2.25	7.50
	1000-	.25	1.25	2.10	7.25
	5000-	.25	1.00	1.90	6.75
	10000-	.25	.95	1.75	6.00

.5" RED LED DISPLAY, 7 segment RHD FND500 Common Cathode
$.89ea., 10/$7.75, 25/$17.00, 100/$62.00

LINEAR CIRCUITS 1/2 PRICE SALE

	REG.	SALE		REG.	SALE
LM300H	$.59	$.30	LM376CN	$.50	$.25
LM301CN	.32	.16	LM380-8	.80	.45
LM302H	.59	.30	LM565N	1.15	.58
LM307CN	.32	.16	LM709H	.39	.20
LM308H	.79	.40	LM733H	.89	.45
LM308CN	.79	.40	LM739N	.89	.45
LM309H	1.05	.53	LM748CN	.35	.18
LM310CN	1.07	.54	LM1414N	1.25	.63
LM311H	.89	.45	LM1800N	2.40	1.20
LM311CN	.89	.45	75453CN		
LM311N	.89	.45	(351CN)	.35	.18
LM322N	.89	.45	75491N	.75	.38
LM340T-6V (7806)	1.19	.60	75492N	.89	.45

I.C. SPECIALS

8038N	$2.75ea.
LM556N	.75ea.
LM567CN	.95ea.
LM1458CN	.45ea.
LM555CN	.45ea.
XR320N	.85ea.

TRANSISTORS

2N3904 NPN TO-92	10/$1.50
2N3906 PNP TO-92	25/$3.00
	100/$11.00

IC BREADBOARD
2 5/16" X 6 9/16" UNIVERSAL BREADBOARD
3 3/16" X 5 1/16"
$1.15ea. 10/$10.00 100/$75.00

DIODES

1N4148	400mw	15/$1.00 100/$5.00
1N4001	rectifier	12/$1.00 100/$7.00
1N4007	rectifier	10/$1.00 100/$9.00

DIPSWITCH - 4 sw 8 pin DIP SPST
1-9 $1.65ea
10-24 1.55ea
25- 1.49ea

DIPSWITCH - 8 sw 16 pin DIP SPST
1-9 $2.10ea
10-24 1.95ea
25- 1.85ea

CLOCK CHIP MM5375AA 4-6 digit 60hz 12hr alarm 24 pin
$1.95 10/$17.50 100/$150.00

REGULATED POWER SUPPLY
provides simultaneous outputs of plus & minus 5V, 12V, & 15V. uses 115/29VCT transformer - 1Amp total output. kit includes PC board (2 1/8" X 3 15/16"), all parts incl transformer, schematic & layout dwg.
$14.95ea
10-24 13.50ea
25- 12.50ea

UART 1602B $3.95ea 10/$35.00 100/$275.00

CRYSTAL CONTROLLED TIME BASE KIT
provides accurate 1 hz, 10 hz & 60 hz double buffered outputs from 9VDC input. CMOS compatible. kit includes PC board, (1 5/8" X 3"), all parts (except battery), schematic, layout dwg, & instructions.
$15.50ea
10-24 13.75ea
25- 12.50ea

Payment by check, M.O., UPS-COD, M/C or VISA. Add $1.00 shipping/handling in US, Canada & Mexico. Other countries $1.00 + 5% of order. California residents add sales tax. Minimum order $10.00

INTERNATIONAL ELECTRONICS UNLIMITED
225 Broadway Jackson Ca 95642
phone 209 223 3870

CIRCLE 47 ON FREE INFORMATION CARD

DIGITAL MULTIMETERS

Sinclair PDM35 Reg. $69.95 $49.95

Hickok LX303 $69.50

B&K PRECISION 3½-Digit Portable DMM Model 2800

Beckman TECH310 $140.

