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JUNE/JULY, 1967

RADIO-TV EXPERIMENTER

Dedicated to America's Electronics Experimenters

JULIAN M. SIENKIEWICZ
WAZCQL/KMD4313

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<td>3/4&quot;</td>
<td>$8.00 Ppd.</td>
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POSITIVE FEEDBACK

JULIAN M. SIENKIEWICZ, EDITOR

CB Rules Change Again? The FCC has released a proposal to amend the CB rules again, this time to require that Class D transceivers be type accepted. This means that no equipment can be licensed unless its manufacturer has submitted data on technical operating characteristics and the FCC finds that the equipment conforms with the technical requirements of the rules.

If the rule changes are adopted, CBers will be allowed to continue use of their existing equipment for five years provided it meets present technical standards. That's five watts input, etc. Six months after adoption of the rules only type accepted equipment can be licensed. And after five years, non-type accepted equipment cannot be used. That'll be no big loss to CBers. After all, who is operating a 1962 rig today? (If you are using an ancient rig, please let the Editor know the Manufacturer and Model No.)

The new rules prohibit the use of external accessories except those furnished by the transceiver manufacturer and as covered by the type acceptance. So you better dump those 30-watt linear amps and the like. CB users will not be permitted to modify their transceivers, nor will they be allowed to change tubes, transistors or crystals, which might affect the ability of the equipment to meet FCC technical standards, except under the supervision of the holder of a first or second class radio operator license. Components can be replaced only with new components approved by the equipment manufacturer. So, if you installed 811's in the final, you're in trouble.

Transmitter power will be rated in terms of mean "output" power, not "input" power as at present. Class D AM transmitter power will be limited to 4 watts and SSB transmitters to 8 watts peak envelope power. This makes sense to the CB buyer. Who cares what goes in, it's what comes out that is important. Some current five-watt input units can barely put out 3 watts while others find 3½ watts easy pickings.

Part 15 Unbanned! What was published in the newspapers early in February about banning the use of Part 15 (less than 100-milliwatt) walkie-

(Continued on page 14)
New Heathkit® AR-15 Solid-State Stereo Receiver

150 Watts...AM-FM Stereo...$329.95†

Field Effect Transistor FM Tuner...cascade 2-stage FET RF amplifiers and an FET mixer provide high overload capability, excellent cross modulation and image rejection. Sensitivity 1.8 µV. Features 4-gang variable capacitor and 6 tuned circuits for extreme selectivity under the most adverse conditions. Completely shielded...completely assembled.

Two Calibrated Tuning Meters...for signal levels, for center tuning—doubles as a VOM for check-out during or after kit assembly. Plus automatic switching to stereo, transformerless design, filtered outputs and a host of other deluxe features. Full details in FREE catalog.

† Kit AR-15, (less cabinet) 28 lbs. $329.95
AE-16, assembled wrap-around walnut cab. 7 lbs. $19.95

AR-15 SPECIFICATIONS—AMPLIFIER SECTION: Dynamic Power Output Per Channel (Music Power Rating): 8 ohm load; 75 watts. Continuous Power Output, Per Channel*: 8 ohm load: 50 watts. Power Bandwidth For Constant 0.9% Total Harmonic Distortion*: 6 Hz to 30 kHz. Frequency Response (1 watt level): ±1 db, 6 to 50,000 Hz. ±3 db, 4 to 70,000 Hz. Harmonic Distortion: Less than 0.05% from 20 to 20,000 Hz at 50 watts output. Less than 0.2% at 1,000 Hz with 50 watts output. Less than 0.25% at 1,000 Hz with 1 watt output. Intermodulation Distortion (68 Hz: 6,000 Hz=4:1): Less than 0.5% with 50 watts output. Less than 0.2% with 1 watt output. Damping Factor: 45. Hum & Noise: Volume control at minimum position: —80 dB. PHONO; Channel Separation: PHONO: 45 db. TAPE & AUX: 55 db. Output Impedance (each channel): 4. 8 & 16 ohms. FM SECTION (Mono): Sensitivity: 1.8 µV. Frequency Response: ±1 db, 20 to 15,000 Hz. Sensitivity: 1.8 µV. Frequency Response: ±1 db, 20 to 15,000 Hz. Harmonic Distortion: Less than 1% at 1,000 Hz with 50% modulation. 19 & 38 kHz: Suppression: 55 db or greater. CMR: 50 db. AM SECTION: Sensitivity: 12 microvolts at 1,000 Hz. Image Rejection: 60 db of 600 Hz. 40 db of 1,000 Hz. IF Rejection: 70 db at 1,000 Hz. Harmonic Distortion: Less than 1.5% at 400 Hz. 90% modulation. Hum & Noise: 45 db. Power Requirements: 105-125 or 210-250 volt 50/60 Hz AC. Dimensions: Overall, 16½" wide x 8½" high x 14½" deep.

*Rated IHF (Institute of High Fidelity) Standards.

Now From The World’s Most Experienced Solid-State Audio Engineers Comes The World’s Most Advanced Stereo Receiver...The New Heathkit AR-15. There’s nothing like it anywhere in the transistor stereo market place. Besides the use of space-age integrated circuits and exclusive crystal filters in the IF section, it boasts other “state-of-the-art” features like these:

150 Watts Dynamic Music Power...the highest power output of any transistor stereo receiver...delivers the coolest, most natural sound you’ve ever heard.

All-Silicon Transistor Circuitry...a total of 69 transistors, 43 diodes and 2 IC’s for maximum reliability.

Positive Circuit Protection...four Zener diodes and two thermal circuit breakers protect the driver and output transistors from overload and short circuits of any duration.

FREE CATALOG

Describes these and over 250 kits for stereo/hifi, color TV, amateur radio, shortwave, test, CB, marine, educational, home and hobby. Save up to 50% by doing the easy assembly yourself. Mail coupon or write Heath Company, Benton Harbor, Michigan 49022

HEATH COMPANY, Dept. 13-6
Benton Harbor, Michigan 49022

[Options for purchase and catalog]

JUNE-JULY, 1967
Learn, Enjoy And Save... Build
Heathkit Rectangular Color TV's With Exclusive Self-Servicing

Exclusive Features That Can't Be Bought
In Ready-Made Sets At Any Price!
All color TV sets require periodic convergence and color purity adjustments. Both Heathkit Color TV's have exclusive built-in servicing aids, so you can perform these adjustments anytime... without calling in a TV serviceman... without any special skills or knowledge. Just flip a switch on the built-in dot generator and a dot pattern appears on the screen. Simple-to-follow instructions and detailed color photos in the manual show exactly what to look for, what to do and how to do it. Results? Beautifully clean and sharp color pictures day in and day out... and up to $200 savings in servicing calls throughout the life of your set.

Exclusive Heath Magma-Shield... surrounds the entire tube to keep out stray magnetic fields and improve color purity. In addition, Automatic Degaussing demagnetizes and "cleans" the picture every time you turn the set on from a "cold" start.

Choice Of Installation... Another Exclusive! Both color TV's are designed for mounting in a wall or your own custom cabinet. Or you can install either set in a choice of factory assembled and finished Heath contemporary walnut or Early American cabinets.

From Parts To Programs In Just 25 Hours. All critical circuits are preassembled, aligned and tested at the factory. The assembly manual guides you the rest of the way with simple, non-technical instructions and giant pictures.

Plus A Host Of Advanced Features... a hi-fi rectangular picture tube with "rare earth" phosphors for brighter, livelier colors and sharper definition... Automatic Color Control and Gated Automatic Gain Control to reduce color fading and insure jitter-free pictures at all times... deluxe VHF Turret Tuner with "memory" fine tuning... 2-Speed Transistor UHF Tuner... Two Hi-Fi Sound Outputs for play through your hi-fi system or connection to the special limited-field speaker... Two VHF Antenna Inputs... 300 ohm balanced and 75 ohm coax... 1-Year Warranty on the picture tube, 90 days on all other parts... plus many more deluxe features. For full details, mail coupon for FREE Heathkit catalog.

*Kit GR-295, everything except cabinet, 131 lbs... $479.95
GRA-295-1, walnut cabinet (shown above) 56 lbs... 19" D. x 31" H. x 34½" W. ...$62.95
Deluxe contemporary walnut & Early American cabinets also available at $94.50 & $99.95

**Kit GR-180, everything except cabinet, 102 lbs... $379.95
GRA-180-1, walnut cabinet (shown above) 41 lbs... 18¾" D. x 28¾" W. x 29" H. ...$49.95
Early American cabinet available at $75.00

NEW! Heathkit Transistor Code Practice Oscillator
Learn Radio-Telegraph Code... ideal for beginning hams, or boy scouts working toward merit badge. Uses unijunction transistor with separate controls to vary tone frequency and volume. Hear tone through built-in speaker or a headphone set... features separate phone jacks for key and headphone outlet. For visual monitoring, just flip a switch and watch the top-panel blinker light. Includes key with plug and cord. 2 lbs.
Your Own Heathkit® Electronics!

NOW ... New Lower Prices On Harmony®-By-Heathkit® Guitars!

**NEW Heathkit Transistor Guitar Amplifier**
60 watts peak power; two channels — one for accompaniment, accordion, organ, or mike, — the other for special effects ... with both variable reverb and tremolo; 2 inputs each channel; two foot switches for reverb & tremolo; two 12" heavy-duty speakers; line bypass reversing switch for hum reduction; one easy-to-build circuit board with 13 transistors, 6 diodes; 28" W. x 9" D. x 19" H. leather-textured black vinyl cabinet of 3/4" stock; 120 v. or 240 v. AC operation; extruded aluminum front panel. 52 lbs.

American Made Harmony-By-Heathkit Guitars
All wood parts factory assembled, finished and polished ... you just mount the trim, pickups and controls in predrilled holes and install the strings ... finish in one evening.

**These Valuable Accessories Included With Every Guitar Kit**

Each guitar includes vinylized chipboard carrying case, cushioned red leather neck strap, connecting cord, Vu-Tuner® visual tuning aid, tuning record, instruction book and pick ... worth $19.50 to $31.50 depending on model.

**Deluxe Guitar ... 3 Pickups ... Hollow Body**
Double-cutaway for easy fingering of 16 frets; ultra-slim fingerboard — 241/4" scale; ultra-slim "uniform feel" neck with adjustable Torque-Lok reinforcing rod; 3 pickups with individually adjustable pole-pieces under each string for emphasis and balance; 3 silent switches select 7 pickup combinations; 4 controls for pickup tone and volume; professional Bigsby vibrato tail-piece; curly maple arched body — 2" rim — shaded cherry red. 17 lbs.

**Silhouette Solid-Body Guitar ... 2 Pickups**
Modified double cutaway leaves 15 frets clear of body; ultra-slim fingerboard — 241/4" scale; ultra-slim neck for "uniform feel"; Torque-Lok adjustable reinforcing rod; 2 pickups with individually adjustable pole-pieces under each string; 4 controls for tone and volume; Harmony type "W" vibrato tail-piece; hardwood solid body, 11/2" rim, shaded cherry red. 13 lbs.