MURAPHONE Cordless Telephone System

Reg. $89.95 $74.95

GTE Flip-Phone $37.95

Portable VOM Multitester

Model VM520 $19.95
• 20 KΩ VDC • 10 KΩ VAC

HICKOK Digital CB In-Line Tester

$169.95 Reg. $399.00 Model 388

100 MHz 8-Digit Counter

• 20 Hz to 100 MHz range • LED display • Fully automatic
Model MAX100 Reg. $150.00 $127.50

6" x 9" 3-Way Speaker

• 20 oz. ceramic magnet
Model 8P2000-69TR $14.95 ea.

CSC Logic Monitor

• Automatically displays static and dynamic logic • Works with DTL, HTL, TTL, and CMOS • 16 LED display
Model LM-1 $59.95

Telephone Answering CODE-A-PHONE

Model 1500 Call Control Reg. $349.95 $249.95
Model 1400 $199.95

FREE

8 pc. Tool Set (value $14.95) with $200.00 purchase from this ad.

Portable Oscilloscopes

15 MHz Dual Trace Triggered Miniscope $389.95 Reg. $465.45 Model MS-215

15 MHz Triggered Miniscope Model MS-15 Reg. $349.80 $289.95

30 MHz Dual Trace Triggered Miniscope Model MS-230 Reg. $598.15 $499.95

CSC Function Generator

Model 2001 Reg. $185.95 $157.95
• Sine-, square-, triangle- and separate TTL square wave output • Frequency range: 1Hz-100KHz

Attache Style Tool Case

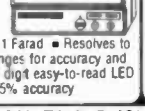
Weller® Xcelite®
Model TC100ST Reg. $499.95 $299.95

Service Master Tool Kit

Model 99-SM Reg. $79.95 $49.95

B&K PRECISION Portable Digital Capacitance Meter

Model 820
• Measures capacitance from 0.1pF to 1 Farad • Resolves to 0.1pF • 10 ranges for accuracy and resolution • 4 digit easy-to-read LED display • 0.5% accuracy



WAHL ISOTIP 60 Cordless Soldering Iron

$29.95 Model 7800

Thermal-Spot Circuit Tester $29.95

Model 5400

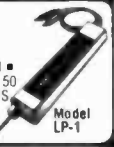
Miniature High Fidelity 3-Way Stereo Speakers

$69.50 PR Reg. $149.95

Model HF-9

CSC Logic Probe

• Compact circuit powered • Detects pulses as short as 50 μsec • DTL/TTL/HTL/CMOS compatibility $44.95



Model LP-1

Proto Preassembled Boards

Model PB-104 $49.95
Fully assembled breadboard contains four QT-59S sockets, seven QT-59B bus strips and four 5-way binding posts

CSC Proto Board with Built-in Power Supplies

• Regulated • Short-proof
Reg. $154.95 $129.95 Model PB-203A

CSC 3½-Digit 0.1% Digital Capacitance Meter Model 3001

• 9 ranges from 1999 pF to 199.9 μF • 0.1% of reading accuracy
Reg. $190.00 $170

DIGITAL MULTIMETER Simpson 461

Complete with nickel-cadmium batteries, AC charger/adapter, test leads $149.95

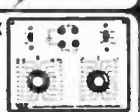
In-Dash Car Stereos

8-Track Tape Player with AM/FM/MPX Radio
Model C-777 $52.50

Cassette Tape Player with AM/FM/MPX Radio
Model CAS-888 $57.50

RC Circuit Box

• 36 resistors (15 Ω to 10 MΩ) • 18 capacitors (100 pf to 0.22 μf)
Reg. $49.95 includes test leads $42.



VIZ Model WC 412A

Magnifier Lamp

Precision ground and polished magnification lens $49.50
Model MG10A

30 MHz LEADER Dual Trace with Delay Line

$899.95 Model LBO-520

BSR X-10

Remote Control for Lights & Appliances

4 Pc Standard Starter Kit • One (1) Standard Command Console • Two (2) Lamp Modules • One (1) Appliance Module Reg. $87.95 $79.50

5 Pc Ultrasonic Starter Kit • One (1) Deluxe Ultrasonic Command Console • One (1) Hand Held Remote Unit • Two (2) Lamp Modules • One (1) Appliance Unit Reg. $112.95 $99.95

Lamp Modules $14.50 Standard Command Console $36.00
Appliance Modules $14.50 Ultrasonic Command Console with Hand Held Remote $59.95
Wall Switch Modules $14.50

Stereo Power Booster

Model POW-40
• 40W stereo
$24.95

Chess Challenger 7

Reg. $110.00 Model BBC $79.95

Weller® Controlled Output Soldering Station

Model WTCPN Reg. $77.50 $54.95

B&K PRECISION 30 MHz Portable Frequency Counter

Reg. $130.00 $65. Model 1827

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over 1000.00	12.50

COD's extra

TOLL FREE (800)645-9518
in N.Y. State call (516) 752-0050

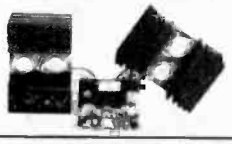
CIRCLE 91 ON FREE INFORMATION CARD

100 W CLASS A POWER AMP KIT

Dynamic Bias Class "A" circuit design makes this unit unique in its class. Crystal clear, 100 watts power output will satisfy the most picky fans. A perfect combination with the TA-1020 low T.I.M. stereo pre-amp.

Specifications:

- Output power: 100W RMS into 8-ohm
  125W RMS into 4-ohm
- Frequency response: 10Hz - 100 KHz
- T.H.D.: less than 0.008%
- S/N ratio: better than 80dB
- Input sensitivity: IV max.
- Power supply: ±40V @ 5 amp



TA-1000 KIT $51.95

Power transformer $15.00 each

PROFESSIONAL 10 OCTAVE STEREO GRAPHIC EQUALIZER!!

Graphic equalizer have been used for years in sound studios and concert arenas but were too expensive to be considered for home use. Now we offer you the facility at an affordable price. This unit can extend your control of your Hi-Fi system by minimizing the non-linearities of the combined speaker/room system. Fantastic features as follows:

- 10 double slide controls for two channels
- Cut out rumble, surface noise and hiss
- Minimizes speaker/room non-linearities
- Frequency response from 30Hz to 16KHz
- 10 tone controls plus defeat, monitor and tape selector.
- Control range ± 12dB in 10 octaves (30Hz, 60Hz, 120Hz, 240Hz, 500Hz, 1KHz, 2KHz, 4KHz, 8KHz, 16KHz.)
- Operating voltage 117V 50/60Hz.

FACTORY ASSEMBLED UNIT, NOT A KIT

SPECIAL PRICE **$117.00** ea

SUB MINI SIZE FET CONDENSER MICROPHONE

Specification:

Sensitivity: — 65dB ± 3db
FEQ. Response: 50 Hz 8 KHz
Output Impedance: 1K ohm max.
Polar Pattern: Omni-directional
Power Supply: 1.5V 10V D.C.
Sound Pressure Level: Max. 120dB
EM4RP **$2.50** ea. or **2 for $4.50**

NEW MARK III 9 Steps 4 Colors LED VU

Stereo level indicator kit with arc-shape display panel!!! This Mark III LED level indicator is a new design PC board with an arc-shape 4 colors LED display (change color from red, yellow, green and the peak output indicated by rose). The power range is very large, from —30dB to +5dB. The Mark III indicator is applicable to 1 watt - 200 watts amplifier operating voltage is 3V - 9V DC at max 400 MA. The circuit uses 10 LEDs per channel. It is very easy to connect to the amplifier. Just hook up with the speaker output!

IN KIT FORM $18.50

SOUND ACTIVATED DISCO LIGHT KIT

Latest design electronic color light organ, with both sound and line input, the three color lights (not included) will change colors with the rhythm of the music; controlled by 3 ranges, low, middle and high. Ideal for party, bar, or home entertainment. Max. controlled output 1000 watts per color (3 colors).