**"Rocket" Guitar ... 2 Pickups ... Hollow Body**
Single cutaway style; ultra-slim fingerboard; ultra-slim neck, steel rod reinforced; 2 pickups with individually adjustable pole-pieces for each string; silent switch selects 3 combinations of pickups; 4 controls for tone and volume; Harmony type "W" vibrato tailpiece; laminated maple arched body, 2" rim; shaded cherry red. 17 lbs.

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JUNE-JULY, 1967
talkies in the citizens band is not true. According to the news report, the FCC was supposed to be considering the move of Part 15 walkie-talkies from the Citizens Band to 49.9 MHz (mc.) at the edge of the six-meter ham band. The story got into the papers because someone had seen a copy of a staff level, in-house FCC document with no official status and leaked the information to the press. (Who bugged the FCC?)

If this phony story were true it would have meant that the 12-million or so unlicensed walkie-talkies now in use would have to be either licensed in the Citizens Radio Service or junked. Also, manufacturers would have had to design new walkie-talkies for the new Part 15 band and rules. Shiploads of walkie-talkies on the way from Japan may have ended up making the Pacific Ocean a wee bit shallower.

If you have a Part 15 walkie-talkie, don’t worry. James Barr, chief of the Safety and Special Radio Services division of the FCC, said "There is no such proposal." Thanks a lot, James. With all those Dick Tracy gadgets buzzing and buzzing the CB channels, someone should do some worrying. Too bad it’s not the FCC.

Wait for a Better Price. IC’s (integrated circuits) have been coming on strong for the past two years and more and more will find their way into consumer products toward the end of 1967. One IC design made by the National Semiconductor Corporation is a voltage regulator. The device is about the size of a quarter-watt transistor case with eight leads. Some of the outstanding characteristics of this voltage regulator are: output voltage adjustable from 2 VDC to 30 VDC; one per cent regulation; adjustable short circuit limiting; and wide-range temperature tolerance. This is just what every experimenter would like to have on his test bench, but hold up fellah’s, the price tag for one unit is $60.00. So be patient, the chips will fall in price as the state of the art and competition increases. If you belong to that breed of disbelievers and would like to see some manufacturer’s specifications, write to National Semiconductor Corporation, Dept. RTV, Danbury, Connecticut 06810 and ask for Technical Bulletin SC-100.
One Side of the Story. Would you believe that Regency Electronics has come out with an all-channel CB rig which does the all-channel act in the grand style—like 69 channels!! So far as we know, this rig is the first-ust with the most-ust.

Hey—don’t go ‘way, Regency’s new Imperial rig is absolutely legal. No, the FCC hasn’t flipped its beanie and opened up another 46 CB channels; credit for the extra elbow room goes to the manufacturer of the rig.

Using an extremely versatile method of voice transmission known as “single sideband,” the Imperial makes triple use of each of the 23 CB channels, the upper sideband, the lower sideband, and the full channel (using regular AM modulation for the full channel use). It would actually be possible for one single sideband (SSB) net to be in full swing on, say, Channel 9/LSB (that’s lower sideband) and a second local net to be operating on 9/USB (U is for upper) and neither net would even be aware of the other one.

Without going into a whole involved complicated technical dissertation which is a major article in itself, suffice it to say, in explanation of the miracle of SSB, that only a small portion of your voice need be transmitted over a radio circuit to achieve communication. In SSB, the transmitter sends out only a portion (not quite half) of the usual signal; it takes up less radio-spectrum space, it’s more concentrated, it carries farther than a standard AM signal. Of course, there is less-than-hi-fi quality here, but you don’t often have occasion to broadcast the Boston Pops over a communications circuit.

At the receiving end, electronics magic locks onto the incoming SSB signal and reprocesses the sliced up signal and out comes something which bears a striking resemblance to the human voice. When heard on a regular AM receiver, an SSB signal cannot be understood; it’s “scrambled.” In fact it sounds like a Russian monkey talking French. The Regency system permits the two SSB circuits to co-exist on the same channel. While the use of SSB offers a certain amount of privacy it has the disadvantage of leaving you with a “scrambled” transmission. In the event you must seek road assistance—while traveling out of range of your base station—standard AM CB rigs just can’t copy you.

The Regency Imperial has solved this problem by giving you the option to switch over instantly to standard AM for communications with all other CB rigs. A front panel switch selects USB, LSB, and AM.

Double conversion is used in the kilo-Hertz inhaler for extra selectivity and the set can pull in all of the weak ones (it’s got half-a-microvolt sensitivity).

Smartly designed with gold and black front panel, it’s got the full assortment of deluxe features including squelch, 2-scale (4-function) meter, illuminated channel selector, universal power supply.

The Imperial goes for $299 and it’s made by Regency Electronics, Inc., 7900 Pendleton Pike, Indianapolis, Ind. 46226. (Always use Zip numbers.)

packed With Power. For those of you who have always wondered about why there isn’t a way to pull the CB rig out from under the
World Famed BREVETTATA
TEAR GAS PISTOL

Appearance of this fine tear gas weapon is similar to real gun. It is ideal for people who work in lonely, dark locations and require protection. Men give this gun to wives and daughters for night security. Many industrial applications. Shooting of gun stays aggressor without permanently injuring him. Neither permit nor license is needed, but it is not sold to minors. It has six cartridges without reloading. Each gun comes with six tear gas shells and six blanks for practice and is shipped prepaid. Gun unit prices include, 12 shells and all shipping costs.

- 1 Gun-unit at $13.07
- 2 Gun-units at $22.06 ............... ($11.43 ea.)
- 3 Gun-units at $29.94 ............... ($9.98 ea.)
- 4 Gun-units at $35.16 ............... ($8.79 ea.)

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Dubbed the Model PAP-1 PORT-A-PAK, it has a collapsible antenna, nifty Texion case, rechargeable battery, battery meter, shoulder strap. It provides up to 8 hours of continuous receiving on a single charge of the batteries.

All you do is pull the rig out of the car, pop it into the PORT-A-PAK, and prance merrily on your way. Pull, pop, prance—as simple as that! All for $59.95.

If you’re interested in this clever unit, contact e.c.i. Electronics Communications, Inc., 56 Hamilton, White Plains, N. Y. 10601.

What’s Watt. Three watts, that’s what—and it all comes from a 2-channel CB station which is carried in the palm of your hand (even if you’ve got a pint-sized mitt).

The rig is the new Duo-Com 123, a latter-day version of the famous Duo-Com 120 which was an integral part of the 1963 expedition to Mount Everest.

The 123 has a lot packed into its tiny case—things such as a dual-conversion receiver, all transistor circuitry, rechargeable nickel-cadmium battery, sealed speaker and mike (both of which can’t be affected by humidity).

The little devil can be yours for $129.50. It’s from Polytronics Laboratories, Inc., 900 Burlington Ave., Silver Spring, Md. 20902. ■
Q & A. Since the transistor was invented in 1947, its widespread use has revolutionized electronics. However, there are many persons interested in electronics who want a better working knowledge of transistors and what these chunks of germanium and silicon can do. 101 Questions and Answers About Transistors, by Leo G. Sands, fills a gap in existing technical literature for many experimenters. This book answers the most frequently asked questions about transistors and their applications in a simple, straightforward manner.

The first part of the text covers questions about basic transistor types, functions, characteristics, and testing. The remaining four parts of the book cover applications. These include the use of the transistor as an amplifier at audio and radio frequencies, as an oscillator, and as a switch for control purposes. Questions and answers about bias stabilization, preamplifiers, superregenerative detectors, phase-shift oscillators, AND and OR circuits, and flip-flops are covered in these parts. No attempt has been made by the author to include mathematics or discussions about atoms, electrons, and holes. Schematic diagrams, graphs, and photographs are frequently used to illustrate the answers.

Anyone desiring to know more about transistors will find this book an easy path to gain a greater familiarity with them. Copies are available from electronics parts distributors and bookstores throughout the country, or from the publisher, Howard W. Sams & Co., Inc., Dept. Q, 4300 West 62nd Street, Indianapolis, Indiana 46206.

Color TV. Now, in one handbook, the amateur TV serviceman has all the service information he needs to tackle any of twelve popular color TV set brands. The RCA Color TV Service Handbook has been compiled in a con-

Radio-TV Experimenter Magazine Rack
For the Outdoor Enthusiast

- Boating Journal 75¢—Editorially directed to fill the needs of America's huge group of small boat owners of outboard engines, inboard/outboard and outboard power units. Suggests cruises, boat tests, racing, designs, maintenance and handling techniques plus coverage on new products.
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soft cover
140 pages

convenient form for specific service information on many makes of 1960-1966 color TV sets. Admittedly, the handbook was written for the professional serviceman; however, RCA has done a fine job in the text's preparation so that any amateur can meet with success. We will qualify the amateur serviceman's required experience by stating that he should know something about color TV. The ol' Bookworm believes this knowledge can be had by any individual who has puttered around the old style black-and-white TV sets and had read a text or two on color TV.

The handbook is divided into ten sections and if you count on your fingers, you will have no problems following the simple directions specified for your make set. The contents cover the following in detail: chassis layouts; purity and convergence adjustments; static and dynamic convergences; black-and-white setup; phase and matrix; color field and miscellaneous adjustments; fuse and circuit breaker data; test equipment information; and receiving tubes used in color TV sets. Just look up the chassis number of your set in the chassis index, and you will be guided to the proper sections in the 140-page handbook. All the information is based on the manufacturer's own service notes. With a little experience the amateur serviceman may become the most wanted man in his immediate color-TV community. See your local parts distributor for price information.

Radio-TV Experimenter

One Always Bites Back. One of the worst things that can happen to a TV serviceman is to run into a series of tough-dog TV sets. They can pile up while you work on easier-to-repair sets; or they can make the easy ones pile up while you spend several hours on a tough-dog
Solving set. SCR's are based upon actual tried and proven techniques. We will be able to avoid trouble causes pinpointing trouble and eliminating it. We will eliminate troubleshoot "pro" Bob Middleton, to help you greatly.

This text will help you select the right approaches and cut down the time required for pinpointing trouble sources. Not only are the best techniques discussed, but pitfalls which can cause so much trouble are pointed out so you can avoid them. All the information included is based upon actual tried-and-proven techniques. This new, enlarged edition contains additional material on servicing color TV receivers including all-transistor TV portables.

Copies are available from electronics parts distributors and bookstores throughout the country, or from the publisher, Howard W. Sams & Co., Inc., 4300 West 62nd Street, Indianapolis, Indiana 46206.

Get Started. Every so often an author comes up with a text on basic theory that is worth singling out for special mention. Carlson Wade's text The Key to Basic Electronics is a short, easy-to-understand course in modern, basic electronics. Although prepared for the beginner, it also can be of use to experimenters wishing to bring themselves up-to-date in this rapidly changing field with its shifting emphasis caused by new components and circuits. Thorough explanations on such basics as electron tubes, amplifiers, oscillators and radio are complemented by chapters dealing with transistors, servo systems, radar and sonar. A special salute should be given to the draftsman who assembled (or should we say composed) the drawings for this text. Tube characteristic curves, CRT scope pattern generation, servo gear trains, sideband pictorials, and many other diagrams supplement the text's crystal clear presentation style. Interested? Write to the publisher, Key Publishing Co., Dept. RTV, 817 Broadway, New York, New York.
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HIGH-FIDELITY AMATEUR RADIO SHORT WAVE RECORDERS GIMMICKS GADGETS TOOLS ETC.