Kit includes aluminum cabinet, all electronic parts, P.C. board and transformer.

(Color Organ)

$45.50 per kit

TY-23

MARK IV 15 STEPS LED POWER LEVEL INDICATOR KIT

This new stereo level indicator kit consists of 36 4-color LED (15 per channel) to indicate the sound level output of your amplifier from —36dB ~ +3dB. Comes with a well-designed silk screen printed plastic panel and has a selector switch to allow floating or gradual output indicating. Power supply is 6~12V D.C. with THG on board input sensitivity controls. This unit can work with any amplifier from 1W to 200W!

Kit includes 70 pcs. driver transistors, 38 pcs. matched 4-color LED, all other electronic components, PC board and front panel.

MARK IV KIT **$31.50**

30W + 30W STEREO HYBRID AMPLIFIER KIT

It works in 12V DC as well! Kit includes 1 PC SANYO STK-043 stereo power amp. IC LM 1458 as pre amp, all other electronic parts, PC Board, all control pots and special heat sink for hybrid. Power transformer not included. It produces ultra hi-fi output up to 60 watts (30 watts per channel) yet gives out less than 0.1% total harmonic distortion between 100Mz and 10KHz.

$32.50 PER KIT

BATTERY POWERED FLUORESCENT LANTERN

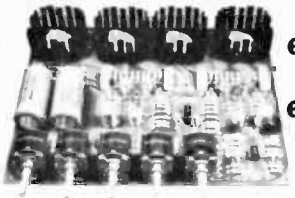
MODEL 888 R

$10.50 EA

FEATURES

- Circuitry: designed for operation by high efficient, high power silicon transistor which enable illumination maintain in a standard level even the battery supply drops to a certain low voltage.
- 9" 6W cool/daylight miniature fluorescent tube.
- 8 x 1.5V UM-1 (size D) dry cell battery.
- Easy sliding door for changing batteries.
- Stainless reflector with wide angle increasing lumination of the lantern.

STEREO AMPLIFIER 60 W + 60 W



COMPLETED UNIT — NOT A KIT!

OCL pre amp. & power stereo amp. with bass, middle, treble 3-way tone control. Fully assembled and tested, ready to work. Total harmonic distortion less than 0.5% at full power. Output maximum is 60 watts per channel at 8Ω. Power supply is 24 - 36V AC or DC. Complete unit. Assembled **$49.50 ea.**

Power transformer **$ 8.50 ea.**

5W AUDIO AMP KIT

2 LM 380 with Volume Control
Power Suply 6 18V DC

ONLY $6.00 EACH

PROFESSIONAL PANEL METERS

Type MU-52E

A. 0-50UA	**8.50 ea.**
B. 0-30VDC	**8.50 ea.**
C. 0-50VDC	**8.50 ea.**
D. 0-3ADC	**9.00 ea.**
E. 0-100VDC	**9.00 ea.**

All meters white face with black scales. Plastic cover.

SPECIAL 0.5" LED SALE ALARM CLOCK MODULE

ASSEMBLED! NOT A KIT!

Features: • 4 digits 0.5" LED Displays • 12 hours real time format • 24 hours alarm audio output • 59 min. countdown timer • 10 min. snooze control.

ONLY **$7.00 EACH**

SPECIAL TRANSFORMER FOR CLOCK **(FREE)**

DIGITAL AUTO SECURITY SYSTEM

4 DIGITS PERSONAL CODE!!

SPECIAL $19.95

- proximity triggered
- voltage triggered
- mechanically triggered

This alarm protects you and itself! Entering protected area will set it off, sounding your car horn or siren you add. Any change in voltage will also trigger the alarm into action. If cables within passenger compartment are cut, the unit protects itself by sounding the alarm. **3-WAY PROTECTION!**

All units factory assembled and tested — Not a kit!

A NEW LED ARRAY AND DRIVER FOR LEVEL METERS

This series covers a wide range of level indication uses, output and input voltage, time related change, temperature, light measurement and sound level. The problem of uneven brilliance often encountered with LED arrangements as well as design problems caused by using several units of varying size are substantially reduced. 12 LEDs in one bar:

LED ARRAY

GL-112R3 Red, Red, Red	**$5.50**
GL-112N3 Green, Yellow, Red	**$6.50**
GL-112M2 Green, Green, Red	**$6.50**
GL-112G3 Green, Green, Green	**$6.50**

0.27"

2.28"

LED DRIVERS

1R 2406G is an I.C. specially designed to drive. 12 LED. The number of LED is lineally illuminated according to the control voltage input terminal 21. Operating voltage is 9 12V D.C. **$5.35 EACH**

DUEL CHANNEL VU METER

P.C. BOARD AVAILABLE AT $4.50 EA.

PROFESSIONAL FM WIRELESS MICROPHONE

TECT model WEM-16 is a factory assembled FM wireless microphone powered by an AA size battery. Transmits in the range of 88-108MHz with 3 transistor circuits and an omni-directional electric condenser. Element built-in plastic tube type case; mike is 6¼" long. With a standard FM radio, can be heard anywhere on a one-acre lot; sound quality was judged very good.

$16.50

FLASHER LED

Unique design combines a jumbo red LED with an IC flasher chip in one package. Operates directly from 5V-7V DC. No dropping resistor neded. Pulse rate 3Hz @ 5V 20mA.

2 for $2.20

BIPOLAR LED RED/GREEN

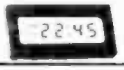
2 colors in one LED, green and red, changes color when reverse voltage supply. Amazing!

2 FOR $1.60

LCD CLOCK MODULE!

• 0.5" LCO 4 digits display • X'tal controlled circuits • D.C. powered (1.5V battery) • 12 hr. or 24 hr. display • 24 hr. alarm set • 60 min. countdown timer • On board dual back-up lights • Dual time zone display • Stop watch function.

NIC1200 (12 hr) $24.50 EA.
NIC2400 (24 hr) $26.50 EA



WANT TO BUILD YOUR OWN BLACK MAGIC BOX ON TOP OF THE TV FOR FIRST RUN MOVIES?

We have all the parts including hard to find UHF variactor tuners and P.C. board. Call us for more information.

CIRCLE 11 ON FREE INFORMATION CARD

FLUORESCENT LIGHT DRIVER KIT

12V DC POWERED
Lights up 8 ~15 Watt Fluorescent Light Tubes. Ideal for camper, outdoor, auto or boat. Kit includes high voltage coil, power transistor, heat sink, all other electronic parts and PC Board. Ilght tube not included!

With Case Only
$6.50 Per Kit

SUPER FM WIRELESS MIC KIT — MARK III

This new desIgned circuit uses high FEQ. FET transistors with 2 stages pre amp. Transmils FM Range (88-120 MHz) up to 2 blocks away and wlth the ultra sensitive condenser microphone that comes with the kit, allows you to pick up any sound wlthin 15 ft. away! Kit includes all electronic parts, OSC coils, and P.C. Board. Power supply 9V D.C.

FMC-105
$11.50 PER KIT

PRESS-A-LIGHT SELF GENERATED FLASHLIGHT

EXCLUSIVE!! $3.95 ea
Model F-179

Never worry about battery, because It has none! Easy to carry in pocket and handy to use. Ideal for emergency light. It generates its own electricity by squeezing grip lever. Put one in your car, boat, camper or home. You may need it some time!

ELECTRONIC DUAL SPEAKER PROTECTOR

Cut off when circuit is shorted or over load to protect your amplifier as well as your speakers. A must for OCL circuits.

KIT FORM
$8.75 EA.

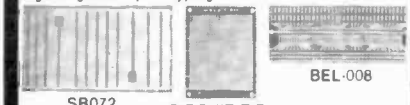
"FISHER" 30 WATT STEREO AMP

MAIN AMP (15W x 2)
Kit includes 2 pcs. Fisher PA 301 Hybrid IC all electronic parts with PC Board. Power supply ± 16V DC (not Included). Power band with (KF 1% ± 3dB). Voltage gain 33dB. 20Hz - 20KHz.