Two-Faced Watch
To aid amateur and commercial radio operators, shortwave listeners, pilots, amateur astronomers, etc., in fast, accurate Greenwich Mean Time logging, this unusual dual-function wrist-watch shows user’s local 12-hour time on a gold and black dial for 20 seconds—then the GMT dial emerges into view and remains in view for 15 seconds, after which it disappears completely, and appearance of the dial changes back to the original black dial for 20 seconds, etc. This dial cycling repeats continually, as the face-changing mechanism is powered by the watch movement. Watch hands remain in full view at all times. User of the GMT watch may read both local time and GMT conversion for his zone (watch illustrated is made for use in the Central U.S. time zone). There is also a Daylight-Saving Time scale. With gold-finish case and crown, black lizard band, and 1-year guaranteed Swiss movement, the unit is available with custom-made GMT dial for $17.95, postpaid in U.S.A.—3 to 5 weeks delivery. The watch may also be personalized with the user’s radio call sign or name for $4.50. Sold by Nordlund Radio Products, 7635 W. Irving Park Rd., Chicago, Ill. 60634.

Handy PA System
The Fedtro MEG-3300 Deluxe is a portable public address system that fits into your hand. The unit features two dynamic microphones, one built in the unit itself, and the other a detachable microphone with coiled extension cable which allows the unit to be carried over the shoulder or mounted on a tripod. The MEG-3300 is powered by four D-size flashlight batteries, is fully transistorized, and features volume control and instant battery loading. It weighs 2¼ lb.; power range is up to 3300 ft. Retail price is $59.95 at Fedtro dealers and electronics parts suppliers. Want more information? Write to Fedtro Inc., Dept. ET, Federal Electronics Building, Rockville Center, New York 11517.

Wide-Band Scope
This 5-in. oscilloscope is ideal for audio and industrial testing as well as black-and-white and color-TV servicing. Model 315A’s panel-control layout incorporates the new Green Line arrangement, featuring easy-on-the-eyes coloring, specially-shaped control knobs and legible, fast-reading pencil markings. Performance: vertical response to 5MHz with 10 mv rms/cm sensitivity; 3-step frequency-compensated vertical attenuator with separate stepless control; 2-stage push-pull vertical amplifier plus cathode-follower input; panel-mounted astigmatism control for extra-sharp trace adjustment; drift-free positioning control for full observation of expended traces; negligible rise-time, over-shoot and square-wave tilt for true

Nordlund Face-Changing Local/GMT Watch
display of complex waveforms; fully automatic sync. The 315A is $134.95 net from Precise Electronics, Dept. RT, 76 E. 2nd St., Mineola, N. Y. 11501.

**FM Lip Service**

Operating within the FM Broadcast band with output power meeting FCC regulations, Channel Master’s Model 6433 wireless FM microphone fills business, home entertainment and recording applications in conjunction with any radio or tuner. With an anti-capacitance alignment tool supplied, the 9-volt, solid-state, battery-powered unit is adjustable over a 90-106 MHz range in the FM band. Its field strength will overpower a commercial station to permit break-in communications in businesses utilizing regular FM radio for background music. When used with a tuner and PA amplifier, and tuned out of range of local stations, the 6433 makes an ideal public address for a roving speaker. Recording fans can team the unit with an FM radio whose output is then sent to a tape recorder for remote “candid” recordings. Response of the under-4-oz. unit is 10 to 100,000 Hz. An input is provided for an external low-impedance dynamic microphone. Channel Master’s 120-day instant, free replacement guarantee applies to this new unit. Suggested list price is $34.95 at dealers everywhere.

Can’t find a dealer? Don’t tell us, tell Channel Master, Ellenville, N. Y. 12428.

**Rechargeable Portable Power Source**

A new, portable 12-volt rechargeable power source with built-in charger, the CRL-1200 Power Pack, powers most battery-operated devices. In transforms easily from one 12-volt appliance to another, including portable TVs, tape recorders, phonographs, camping lights, ski-trail lights, portable radios, electric shavers, PA systems, portable power tools, movie cameras, portable lamps, electric typewriters and CB and FM radio communication units. The CRL-1200 can operate continuously up to 40 hours or more, depending on the current requirements of the equipment. The average portable TV set will...
New Products

operate for 5 to 8 hours. Charging time is seven hours for 90% charge and 12 hours for a complete charge. It operates efficiently from −30°F to +122°F, and can’t be damaged even if the temperature drops to −60°F or rises to +158°F. Charge loss during storage is only 3% per month. After 2 1/2 years of shelf life, the Power Pack can be recharged to original full capacity.

All 12-volt devices already equipped with a cigarette lighter plug fit the socket of the Power Pack, which includes two RP-680 6-volt, 8-ampere-hour, lead-silica-gel batteries and one CRL-1000 (1.2 ampere rate) automatic charger in a genuine black leather carrying case 8 1/2 x 2 1/4 x 9 in. Available through major electronic outlets, the CRL-1200 Power Pack retails for $49.95, or write to Centralab, P.O. Box 591, Milwaukee, Wis. 53201.

Fits All the News That’s Broadcasted

For listening to the news broadcasts that emanate from the capital cities all around the globe, don’t overlook EICO’s new Space Ranger Model 711. Easy-to-build kit is $49.95; factory-assembled it’s $69.95. A flip of the switch brings broadcasts by amateur radio enthusiasts, ship-toship, weather reporters, CBers, Coast Guard, or leisure listening on the standard AM broadcast band. The 711 is a superheterodyne receiver tuning 550 kHz through 30 MHz—including the popular amateur radio bands of 160, 75, 40, 20, 15 and 10 meters. The unit has a built-in ferrite rod antenna and provision for external antenna. The built-in S meter tells you when you are exactly on a station. Pin-point accuracy of tuning is achieved by electrical band-spread tuning. Continuous Wave (CW) code and Single Sideband (SSB) transmissions are received with the help of the integral variable BFO (beat frequency oscillator). For additional selectivity, the 711 has an output for connecting a Q-multiplier. There’s a 4-in. PM speaker, headphone jack, and transformer-operated power supply. Size is 6 x 13 1/2 x 9 in., construction is printed-circuit board, weight is 17 lb. At all EICO Electronic Instrument Co., Inc., dealers and electronics mail order houses.

Converting All Calls!

You can listen to Police, Fire, mobile radio telephone, VHF marine, many other exciting calls on your car or home radio with the Tunaverter and 6-1 reduction tuning—in other words, you can “tune the band.” Model 375 tunes 37 to 50 MHz; VHF model 1564 tunes 150-164 MHz and VHF marine calls. Fully transistorized, the Tunaverter measures 2 1/4 x 3 1/2 x 4 1/4 in. and uses a self-contained 9-volt battery, and comes with a 24-in. connecting coax cable and mobile mount for your auto radio. The on/off switch automatically switches from broadcast to VHF reception. Price is $29.95, postpaid in the U.S. or Canada. Optional output kit for using Tunaverter with home and transistor radios is $1.25. Get more information from Herbert Salch & Co., Marketing Div. of Tompkins Radio Products, Woodsboro PR4, Texas 78393.

DX Buster

The Explor-Air Mark V is a precision-built AM broadcast and shortwave receiver in a compact (14 x 8 x 6 in.) walnut-grained metal cabinet. Full coverage on 5 bands: medium wave (0.55-1.6 MHz); international 49 meter (5.9-6.25 MHz); shortwave 31 meter (9.45-9.8 MHz); broadcast 25 meter (11.45-12 MHz); 19 meter (15.05 to 15.5 MHz). It’s AC transformer-powered, has superheterodyne circuitry with individual tuned circuits for each band and a big slide-rule dial calibrated for easy reading. There are controls for tuning, volume off/on,
**Lafayette Explor-Air Mark V Receiver**

tone, band selector. Tube complement: 6BE6 converter, 6BA6 IF amplifier, 6AV6 detector and 1st audio, 6AQ5 audio output, and full-wave silicon rectifiers. There's a built-in 4-in. PM speaker, rear-panel connection for shortwave antenna, and front-panel headphone jack. For 105-125 V, 50-60 Hz AC. Priced at $49.95, the Explor-Air weighs 11 lbs. Imported by Lafayette Radio Electronics, 111 Jericho Tpke., Syosset, N. Y. 11791.

**Latest Epoxy Epoch Episode**

For such applications as fastening of brackets, handles, hardware, small parts and components to cabinets, chassis or enclosures, try Leal-Lok, a new non-mix epoxy spray adhesive. This one-part material in aerosol containers is also recommended for bonding nameplates. Leal-Lok is activated by contact with the air, eliminating the need for clamps and fixtures for most applications. Curing takes 8-16 hours to develop full joint strength; and baking in an oven for 1 hour at 150°F speeds curing. Price: $2.00. For literature write to Leal Co., 1716 S. 6th St., Camden, N. J. 08104.

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**Waddayamean ya didn't know the light was red?**

June-July, 1967
**Convert Aero Bander?**

*In your December-January 1965-1966 issue, you published an article about the Aero-Band converter which covers the 108-135 MHz band. Is there any way to modify the unit to cover the police band in the 145-160 MHz range and still use it to cover the aeronautical band?*

—J. J., Florissant, Mo.

Switching coils at such high frequencies is difficult. It is done with intricate mechanisms in TV tuners, but I would not recommend it for this purpose. Why don’t you just build another converter of the same type, but using coils of fewer turns for receiving in the police band? Of course you could try using a little less capacitance across the tuned circuits to raise the frequency to the 145-160 MHz (mc) band. If the transmitters you want to hear are using FM, you’re out of luck—aircraft use AM.

**Lightning Light**

*Since I am interested in meteorology I would like to build a lightning-discharge indicator which indicates lightning flashes with a neon bulb or another device. Can you give me a circuit?*

—C. H., Bushnell, Illinois

For specific information you should talk with a U.S. Weather Bureau meteorologist in Chicago or St. Louis. A neon lamp connected to a radio antenna and ground, as shown in the diagram, should flash when static charges are high—in excess of 60 volts for an NE-2 lamp.

**Color-TV Problem**

*On our color TV set, the colors all run into the white. One side of a face is sometimes purple and the other side green. The convergence has been checked. We are about 100 miles from a station. Could our 11-year-old antenna cause this? Would a new antenna help?*

—F. R. M., Ponce City, Oklahoma

Sounds familiar. Happens in New York, too—within sight of the TV-station antennas on top of the Empire State Building. For good color TV, get the best antenna you can (most directive and highest gain) and use low-loss coaxial cable instead of twin-lead as the transmission line. After the new antenna system has been installed, get a competent service technician to adjust and degauss your set.

**Service Library**

*I need books and schematics of Sears, Admiral and other TV sets, also a field-strength meter. I have put up 100 antennas for my customers and TV signals are weak here. I want to be a subscriber to your magazine. It’s great.*

—J. A. W., East Stroudsburg, Penna.

Schematics of most TV sets are available from the manufacturers and in the form of Photo Facts kits from Howard W. Sams & Co., Inc., Indianapolis 6, Indiana, and in schematic books from Hayden/Rider/Ahrens, 116 West 14th Street, New York 11, New York. TV field-strength meters are made by several companies including Jerrold Corporation, 401 Walnut Street, Philadelphia, Pennsylvania. To subscribe, just send us your check. Glad you like our magazine.

**Try a Mouse Trap!**

*A light fingered chap at work relieves his fellow employees of a five or ten spot when we leave our billfolds in our jacket pockets. I just got touched myself. I would like to put a transmitter in my jacket which would actuate a buzzer 20 feet away. Two aluminum plates could be put into the wallet to act as a switch which would close when the wallet is removed from the pocket. Any suggestions?*

—M. B., New Hyde Park, N. Y.

Get one of those money clips and keep your long green in your trouser pockets. Your problem could be solved your way if those tiny clip-on transmitters used on “The Man From U.N.C.L.E.” TV show were real and available. You could get a pocket-size garage-door control transmitter and wire its switch terminals to aluminum plates as you suggested. But, it would cost you about two ten spots and a five.
Fixed Antenna for Portable FM

How can I connect an external antenna to my portable FM-broadcast receiver which has a monopole telescoping antenna?

—F. M. B., Latham, New York

Get a 75 to 300-ohm antenna matching transformer (FM/TV), such as the JFD MT-50, which has screw terminals, and connect it as shown in the diagram. Use short leads with alligator clips to connect to the monopole antenna (not extended) and the receiver chassis.

Seek and Ye Shall Find!

I have a number of transistors and diodes of various types in some quantity. Is it possible to make an intercom using them?

—S. B., Key West, Florida

Get a copy of “Datadex” (DT-2) on transistors from a radio parts store or from IRC, 401 North Broad Street, Philadelphia, Penna. It lists the equivalents of the transistors you identified by type number in your letter. There are jillions of transistor types, many of them interchangeable. Look through back issues for intercom diagrams and match the transistors you have with those specified.

BFO Problem

I built the BFO described in one of your recent issues. It doesn't seem to have sufficient output to demodulate SSB. Only a direct connection to the antenna will produce any signal. Any help?


Feed the output of the BFO through a very small capacitor to the plate of your receiver's IF amplifier or to the detector. Connect the ground to the receiver chassis.

Low Down On Converter

Are converters practical for receiving low frequencies below 100 kHz (kc), say as low as 15 kHz? Are there any receivers that tune these frequencies?


Yes, but there are some problems since you will be converting frequencies up instead of down. There's nothing much to hear below 140 kHz except standard-frequency signals of value to laboratories. The diagram shows a circuit of a converter for 140-425 KHz. Your parts store should be able to order the coils for you. You may not be able to gang tuning capacitors C1 and C2. Set your BCB radio to about 550 kHz, tune in stations at 200 and 240 kHz, and adjust C2 for the best reception. If your receiver doesn't have an antenna connection, place the converter so that T3 (a ferrite loop antenna) is close to the radio's loop antenna.

Thinks It's a Hangar

My radio-controlled garage door opens by itself when plane traffic over my roof is heavy. What causes this and how can I stop it?

—E. M., Flushing, N. Y.

Your garage door control probably operates at around 200 MHz as permitted under Part 15 of the FCC rules for unlicensed operation of radio-control transmitters. It is probably actuated by signals from radio equipment on aircraft nearby. You should have both the transmitter in your car and the receiver in your garage retuned to another frequency. Check with the manufacturer for possible conversions to tone-coded operation. (turn page)
FM Crystal Set

How can I convert my AM crystal set to FM?

—M. T. J., Audubon, Iowa

You wouldn't be happy with the results. You need a superhet receiver in order to get sufficient frequency deviation at the detector.

No-License FM Broadcast

We operate a low-power FM station without a license under Part 15 of the FCC rules. We broadcast regular programs and would like to have a telephone, listed in the phone book, so our listeners can call us. Should we contact the FCC and get them to reserve our call letters, WKAF-FM, for us or should we get our station listed in the phone book as "Radio Freedom" or some other name?

—W. F. and V. W., Kankakee, Ill.

The FCC assigns call letters to licensed stations only. If your transmitter operates in the 88 to 108-MHz FM broadcast band, make sure it is one that has been type approved by the FCC. Otherwise, you can't operate it lawfully without a station license. At other frequencies above 70 MHz transmission is limited to one second and cannot be resumed until after a 29-second waiting period.

What Luck!

In my 14-transistor radio, two of the transistors are connected as diodes. Two other PNP transistors have their collectors and emitters connected together. An example is Q2 in the enclosed diagram. I don't understand how Q2 works. Do you know?

—H. P. W., Wichita Falls, Texas

You're lucky your set actually has all 14 of its transistors connected. Some gyp manufacturers install transistors that aren't even connected into the circuit so they can claim to have an umpteen transistor radio. There must be an error in the diagram you sent us. The collector and emitter of Q2 should not be connected together. Otherwise, Q2 would not function as the local oscillator which it apparently is.

It's a Problem!

How can I convert a UHF television converter to receive the 216-470 MHz band between the VHF and UHF television bands?

—W. B. T., Atlantic City, N. J.

It might be tricky. If it uses coils, increase their inductance. If it uses tuned lines, lengthen them. You should have a VHF-UHF signal generator, which is expensive, for making the adjustments. There's not much to listen to in that range except in the 450-470 MHz (mc) land mobile band where you might hear a taxi dispatcher. It won't work with a conventional (intercarrier sound) TV set unless you add an oscillator to simulate the video RF carrier. (To produce the sound, both the audio RF carrier and video RF carrier must be present.)
Makino Limiter for CB

I have two CB sets that are very noisy. A schematic is enclosed. Please tell me how to modify the circuit to employ a Makino limiter circuit.

—P. L. McG., Knoxville, Tennessee.

The first diagram shows the present detector, noise limiter and AVC circuits in your set. All three share the three diodes of a 6BJ7 tube. The second diagram shows the modified circuit. Note that one of the diodes is now used as an AVC rectifier. The tube-socket terminal numbers are noted on the diagram.

Chill It!

Where can I get complete specifications on the thermoelectric modules described briefly in Lou Garner’s article back in 1965?

—J. S., Panorama City, California

Write directly to: Cambridge Thermionic Corp., 445 Concord Avenue, Cambridge, Massachusetts.

Good Listening? Listen Good!

You told D. E. H. of Mt. Orab, Ohio, that he should discard his old Atwater Kent 20 radio and forget about it completely. How wrong you are. I have several old radio receivers that I have rehabilitated, and most of the new ones of today can’t even begin to compare with them. If it is possible, please send me the name and address of the writer of this letter and I will gladly give him the information that he requires, at no charge. Unless an old radio is in very bad shape, it can always be repaired. I do much of this as a hobby.

—J. P., Kansas City, Kansas

No, we didn’t say to discard it. We suggested that it be given to a museum where it can be seen by many. Of course it can be modernized but it won’t work as well as a cheap pocket transistor radio. If it were a later model superhet instead of a very early TRF, the owner might get some satisfaction out of his investment in modernization. Why don’t you write an article for us about modernizing old radios so many can benefit from your experience and ideas?

Semiconductors for Type 80

How can I use semiconductor diodes instead of a type 80 rectifier tube used in the pre-World War II power transformer radios?

—W. W. (Address not given)

Whether you want to replace an 80, a 5Z3, or a more modern 5Y3, the best way to do it is to make a plug-in adapter from the base of a defective tube. Use diodes with a 150-ma, 600-volt piv (prv) rating. (To replace other rectifier tubes you may need 750 ma diodes—with two or more connected in series to handle the piv

Try, Try Again

I repair radio and TV sets as a hobby and have come across a trouble that has stumped me. Recently, I replaced its 50CS tube and the radio played well for a few days. Then, the two local stations started to sound distorted and a noise like static is heard. All other stations sound normal. I cleaned the tuning capacitor and tested all the tubes and then replaced all of them except the 50CS. There was no improvement. Got any ideas?


Sounds like front-end overloading. It could be caused by inadequate AVC voltage. Check the capacitors in the AVC circuit (could be leaky or shorted), also the resistors. Also, it could be the incorrect bias on the 50CS.

June-July, 1967

27
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Ask Me Another

rating of the tube.) Generally the silicon diodes will give a higher B-plus voltage than the tube did so the voltage drop across the resistor (that you must connect in series with the diodes) won't be noticed. Without the resistor, very-high current surges into the input filter capacitor can "pop" those diodes the first time you turn the power on. You don't have this with a tube-type rectifier. The filament warm-up time lets current increase slowly with no surge.

If you wire the diodes directly to the rectifier-tube socket, run the pigtail leads down through the tube-pin holes in the wafer sockets to prevent someone from plugging a tube into the socket and upsetting things.

Surplus Is a Problem

I recently purchased a shortwave radio from a friend for $20. It is black, very heavy and looks like a war surplus product. It was designed for battery operation but has been converted to AC, using an external power transformer. I can tune in many foreign stations. What make and model is it? On the front panel it says "before operating read TM 11-850." Where can I get the manual? Are tubes and parts available?

—B. C. H., Cherryfield, Me.

Judging from the picture you sent, the receiver is probably a BC-312 or BC-348 made for the Signal Corps (circa 1942). Tubes are available but mechanical parts would be difficult to find. If a reader knows where a manual is available, contacting B.C.H. at P.O. Box 144 in Cherryfield, Me., would be a nice gesture.

Sorry About That!

I sent a question to Ask Me Another. Will the answer be sent to me by mail or published?

—R. W., Brooklyn, N. Y.

No questions can be answered by mail even if return postage is sent. Questions will be answered in the magazine as soon as possible and as space permits. Short questions get speedier answers.
**Tone It Down**

How can I add bass and treble controls to my amplifier?

—C. R. C., Woodstock, Illinois

According to the diagram you sent (partially reproduced here), you already have a treble control (R1). To add a bass control, break the circuit at “X” and add R2 and C2. Try a 5-megohm potentiometer for R2 and a 1000-picofarad capacitor for C2. Try various values for C2 until you get the desired effect.

---

**Fruitless Labor**

How can I convert the pocket mike described in the Feb.-Mar. issue of Radio-TV Experimentor from the 88-108 MHz FM band to the 540-1600 kHz AM band?


We’re talking about apples and oranges now. One is an FM device for the VHF band, the other an AM device for the MF (medium frequency) band. For the AM band you need an effective antenna. This is easily achieved in the VHF band because of the much shorter wavelengths. In the AM broadcast band (MF), you should wire the transmitter directly to the receiver input, or drag around a wire antenna about 20 feet long. While a basic circuit could be included here, you might be very disappointed with the results. Perhaps some reader will design and build an AM/FM pocket mike and write it up for us.