Super Buy
Only $18.50

UNIVERSAL PROJECT BOARD

All P.C. boards are made from high quality phenolic, predrilled in different patterns for different purpose. All boards 1/16" single sided copper. Hole spacing is standard 0.1". Fits all kinds of I.C. transistors, capacitors and resistors. Ideal for school projects, engineering desIgns and prototyping.



SB072 CIRCUIT FIT BEL-008

M-34 BEL101 BEL202

BEL101	3½"x6"	$1.75 EA.
SB072	3½"x6"	$1.75 EA.
M-34	3"x5"	$1.75 EA.
CIRCUIT FIT	3"x3½"	$1.25 EA.
BEL202	3"x4"	$1.25 EA.
BEL-008	2¼"x5½"	$1.25 EA.

PUSH-BUTTON SWITCH

N/Open Contact
Color: Red, White, Blue, Green, Black
3/$1.00
N/Close also Available
50¢ each
LARGE QTY. AVAILABLE

HEAVY DUTY CLIP LEADS

10 pairs — 5 colors Alligator clips on a 22" long lead. Ideal for any testing.
$2.20/pack

BATTERIES

PK/$10.00
2 PKS/$19.00
ILLUSTRATED LESS COVER

NICKEL CADMIUM BATTERY PACK 'D' SIZE

Output: 3.6 Volts @ 3.0 Amp/Hour. Consists of three each, 1.2 Volt "D" size Nickel Cadmium Cells stacked and plastic film encapsulated. Tabs are provided at each end for electrical connections. The individual cells can be cut apart if desired. Rated recharge rate is 30 mA, 14-18 hours. Size 1¼" dia. x 7" long. New. Shpg. Wt. each pack, 1 lb.

"C" SIZE BATTERY PACK

10 C size ni-cd battery in dng pack, gives out 12.5V D.C. 1.8 amp per hour. All fresh code, pull-out from movie cameras. Can be disconnected to use as single c cells. Hard to find $15.00 per pack of 10 batteries

ELECTRONIC ALARM SIREN

COMPLETE UNIT
Ideal for use as an Alarm Unit or hookup to your car back-up to make a reverse Indicator. Light Output up to 130dB. Voltage supply 6 12V

AU-999 $7.50

SUB MINIATURE TOGGLE SWITCH

SPST 2 FOR 2.80 SPDT 2 FOR 3.20
6 AMP 125V AC CONTACT

TRANSFORMERS

ALL 117 VOLT INPUT

30V	4 AMP	$8.50 EA.
36V CT	3 AMP	$10.50 EA.
48V CT	3 AMP	$10.50 EA.
24V CT	0.5 AMP	$3.00 EA.
18V CT	0.5 AMP	$3.00 EA.
12V CT	0.5 AMP	$2.50 EA.
6.3V	0.5 AMP	$2.00 EA.

AC POWER SUPPLY

Wall Type Transformer

12V AC	Output	200 MA	$2.75 EA.
16V CT AC	Output	100 MA	$2.10 EA.
6V DC	Output	120 MA	$1.90 EA.
12V DC	Output	100 MA	$1.90 EA.

ULTRASONIC SWITCH KIT

Kit includes the Ultra Sonic Transducers, 2 PC Boards for transmitter and receiver. All electronic parts and instructions. Easy to build and a lot of uses such as remote control for TV, garage door, alarm system or counter. Unit operates by 9-12 DC. $15.50

COMPLETE TIME MODULE

0.3" digits LCD Clock Module with month and date, hour, minute and seconds. As well as stop watch function!! Battery and back up light is with the module. Size of the module is 1" dia. Ideal for use in auto panel, computer, Instrument and many others! $8.95 EACH

SOUND ACTIVATED SWITCH

All parts completed on a PC Board SCR will turn on relay, buzzer or trigger other circuit for 2 - 10 sec. (adjustable). Ideal for use as door alarm, sound controlled toys and many other projects. Supply voltage 4.5V 9V D.C.

$1.75 ea. 2 for $3.00

FM WIRELESS MIC KIT

It is not a pack of cigarettes. It is a new FM wireless mic kit! New design PC board fits into a plastic cigarette box (case included). Uses a condensor microphone to allow you to have a better response in sound pick-up. Transmits up to 350 ft.! With an LED indicator to signal the unit is on ±FMM2 KIT FORM $7.95

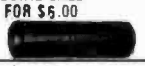
REGULATED DUAL VOLTAGE SUPPLY KIT

±4 30V DC 800 MA adjustable, fully regulated by Fairchild 78MG and 79MG voltage regulator I.C. Kit includes all electronic parts, filter capacitors, I.C., heat sinks and P.C. board.

$12.50 PER KIT

AA SIZE NI-CD

SPECIAL SALE
4 FOR $5.00
RECHARGEABLE BATTERIES
LIMITED QUANTITY AVAILABLE



POCKET SIZE AM-FM RADIO TR-945 with LED TUNING EYE

New design body with see thru speaker grill.
SPECIAL PRICE $16.50 EACH

TR-945

POWER SUPPLY KIT

0-30V D.C. REGULATED
Uses UA723 and ZN3055 Power TR output can be adjusted from 0-30V, 2 AMP. Complete with PC board and all electronic parts.

Transformer for Power Supply, 2 AMP 24V x 2 $8.50

0-30 Power Supply $10.50 each

I.C. TEST CLIPS

Same as the E-Z clips With 20" Long Leads In Black and Red Colors $2.75 per pair

SOUND GENERATOR I.C.

Creates almost any type of sound — gun shot, explosion, train, car crash, star war, birds, organ ext. A built-in audio amplifier provides high level output. Operates from one 9V battery, 28 pin dip; we supply the datas. $2.90 EACH

ELECTRONIC SWITCH KIT

CONDENSER TYPE
Touch On Touch Off uses 7473 I.C. and 12V relay
$5.50 each

1 WATT AUDIO AMP

All parts are pre-assembled on a mini PC Board. Supply Voltage 6 9V D.C. SPECIAL PRICE $1.95 ea.

LOW TIM DC STEREO PRE-AMP KIT TA-10 20

Incorporates brand-new D.C. design that gives a frequency response from 0Hz — 100KHz ±0.5dB! Added features like tone defeat and loudness control let you tailor your own frequency supplies to eliminate power fluctuation!
Specifications: • T.H.D. less than .005% • T.I.M. less than .005% • Frequency response: DC to 100KHz ±0.5dB • RIAA deviation: ±0.2dB • S/N ratio: better than 70dB • Sensitivity: Phono 2MV 47K/Aux. 100MV 100K • Output level: 1.3V • Max. output: 15V • Tone control: bass ±10dB @ 50Hz/treble ±10dB @ 15Hz • Power supply: ±24 D.C. @ 0.5A
Kit comes with regulated power supply, all you need is a 48V C.T. transformer @ 0.5A.

ONLY $44.50
X'former
$4.50 ea.

SOLID STATE ELECTRONIC BUZZER

Mini size 1" x ¾" x ¾"
Supply voltage 1.5V - 12V
Ideal for Alarm or Tone Indicator

$1.50 each

FORMULA INTERNATIONAL INC.

8/80

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Outside Calif. (Includes Mex co & Canada)	10%	10%
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BOULDER, COLO. 80322

INTRODUCING HOBBY-BLOX™

The new modular circuit building system designed especially for electronic hobbyists.

Until now, you had to buy "professional" solderless breadboards for your projects and pay "professional" prices. Now there's Hobby-Blox™, a totally new circuit-building system that's not only economically priced but offers many more advantages to the hobbyist.