---

**My Boo-Boo**

In the Dec.-Jan. issue of Radio-TV Experimentor, in response to the question of J. A. C. which was entitled “Too Much Soup” you said that the images of stations on 1450 kHz and 1490 kHz, picked up at 540 kHz and 580 kHz respectively, were not images. I don’t think you’re right.

—J. D., Pittsburgh, Pa.

I was wrong. If the receiver has a 455-kHz (kc) 1F and is tuned to 540 kHz, its oscillator will be at 995 kHz (if oscillator operates at higher frequency than intended signal). Thus, when tuned to 540 kHz, the receiver could pick up a signal from a station on 1450 kHz since that signal beating with the 995-kHz oscillator signal will produce a 455-kHz IF signal (1450-995=455). The same would be true at 580 kHz where the oscillator operates at 1035 kHz (1490-1035=455). What reader J. A. C. needs is a tuned preselector ahead of his receiver or a radio with an RF stage. Thanks to Jim Kyle, John Berry and David Lawry who wrote to call my attention to the error. My boo-boo reminds me of the day I tried to find out who swiped my hat—it was on my head.

---

**TVI from Receiver**

When I tune my shortwave receiver past certain frequencies, interference is caused to my TV set. I wrote the manufacturer of the TV set who charged me $5 for a device which didn’t work. How can I stop the interference?

—R. K., Morton Grove, Ill.

The local oscillator of your shortwave set is probably radiating and is being picked up by the TV antenna or IF amplifier. Your shortwave receiver may be inadequately shielded. Move it and its antenna as far away as possible from the TV set and its antenna. Try grounding your shortwave receiver chassis (but not if it is an AC-DC type). You might also try a line filter just in case the interfering signal is being fed through the power line.

---

**Solid-State Shortwave**

For several years I have been trying to find an all-transistor portable shortwave receiver that will cover from about 1.5 MHz to about 9 MHz, which has band spread tuning, BFO, telescoping antenna, and is operable from a 9-volt battery and AC through an adaptor. Do you know of any such receiver?


There are many portable shortwave receivers on the market, none of which meet your speci-
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Ask Me Another

Your radio probably has a built-in loop antenna if it was manufactured after 1940. To avoid having to open up the set, you can fasten an external flat loop antenna (salvaged from a discarded radio) to the back of the set, connected to an external antenna and ground as shown in the diagram. The signals picked up by the antenna will be inductively coupled from the external loop to the internal loop. Adjust the distance between the loops for best reception.

Shame, Shame

I would like to know where I can buy or order Amperite delay relays and at what prices.

—L. E. M., Chicago, Ill.

At Allied Radio, 100 N. Western Ave., on your town’s west side or directly from Amperite Co., 600 Palisade Ave., Union City, N. J. 07087.

BCI from Thermostat

The aquarium heater in our house causes annoying noise in my radio receiver as the thermostat cuts in and out. I have tried many different commercial static eliminators, but none have worked. What should I do?

—M. E. B., Jacksonville, Ill.

Capacitors should be connected directly to the thermostat but there is no room and there is danger of lousing up the heater and cooking the fish. Get a new heater with built-in radio interference filters.
TORNADO BUSTING

Unbelievable though it sounds, man has found an electronic method to short-circuit a raging twister!

If you hank to watch a real tornado in action, find a rock to sit on in the middle of Kansas, between four and six in the afternoon, on Friday the Thirteenth, in May. If tornado statistics mean anything, you should be in the ideal space-time orientation to satisfy your penchant for uncontrolled violence.

But if you have ever been pushed around by a tornado, or if you have seen the calamitous aftermath of its fantastic power, you probably go right along with those who would like to see these wind-spooks blasted out of existence. And it might just happen that while you are sitting on that rock in Kansas, someone may come along and try to do precisely that—with a 40 millimeter cannon! Should this happen, don't pass the artilleryman off as some sort of a nut—a latter-day Don Quixote tilting with space age windmills—because he will be conducting a wholly rational and sophisticated scientific experiment. His aim will be to short-circuit the biggest electrostatic motor in existence—the tornado.

The notion of shooting down tornados is still only a scientific theory which has yet to be proved out with a full-blown tornado. But miniature tornados are being created under controlled laboratory conditions. They behave like electrostatic motors, and can be turned on and off at will. If these man-made tornados accurately reflect actual electrical conditions in real tornados, a new war against the elements may one day erupt in Kansas or some other convenient location in the midwestern tornado belt.
TORNADO BUSTING

If the idea works, there will be immeasurable benefits in lives saved and property protected from total devastation. During the half century since 1916, there have been over 14,000 recorded tornadoes within the borders of the United States; the total death toll has been about 10,000; the estimated property damage now approaches the $800 million mark.

How numerous and how widespread is this natural enemy? Fig. 1 shows tornadoes occur in most areas east of the Rocky Mountains, although they are mostly concentrated in the midwest. The average number of tornadoes per year works out to 276 on basis of a near half-century of records. But this figure is grossly misleading because tornado-counting has become fully organized only in relatively recent times. If the recorded tornadoes of the past ten years are averaged, the annual U. S. tornado expectation works out to about 660 a year!

The whirling winds of a tornado can climb to speeds of 500 miles an hour. As if this were not enough, updrafts moving up to 200 miles an hour, and barometer-shattering vacuums inside the tornado funnels literally cause houses to explode and add to their destructive power.

Small wonder that year after year death and property-damage statistics continue to increase. Individual storms often create appalling losses of life and property. For example, 317 people were killed by one tornado in Mississippi in 1840; another storm travelled 219 miles in 1925 leaving in its wake 689 dead, 1,980 injured and $17 million worth of destroyed property; a 1953 tornado in Massachusetts set an all time record of $52 million in property damage; and only two years ago a storm in the midwest killed 240 and injured 5,000 people.

The Genesis of Terror. How are tornadoes formed? What accounts for their tremendous power? The scientific community still has no definite answers, mainly because intensive study of the mechanics of tornado formation has been going on only during the past decade or so.

Clues were sought in the various observable characteristics of the storms. There are always powerful electrical disturbances; sounds described variously as roaring freight trains or the buzzing of millions of bees are characteristic; heavy rains or hailstorms usually accompany tornadoes; and at times those curious lights known as St. Elmo’s Fire are seen on the ground in the vicinity of tornadoes.

There is increasing evidence supporting the idea that tornadoes are spawned by enormous positive and negative electrical charges that are built up in clouds by rising columns of air. But the puzzle still to be unravelled concerns the triggering mechanism that suddenly taps these reservoirs of electrical power.

Early Researches. A number of scientists have contributed to tornado studies. Notable among these probings were the speculations and experiments conducted by researcher Paul Silberg of Raytheon Company. A few years ago Silberg theorized that tor-

AVERAGE ANNUAL TORNADO FREQUENCY

![AVERAGE ANNUAL TORNADO FREQUENCY](image)

Fig. 1. Occurrence of nature’s malevolent force is seldom in the mountainous regions. Most likely areas are the flat open sections of the great plains of the central United States.

Radio-TV Experimenter

www.americanradiohistory.com
Tornados could perhaps be generated by electrical energy stored in clouds; but as recently as 1962 Silberg had to admit that there was no real proof that the electrical energy (known to be accumulated in clouds) actually does create the storms. There was the possibility that the storms might be created by some other unknown mechanisms, and that the electrical phenomena associated with tornados were the results, not causes, of the storms.

Silberg conducted several laboratory experiments in an effort to separate cause and effect. In one experiment he placed sixteen spherical electrodes into a ring configuration, then energized the system by connecting a small Van de Graaff electrostatic generator to only two of the spheres. He placed polyethylene and brass rotors in the center of the ring of spheres to serve as sensitive detectors of electrical charges. When the Van de Graaff generator was turned on, these rotors revolved at rates varying from 20 to 150 revolutions per minute. Waveform analyses indicated that the spinning action generated pulsed oscillations against the background electrostatic field configuration. This was taken as clear indication that rotary and vertical motion could be induced electrostatically.

In a second experiment, Silberg placed a

Dr. Vernon J. Rossow, a scientist at NASA’s Ames Research Center (near Mountain View, Calif.) with some of the laboratory apparatus.

similar electrode configuration inside a large transparent tube. A 90-kv electrostatic power supply was used to charge the system. When smoke was introduced into the tube, it acquired a rotary fluid motion whenever the power was on, and stopped moving when the power was cut off.

**NASA Stirs Up a Storm.** Using the discoveries of Silberg and other scientists as a springboard, NASA researcher Vernon Rossow (Ames Research Center, Moffet Field, Calif.) has gone ahead to develop more sophisticated theories about tornado formation. Rossow is now making miniature tornados in his laboratory by imposing high electrostatic charges onto jets of cooled steam. Rossow believes he is getting close to answering the vital questions about tornado formation. He also has ideas about how to knock out tornados before they can go on their rampages.

**Super Motor.** Rossow visualizes a tornado as a super-size electrostatic motor somewhat like that in the simplified diagram in Fig. 2. This motor has large, fixed electrodes charged to a high voltage differential. Between the electrodes is a rotor which transfers charges from one electrode to the other, thereby tending to neutralize the electric field. As the electrostatic forces of repulsion and attraction on the charge-carrying elements of the rotor make the rotor spin, the reservoir of electrical energy in the system is converted to mechanical energy in the rotor.

A typical cycle starts with the rotor ends in grazing contact with the electrodes so that they are charged to the same potentials as the adjacent electrodes. Since bodies with identical charges repel one another, and opposite bodies attract, the rotor ends are driven away from the starting positions. At the end of a half-revolution, the initial charge is deposited on the opposite electrode while a new charge of opposite sign is picked up and the process is repeated again and again.

The rotor may have any number of charge carriers and any number of electrode pairs. The speed of rotation depends on the charges on the rotor ends and electrodes, and on the friction of the surrounding medium. The rotor can move in either direction with equal effectiveness.

The analogous condition in a storm cloud would consist of charged positive and negative regions in the cloud replacing the fixed electrodes, a gaseous rotor composed of
charged water droplets, and air as the rotor spindle.

It is theorized that two elongated regions in a cloud become filled with charged water droplets (Fig. 3). It is further theorized that the intensity of the electric field between the charged regions is too low for discharge by lightning, but strong enough to drive fluid motion. It is estimated that this potential is in the order of 3,000 to 10,000 V/m.

When the potential (E) is large enough, a sizable eddy of cyclonic or anti-cyclonic rotation (clockwise or counterclockwise—depending on whether it is in the northern or southern hemisphere) from winds in the storm clouds disturbs the charged fluid system enough so that the unstable system is put into motion as shown in Fig. 4. There is a build-up of circulatory motion resulting from transfer of charge from one region to the other in a manner analogous to the electrostatic motor discussed earlier.

Since a well-charged region must be available to drive the induced vortex, the circulatory flow fluid (the central uncharged core and adjacent mixing areas) must move to new charged regions; this movement determines the path of the tornado. The "wake" is made up of nearly neutral fluid consisting of positively and negatively charged droplets that are coalescing to produce rain (which sometimes falls in the form of hail). Light emitted during this coalescence may account for the steady glow often seen to accompany tornados.

The initial rotary movement soon extends to the ground in the characteristic shape of a tornado funnel because of convection of vorticity, downdrafts, or viscous shear. This is a predictable and characteristic aspect of almost any vortex, as witness the behavior of water draining rapidly out of a sink or bath tub.

An admittedly over-simplified version of the theorized flow field is shown in Fig. 5. In the laboratory, the charge transfer positions are approximated by grids 1 and 2 which remove arriving charges and recharge the carrying water particles with charges of the opposite sign. In an actual tornado the arriving gases are thought to be expelled into adjacent cloud regions and the departing gases are drawn into the charge carrying channel at the same rate. The two contact points (grids 1 and 2) would behave like solid barriers in an actual tornado.

Laboratory Simulation. Rossow found that he could make small, four-inch high tornadoes in his laboratory from steam mixed...
The final grid system (Fig. 9) was made to resemble an electrostatic vortex over ground. Note the asymmetric positioning of the grids; these off-set positions were found to be necessary in order to achieve the maximum degree of circulation.

**Bigger Tornadoes.** You might think that Rossow would be satisfied now that he can turn his four-inch tornadoes on and off at will. Not so. The scientist is hard at work seeking ways to make bigger tornadoes in his lab. These, he believes, will lead to better measurements of the velocity of the field, more accurate descriptions of the way in which vorticity is transferred to the ground, and in general more accurate knowledge about all the variables that are critical for vortex formation.

**How to Stop Tornadoes.** A laboratory tornado can be stopped by the simple act of turning off the electrical power; the whole system coasts to a stop as soon as the residual charges on the electrodes are neutralized.

But how might it be possible turn off full-sized natural tornadoes? In theory, in exactly the same way—by removing the power that drives the tornado, if the driving mechanism behind a real tornado is in fact similar to that used in the laboratory. One approach would be to find some way of preventing the electrical charging of clouds to those conditions which would be conducive to tornado formation. However, this approach at present would seem to be applicable only in science fiction.

A more realistic method, it seems, would

---

**Fig. 5.** A charge-carrying channel in the vortex moves positive and negative charges in opposite directions between charged cloud areas. Grids supply charge in laboratory with enough cool air to bring the system to the point of condensation. Sharp-pointed electrodes are used as charge injectors.

A lot of preliminary experimentation was needed before Rossow could set up a reliable tornado generator. First various shapes and arrangements of electrode grids were used to determine the flow streamlines that would result. The first tests were made with a linear electrostatic generator diagramed in Fig. 6. From these tests it was learned that sufficient charge (using 20,000 volts) to set the steam-air mixture into motion could be obtained with several wire points, 0.2 millimeters in diameter, which projected a short distance downstream of the wire grid.

The grids were then arranged in circular configurations inside a cylindrical boundary (Fig. 7) and suspended over a ground plane (Fig. 8). The drawings show the types of vortexes that were obtained in each case.

**Fig. 6.** A linear accelerator was used to study grid shapes. Wire points, directed downstream of steam jet, were found necessary in order to achieve maximum vapor acceleration.

**Fig. 7.** With charged grids mounted in a circle, steam (injected at bottom) formed a rapidly turning tornado-like vortex in test chamber.
TORNADO BUSTING

Fig. 8. The circular grid arrangement produces an electrostatic vortex over a ground plane when cylindrical boundary is absent.

Fig. 9. This asymmetric grid arrangement simulates charged cloud regions over the earth.

would quickly short out the charges and tend to neutralize the electric field in the cloud. Such neutralization would remove the driving power behind the tornado and the storm would presumably coast to a stop.

Do Rossow's experiments prove that tornadoes can be shot down in this manner? "No," says the scientifically cautious researcher, "quite the opposite. If actual field tests with cannon are successful, those results would prove that the electrostatic motor theory is in fact correct."

War Without End. Assuming that theory will prove to be fact, one can begin to imagine the type of war that would be waged against these natural enemies. One of the major problems would be to find the tornadoes and put them out of action in extremely short periods of time. The "lives" of tornadoes are known to extend anywhere from a few seconds to as long as four hours; the average duration is only about 4 minutes! Some tornadoes only travel a few feet while others are known to have travelled far greater distances—as much as 400 miles; the average path length is about 2 miles.

Obviously, the "average" tornado would be a most elusive adversary; it would materialize almost instantly, travel 2 miles in four minutes, and disappear. Is it even possible to make contact, much less prepare to fight such a foe?

The problem appears somewhat less formidable when it is remembered that statistical averages represent the composite picture of very short-lived tornadoes which would have relatively little time to wreak widespread havoc, and the longer-lived tornadoes which present greater dangers. A great many tornadoes occur in areas where they are likely to do little or no serious damage—as (Continued on page 116)
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Transistor experiments on programmed breadboard — using oscilloscope.

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JUNE-JULY, 1967
"Serves you right! You and your imported bargains!"

"Are you certain that the antenna has to be assembled in the house?"

"Doris, have you seen my instruction book?"

"No, they won't make nice earrings! They're going to make a nice receiver!"
A fantastic new semiconductor device has recently left the laboratory stage and is now available "off-the-shelf" from many electronic parts dealers handling industrial components. The device is the gallium-arsenide diode, which emits invisible infrared rays when current is made to pass through it. Modulate it, and you can transmit intelligence between two distant points!

If you have been searching for a real Science Fair show stopper—look no further. Build this gallium-arsenide (GaAs is the scientific abbreviation) Infrared Communicator system and transmit music or sound over an invisible beam to distances of 100-feet and more.

As the radio-frequency spectrum becomes more cluttered and jammed, light-beam communication links employing similar semiconductor devices will take over. Experimental systems are now in operation (like the Infrared Communicator, only on a much larger and more expensive scale) and have successfully transmitted audio and video information over distances of 30 miles and more.

The Gallium-Arsenide Diode. The General Electric LED-9 emitting diode was chosen for this system since it proved to be the most readily available and the least expensive ($12.00 from Allied Radio) of the currently available diodes. The actual GaAs semiconductor chip measures only 0.010-in. in diameter. A transistor-type enclosure, with a glass lens mounted on the top of the case, houses the tiny chip. The entire pack-

**Fig. 1.** Emission of the GaAs diode (left) is shown on an enlarged segment of electromagnetic spectrum. This is the portion indicated as near infrared in the chart below.
INFRARED COMMUNICATOR

Fig. 2. Simplified schematic of output circuit used to modulate gallium-arsenide diode.

Fig. 3. Complete schematic diagram of amplifier modification to infrared transmitter.

Fig. 4. Completed infrared transmitter is mounted on tripod to make aiming easier.

age is not much bigger than the head of a wooden match! Infrared light is emitted from the diode junction when DC current is passed through it in the forward direction (forward bias.) This phenomenon is known as electroluminescence. The emitted light output is directly proportional to the amount of current passing through the diode.

As shown in Fig. 1, the diode emits a very narrow "band" of frequencies at 0.9 micron (9,000 Angstroms). This lies in the near-infrared region of the electromagnetic spectrum. The emitted light is non-coherent even though the bandwidth is very narrow. Specially designed, more costly diodes, can be made to emit coherent (single frequency) light. They must be pulsed with extremely high-current, short-duration pulses. This special class of emitting diodes are sometimes referred to as laser diodes. The emitted light output of the GaAs diode can be amplitude modulated, and the operation is similar to an AM transmitter. GaAs diodes have inherently fast response and can therefore be modulated up to about 100 MHZ. Audio and video information can be easily transmitted by these diodes.

Under normal operating conditions, the power output of the GE LED-9 is low—about 50 microwatts! This probably doesn't sound like much power. However, by employing proper optics, the emitted light can be beamed over a considerable distance.

How The Transmitter Works. The simplified electrical diagram of the transmitter is shown in Fig. 2. Battery supply, B1, furnishes the DC forward bias for the diode. Resistor R2 serves as the DC current limiter, and also as the AC load resistor. Capacitor C1 couples the AC modulating current from the audio amplifier to the diode. The output impedance of the audio amplifier closely matches the AC impedance of the diode circuit.

The complete schematic diagram of the transmitter is shown in Fig. 3. Battery supply, B1, consists of four D-size flashlight cells connected in series to provide 6 volts. B1 powers the audio amplifier and also provides the DC bias for the GaAs emitting diode.

Using a Lafayette preassembled audio amplifier greatly simplifies the circuit. Since this amplifier provides lots of gain, it is possible to use any type of microphone, such as a crystal or ceramic type. So of course you can even feed the output of a phonograph cartridge into the amplifier. Since the
Fig. 5. Schematic diagram shows added components you must connect to use ready-wired transistor amplifier as receiver for infrared transmitter on facing page.

Fig. 6. Major external difference between transmitter and receiver is the speaker grille on one side of receiver.

Fig. 7. Dimensions of mirror mount are given above. Disc can be cut from wood, plastic or fiber as long as material is rigid enough to hold mirror in place and will not be affected by variations in temperature or humidity.

Output of a crystal cartridge is usually much higher than that of a microphone you may have to reduce the signal level through a separate gain control.

Referring to the schematic diagram, you will notice that not all of the amplifier leads are used. The diagram shows which wires to remove.

Bias current through the diode is limited by R2 to approximately 80 milliamps. R1 serves as the gain control, and is used to set the modulation level. Over-modulation will cause the audio signal to be clipped by the diode resulting in a distorted signal. Therefore, R1 is adjusted to prevent this.

The completed transmitter package is shown in Fig. 4. It consists of a mirror assembly mounted on a standard 5 x 10 x 3-inch chassis. The diode is held in the focal point of the mirror with a special bracket. A 5½-inch diameter “mangin” mirror (available from Edmund Scientific for $5.00) is used. The infrared rays emitted from the diode are focused into a very narrow beam, very much like that from an automobile spotlight. This beam is aimed at the receiver unit which employs a similar set of optics.

The Receiver. The complete schematic diagram of the receiver is shown in Fig. 5. Basically, it is a silicon solar cell feeding
INFRARED COMMUNICATOR

another preassembled Lafayette audio amplifier. The solar cell detects the infrared rays emitted by the GaAs diode. Its spectral response very closely matches the spectral emission of the GaAs diode. The silicon solar cell spectral sensitivity curve looks very much like the spectral emission curve of the GaAs diode shown in Fig. 1. The silicon solar cell is also a very "fast" detector and therefore easily responds to the audio modulation content of the infrared beam.

Battery supply, B2, consists of four D-size flashlight batteries in series to provide 6 VDC. R3 serves as the volume control for a 4-inch 3.2-ohm PM speaker connected to the output of the audio amplifier.

The completed receiver package is shown in Fig. 6. Like the transmitter, it consists of a mirror assembly mounted on a standard 5 x 10 x 3-inch chassis. Here the solar cell is held in the focal point of the 5½-inch "mangin" mirror with a special bracket. The infrared beam from the transmitter is focused on the silicon solar cell by the mirror. A shielded lead must be used to connect the solar cell to the input of the amplifier within the chassis enclosure.

Size of the solar cell is not important. The cell used here measures 0.4 x 0.4-in. (equivalent to a Hoffman type 110C). Any of the smaller sizes (as specified in the Parts List)

Fig. 8. Diode mounting bracket (left) holds diode in focal point of mirror.