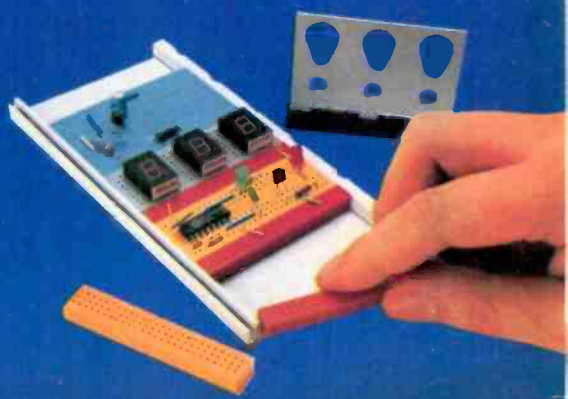
At the core of the system are two expandable starter packs (priced under $7.00), one for discrete component projects, the other for integrated circuit projects. Each comes with a number of Hobby-Blox modules that fit into a tray and an illustrated project booklet. In addition, the system includes 14 separate component packs you can purchase individually — terminal, distribution and bus strips, speaker panels, binding posts, etc. — priced from $1.29 to $3.59.

The Hobby-Blox system is easy to use because the modules are color-keyed and letter/number indexed. It's time-saving, because they're solderless. It's compatible with DIP's of all sizes and a wide variety of discrete components. And you save money, because the parts can be reused again and again.

How far can you go with the Hobby-Blox system? Take a look at the example above. Then you'll know why we say, "your only limit is your own imagination!"

For a free catalog and the name of your nearest Hobby-Blox dealer call toll-free (800) 321-9668.

Prices shown are current suggested U.S. resale.



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1359 West Jackson Street
Painesville, Ohio 44077
(216) 354-2101

In Europe, contact A P PRODUCTS GmbH
Baeumlesweg 21 • D-7031 Weil 1 • W. Germany

CIRCLE 20 ON FREE INFORMATION CARD

In one year our K40™ antenna has become the largest selling CB antenna in the world!

1. It's the most expensive...

$42.50 suggested retail

And when you pay more, you expect more!

MORE PERFORMANCE: The K40 is guaranteed to transmit further or receive clearer than any antenna it replaces. We know it will. We've tested it with 771 CB'ers just like you for one year.

MORE FLEXIBILITY: You can fit your K40 to any mounting surface. It will fit any vehicle you'll ever own! That includes choppers, dune buggies, gutters, mirror mounts, luggage racks, trunks, hatchbacks, through roofs, semis, pick ups and RV's.

MORE QUALITY: It's not imported. It's not made in Taiwan, Korea or Japan. It's American made in an American town. It's made with better materials that cost more and by professional people we pay more. And we designed it right here in the U.S.A.

*Including optional mounts at extra cost.

2. It's made better...

3. It's proven best!

...Here's what the leading CB publications said.

CB TIMES: "... it's not often that a product bursts onto the market scene, dominates and improves CB'ing for everyone. American Antenna and the K40 are doing it—repeated tests showed the K40 could out-perform the major competitive brands."

RADIO-ELECTRONICS: "The results of our tests showed that, in three different positions of the monitoring receiver, the *model K40* equaled or out-performed the competitive antenna. Apparently, American Antenna's advertising is not merely Madison Avenue showmanship."

PERSONAL COMMUNICATIONS: "... an impressive 95% of the trials, the K40 out-performed the existing mobile antennas. We had to try one for ourselves.

"... in every case, the K40 either equaled or out-performed its competitor.

"No ifs, ands, or buts! The K40 Antenna from American Antenna would have to be just about the best antenna around.

CB MAGAZINE: "Introduced in October, 1977, the K40 quickly became the top seller and in mid 1978, became the number one selling antenna in the nation."

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—H. Bachert, Jr., 15 King Rd., Park Ridge, NJ

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—Jerome R. Brown, 7800 S. Linder, Burbank, IL

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