Fig. 9. Solar cell bracket is just about identical to that in Fig. 8.

PARTS LIST FOR INFRARED COMMUNICATOR

2—5½-in. diameter mirrors (Edmund Scientific No. 70080)
1—4-in. PM speaker (Lafayette 99C6268 or equiv.)
4—Dual D-size battery holders (Keystone 176 or equiv.)
4—½-in. spacers, ½-in. O.D., tapped 6-32 (H. H. Smith ceramic stand-off insulator type 2641 or equiv.)
2—Knobs
2—¼-in. rubber grommets
1—Terminal strip
3—Solder lugs
Misc.—Shielded wire, microphone, speaker grill, sheet plastic or plywood, plastic rod or wood dowel, brass or copper strap, 6-32 hardware, hookup wire, solder, etc.

Estimated cost: $45.00
Construction time: 7 hours

Radio-TV EXPERIMENTER
will work equally well if connected properly.

**Construction.** Construction details of the mirror holders are given in Fig. 7. You can use any material, such as plastic, wood, pressed hardboard, etc., to construct the holders. The main objective is to hold the glass mirrors securely without chipping, cracking or otherwise damaging them. Ceramic spacers (they're actually stand-off insulators) are used to secure the mirror holders to the chassis enclosures.

Two identical J-shaped brackets are fabricated for the GaAs diode and the solar cell. Details are shown in Fig. 8 and Fig. 9. Heavy aluminum, copper or brass strap material should be used to fabricate the brackets since it is important that the GaAs diode and the solar cell are rigidly supported in the focal points of the mirrors. Each bracket is built in two halves. The holes for the 6-32 screws used to fasten the two halves together should be long slots to permit “focusing” the GaAs diode and the solar cell. The heavy strap material can usually be found at any sheetmetal shop or in the do-it-yourself materials section of hardware and building supply dealers.

The GaAs diode is mounted in a 3/16-in. hole. Slot the end of the bracket as shown in Fig. 9, then press fit the diode into the hole.

The rear of the solar cell is pretinned with a low-melting-point solder. Solder the solar cell directly to the bracket (if you use copper or brass) as shown in Fig. 8. The inner conductor of the shielded lead is soldered to the conducting strip on the front side of the solar cell. The outer shield is soldered directly to the bracket.

**Operation.** Successful operation of the Infrared Communicator, particularly over any distance, hinges on how well you align the optics. It is suggested that both units be mounted on tripods for added versatility.

You can focus the GaAs diode and the silicon solar cell in the following manner. Set the units about 25-feet apart and aimed at each other. Both units should be turned on. Turn the volume control on the receiver all the way up. You will hear the internal noise (rushing sound) generated by the audio amplifier. Now turn the gain up on the transmitter. You will hear an added noise level in the receiver. This is due to

(Continued on page 116)
BANANA BELT DX

by C. M. Stanbury II

Of all the areas on earth a DXer can tackle, one of the most challenging is right in his own backyard. Central America, stretching southeastwardly from Guatemala to Panama (and the Panama Canal Zone), can be logged either on shortwave or the broadcast band, though few of its stations have high power and most are tricky to QSL. In other words, the eight tiny countries of Central America will give every DXer a chance to try all his DX skills.

Guatemala. Moving from west to east, we start with Guatemala which has the longest history of any Central American nation. Here civilization reaches all the way back to the Mayan empire. More recently, Guatemala was the scene of the first Communist takeover in Latin America which took place in the early '50s. Said red regime was subsequently overthrown by the CIA, and presently, the government is slightly right of center.

Possibly the most interesting DX catch is TGBA "Radio Maya" at Barillas on 2360 kHz. Although above the MW BCB, that is still technically MW territory. In addition to Spanish, this religious station also transmits in such exotic languages as Cluj, Mam and K'jobal. Everything about TGBA seemed so unusual that one well known club editor even went so far as to compare it with a hoax station. (You can't believe everything you read!) But, there really is a R.Maya and on good evenings it can be heard prior to their 2200 EST S/Off.

Of course Guatemala's most powerful station is government owned R.Nacional at Guatemala City. During the communist era it was, needless to say, very active on the international bands. Currently, R.Nacional uses only one SW frequency, 6180 kHz (TGWB) where it is very heavily QRMed. The BCB frequency, 640 kHz (TGW) also suffers severe interference from CMQ in Havana (Havana, if you prefer the English spelling) as well as our own KFI in Los Angeles.

Ironically, a low powered regional government station is much better heard in the U.S. and Canada than the main Guatemala City transmitters. This station is TGFP, R.Nacional Tikal on 6205 kHz at Flores Peten, often heard evenings until they S/Off at 2330 EST. Incidentally, TGFP is located in the heart of Guatemala's wild northern jungle. Finally, novices hunting Guatemala

Here's how you can peel off Central American QSLs and become a real pro on the Banana Belt bands!

46

www.americanradiohistory.com
The author has bagged a few QSLs. Top left is Panama's HOMN on the BCB, bottom left lighthouse station TIFC on 1075 kHz in Costa Rica, and at right is Guatemala's BCB station TG/W, "La Voz de Guatemala."
Banana Belt DX

should start with TGNB R. Cultural at Guatemala City which has English religious programming on 9670 kHz at 2200-2300 EST.

**British Honduras.** Roughly 90 miles east of Flores Peten we find Belize, capitol city of British Honduras. In a year or two, this country expects to graduate from colony to independent nation status. Then the whole country will be known as Belize. (A new hot country for DXers and stamp collectors.) Unfortunately, Guatemala is holding up proceedings by claiming British Honduras as its own. These claims were pressed most vigorously during Guatemala’s red period, via potent R.Nacional, and these claims are still being pressed although somewhat more quietly.

R.Belize is widely logged by North American DXers, both on the MW broadcast band (where they have a 20 kw transmitter on 834 kHz) and on 3300 kHz. The latter is 90-M territory. R.Belize is apparently the only broadcast station in Central America without call letters.

**Honduras.** Moving south along Guatemala’s eastern border, and crossing the Gulf of Honduras we come to the Republic of Honduras. This country has a long history of dictatorships and poverty. Currently, however, there is a form of democracy and it shows a few signs of prosperity as demonstrated by the appearance of broadcast stations in the smaller cities (really large towns). For example, HRRZ, R.Juticalpa on 4950 kHz, can occasionally be heard up here evenings until 2200 S/Off. Incidentally, when the CIA overthrew Guatemala’s red regime, its army marched from Nueva Oco-tepeque which today boasts HROE “La Voz de las Fronteras” on 5035 kHz, usually blocked for DXers by QRM.

There is no Honduran station easily heard by SWLs and many are eradicated verifiers. One that will QSL correct reports consistently is missionary station HRVC R.Evangelica on 4820 kHz at the capitol, Tegucigalpa. Further, HRVC has English programs on Sundays prior to their 2230 S/Off. Moving up a little in frequency, HRQ R.Suyapa at San Pedro Sula is heard from time to time during evening hours on 6125 kHz, 49-M territory. With an ever increasing sunspot count, more and more high powered European QRM will be vacating this band thus making stations like HRQ easier to hear. R.Suyapa often identifies itself and S/Off is 2300 EST.

**El Salvador.** South of Honduras, cutting off most of its Pacific coast, is tiny El Salva-

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**ABBREVIATIONS**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>BCB</td>
<td>broadcast band</td>
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<tr>
<td>CIA</td>
<td>Central Intelligence Agency</td>
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<tr>
<td>DX</td>
<td>long distance, distant (contact or country)</td>
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<tr>
<td>DXer</td>
<td>hobbyist who seeks DX contacts</td>
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<tr>
<td>EST</td>
<td>Eastern Standard Time</td>
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<tr>
<td>kHz</td>
<td>kilohertz (kilocycles)</td>
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<tr>
<td>kw</td>
<td>kilowatts</td>
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<tr>
<td>M</td>
<td>meters</td>
</tr>
<tr>
<td>MW</td>
<td>medium wave</td>
</tr>
<tr>
<td>QRM</td>
<td>noise and signals interfering with desired signal</td>
</tr>
<tr>
<td>QSL</td>
<td>decorated postal card or letter from station acknowledging reception report</td>
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<tr>
<td>R.</td>
<td>Radio (as in Radio Maya)</td>
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<tr>
<td>S/Off</td>
<td>sign off</td>
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<tr>
<td>SW</td>
<td>shortwave</td>
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<tr>
<td>SWBC</td>
<td>shortwave broadcast</td>
</tr>
<tr>
<td>SWL</td>
<td>shortwave listener</td>
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</table>

Console of YNOL (“Ondas del Luz”) is prime Central American target for many DXers.

This country shouldn’t give SWLs much trouble as government owned YSS R.Nacional at the capitol San Salvador operates up on 31 meters, 9555 kHz where they are often heard at 0700-1200 EST, late afternoons and evenings. YSS also has a potent BCB signal on 655 kHz. If your broadcast band receiver has any kind of selectivity at all, you should be able to log them evenings. Unless, of course, you live in Nashville (WSM 650) or New York City (WNBC 660).

**Nicaragua.** East of Honduras is Nica- (Continued on page 118)
Let this dual voice coil speaker reduce much of the clutter from your desk and free your operating position for important work.

by Herb Friedman, W2ZLF / KBI9457

If your CB operations consist of something more than sitting back and chewing the fat on 11 meters, your operating position is probably jammed to the edges of the desk with gear. Perhaps a radio to fill the silent voids between calls, maybe a second transceiver to cover the H.E.L.P. channel if you're involved in a REACT operation, possibly a public-service receiver for police and fire calls if you're part of an emergency net.

Yet, as important as all the auxiliary equipment might be, rare is the professional communications center that buries the operator under a mountain of equipment. Generally, the signal from secondary equipment is fed from a remote location, such as a closet, to a speaker at the operating position; and even the primary equipment might be remote controlled. In fact, in some of the really complex communications centers there is but a single speaker at the operating position, with a special electronic switch rapidly "cutting" the speaker into several circuits, so that a single speaker carries two or more signal circuits.

While electronic switching is somewhat expensive, there is still an inexpensive way for the CB'er to get more than one signal out of a single speaker; thereby freeing the operating position from the clutter of some of the receiving equipment.

One pathway to a clutter-free communications center is through the CB Signal Center. The Signal Center has but a single 6-inch speaker, yet the speaker can be connected to two separate receivers (or transceivers) at the same time. The levels can be preset so that one signal source is reproduced at a background level—such as music from a radio—while the second signal, say from a CB transceiver, comes in much louder and overrides the background signal.

Either signal circuit can be totally disabled, or if desired, the level from each receiver can be controlled directly at the Signal Center. The total flexibility of the Signal Center depends on how much you want to build in. In fact, total signal control can be built into the Signal Center so that all equipment can be placed in a closet. All you'll need is a remote (long cord) cable for the push-to-talk microphone.

How It Works. The heart of the signal center is a dual-voice-coil speaker, Utah's model SP6D-M1. As shown in the diagram below, each voice coil is completely dependent of the other, and each voice coil can be connected to an individual receiver. If the speaker is connected to two radios, the two separate radio programs will be reproduced. If one voice coil is connected to
**CB Signal Center**

a radio and the other connected to a CB transceiver, both the radio program and the CB signals will be heard.

Add the appropriate switching and volume control facilities shown in the **Signal Center** schematic and the **Signal Center** can control all the volume and program switching adjustments.

The schematic of the **Signal Center** shows two possible connections you can utilize. The connections for REC 1 has provisions for controlling the volume at the speaker. With the volume control of REC 1 set ¾ to full open, the volume is adjusted at the speaker by the L-pad (R1)—a speaker-level volume control that provides proper impedance match to the receiver's output transformer.

If you don't need volume control at the speaker, you can use the circuit shown for REC 2; a switch to cut the speaker in and out (S2) and a load resistor (R2).

If you have no need to completely disable either signal source the switches can be eliminated. Of course, an L-pad can be used in both circuits to provide individual remote volume control.

**Why The Load Resistor.** If an L-pad is not used, the load resistor, R2, **must** be used to provide the correct terminating impedance for the receiver. This is because the impedance of each of the speaker's voice coils are 20 ohms. For 5-watt CB transceivers and table radios (which normally use a 3.2-ohm speaker) R2 is 3.9 ohms at two watts. (The 3.9-ohm resistor in parallel with the 20-ohm speaker provides a total impedance of approximately 3.2 ohms.) For 6 to 8-ohm speaker circuits R2 should be 10-ohms at 2 watts.

Resistor R2 isn't needed when an L-pad is used as the pad will “compensate” for the 20-ohm speaker voice coil mismatch as long as the L-pad isn't set “wide open.” Just keep the L-pad backed-off slightly from full-open and you'll have no mismatch problems at all.

Keep in mind that the matching resistor does “eat up” some output level, and the receiver's volume control will have to be advanced slightly from the usual setting to obtain the “normal” speaker level.

**Building the Signal Center.** The unit shown in the illustrations incorporates the circuits shown in the large schematic; an L-pad control on REC 1 and a matching resistor for REC 2. It is housed in a 6-inch wooden speaker baffle.
While a metal enclosure might look more pro, keep in mind that a wood baffle produces a superior sound, with none of the metallic "ring" common to metal enclosures (you'll be surprised how good your transceiver sounds when you get the speaker out of the metal coffin).

If your speaker baffle doesn't come complete with a back panel cut one from a piece of plywood. If the speaker sounds boxy or hollow with the back on, simply drill two or three ½-in. holes in the back panel.

Install input jacks J1 and J2 on the back panel. If you don't use an L-pad solder the load resistors (R2) directly across the jacks. The load resistor (not shown in the photographs) is wired directly across the solder terminals of J2. Connect about 12 inches of two-wire zip-type (thin parallel) speaker wire to each of the jacks and then set the panel aside.

Temporarily mount the speaker so you can judge the clearance for the switches. Mark the locations for the switches in the upper corners, then remove the speaker and drill the holes for the switches. If you use L-pads they can be installed on the top of the baffle as shown in the photographs.

Mount the switches, the L-pad, do as much wiring as possible, and then install the speaker. Complete the speaker wiring and connect the leads from the back panel. Finally, use four wood screws to hold the back in place.

Connecting the Receivers. If both speaker circuits are to be connected to CB or communications receivers make up a patch cord with a phono plug at one end (for J1 and J2) and a plug at the other end that matches the headphone or remote speaker jack on the receiver. Simply plug the one end of the cord into the Signal Center and the other into the receiver.

If the receiver doesn't have a headphone or remote speaker jack, or if you're connecting to a radio, you'll have to make a slight modification to that speaker circuit.

Disconnect the leads at the radio's (or
Often it is just a matter of inserting a plug into a jack to connect the BCB receiver or CB rig to the CB Signal Center speaker circuit. As shown in the photographs, solder a terminal strip to one speaker terminal. Re-install the speaker but connect one of the leads to the speaker to the insulated terminal (disabling the internal speaker). Then solder a length of zip or speaker wire to the speaker terminal having the output transformer lead, and to the insulated terminal.

If the receiver or radio doesn't have a power transformer, and is the so-called AC-DC type, you must make certain you don't bring out a “grounded” speaker lead as this might create a shock hazard by making the shell of P1 or P2 one side of the AC power line. As shown in the photograph, check that one speaker terminal is not connected to the speaker frame—with the frame, in turn, connected to the radio's chassis (this is common in many radios). If you do find a ground strap, or a direct connection between the speaker terminal and the frame, make certain it is this connection that is opened and connected to the insulated terminal strip.

Finally, label the switches and jacks so you’ll know what is what and get rid of the junk at the operating position. Unlike 30 years ago, the sure sign of a professional operation is a completely clear desk, not a wall of dials, meters and cabinets.

**SOLID-STATE BULL/BEAR TICKER NEEDS NO TAPE**

A new display system with a semiconductor “brain” that functions at nearly the speed of light will soon give brokers and investors a better picture of the stock market. Legible in any lighting environment, the new system is the first one able to keep pace with even the busiest market, according to Trans-Lux Corp., designer and manufacturer of the new tapeless ticker apparatus.

Called Trans-Jet, the system links directly to the nation-wide communications networks of stock exchanges to instantaneously display market quotations. It needs neither ticker nor tape because its “brain” converts network signals into quotations via pneumatically-driven, high-contrast luminescent discs fixed to a conveyor belt.

Our photos depict three views of the new system; in center photo, Trans-Lux chief engineer Charles J. Holloman shows technician James Lusk the printed circuit board containing the system’s logic “brain.”
Let electronics stand guard when you leave your wheels unattended!

You almost could give odds that in the next few months someone you know will have his car stolen or broken into. Fact is, auto break-in and theft is fast becoming the All American Sport, for you've not only got professional thieves to contend with, you've got the local hoods who believe any shiny new car belongs to them.

Insurance? Next to worthless! You can never get back the true value of your car since most insurance policies are limited to actual cash value (ACV), meaning you get about what it's worth on a legitimate trade-in. Whether it's spotless and smooth-running, or it has a one-lung engine and mashed fenders, it's still worth the same ACV. Contents stolen or damaged? Not covered by car insurance! That CB rig, camera, or luggage (filled with vacation clothes) is completely lost if you don't have separate theft insurance—the expensive kind.

But invest about $17 and an hour's work installing the Auto Siren Sentry and you've got just about the best theft "insurance" you can buy. The Auto Alarm fights theft and break-in two ways. Firstly, it sticks out like Jayne Mansfield at a Boy Scout meeting. Right there on the fender is a key switch which in any man's language means "Watch Out," this car is wired for sound.

Secondly, the instant anyone tries to open a door, the hood or the trunk, a screaming siren fills the neighborhood; and it can only be turned off with a key. Unlike other theft alarms which shut off when a door is closed or if the trip switch is taped down, the Auto Alarm cannot be silenced other than with the alarm's key or ripping loose the connections. Keep the wires hidden and friend thief will take off on foot before he can find the wires. No thief is going to try driving around with a siren roaring under the hood. Police take a dim view of a "civilian" car with a siren.

How It Works. The schematic diagram shows how the siren and locking circuits work. M1, an electronic siren module, in conjunction with speaker SPKR, comprise the siren. The positive voltage input is fed through S1, a key-lock switch, to the module. R1 is simply a dropping resistor for the module which works best with a 6- to 10-volt input.

The negative battery connection to the siren module is made through normally closed pushbutton switches, like those used to turn on courtesy lights when a door is opened (these switches are indicated by the dotted lines in the schematic).

Trace the circuit through. Note that when a door is opened, the associated switch connects terminal 2 of terminal strip TS1 to ground—completing the power connection to the module and the siren "sounds off." Also note that when terminal 2 is grounded...


**AUTO SIREN SENTRY**

relay K1 is energized, pulling down K1’s armature or wiper contact. When the moving contact touches this normally open terminal (#2) it parallels the door and trunk switches and "permanently" grounds the relay and the module’s ground connection—the siren keeps sounding even if the door is closed (opening the -switch). The only way K1 can be released—to turn off the *Auto Siren Sentry*—is to interrupt the positive battery connection by opening key switch S1.

**Protecting The User.** Since key-switch S1 is mounted on the fender—and you want it there for all to see—it protects the user against the embarrassment which might be caused by the siren going off as he attempts to leave the car (which will happen if the alarm switch is mounted inside the car). After the user leaves the car, the alarm is set by turning S1 to on. Before getting into the car, the driver then turns S1 to off. Naturally, if S1 is mounted inside the car the alarm will sound whenever the driver enters the car. Mount the key switch out on the fender for your own peace of mind.

**Construction.** Actually, there isn’t much involved in building the *Auto Siren Sentry*. The siren module is an *EICOCRAFT Siren Module Kit*—type EC-100, which can be assembled in a matter of minutes. There is but a handful of components which are mounted on a pre-punched and "component position marked" printed circuit board. However, assemble only the board itself, do not make the external connections given in the instructions as the *Auto Siren Sentry* uses a simpler external wiring harness that given with the module.

After the module is completed, connect a 10-inch length of black wire to terminal G, loop the wire under the board and solder the end to F. Connect a 1-inch length of bare wire to C. Connect a bare-wire jumper from point A to point B. Then connect two wires of the same color to D and E, the speaker terminals. Note that the board shows the battery connection to A and B; ignore these instructions. In the *Auto Siren Sentry* the positive battery connection is the

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**PARTS LIST**

- **K1**—S.p.d.t. relay (Potter and Brumfield RS5D-12VDC, Allied 41D5504—P & B RS5D-6VDC, Allied 41D5896 or equiv.)
- **M1**—Siren Module (EICOCRAFT EC-100 or equiv.)
- **R1**—10-ohm, 5-watt resistor (see text)
- **S1**—Key-lock switch (Lafayette 33C6401 or equiv.)
- **SPKR**—Weatherproof speaker (Lafayette 44C-5201 or equiv.)
- **TS1**—Terminal strip (see text)
- **Misc.**—Wire, solder, mounting hardware, solder lugs, etc.

Note: The EC-100 Siren Kit is available from Custom Electronics, P.O. Box 124, Springfield Gardens, N. Y. 11413. Price is $4.95 plus 35c postage and handling.

Estimated cost: $17.00
Construction time: 2 hours

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Inexpensive key-lock switch set in fender advertises burglar alarm. Presence of lock alone will give some theft protection.
short bare wire at C while the negative battery connection is the black wire going to F and G. After all cabinet holes are cut in the main section of a 3 x 5 x 7-inch aluminum cabinet, mount the siren module as shown in the photographs, on the bottom as close as possible to one side; use stand-offs between the board and the cabinet to avoid shorting the printed-circuit wiring. The stand-offs as well as the necessary mounting hardware are supplied with the module.

The speaker is a three-inch waterproof type. The speaker specified in the Parts List is supplied in a metal cabinet having an integral gimbal bracket. If the speaker is installed as shown, in an aluminum cabinet, place a piece of perforated phenolic board in front of the speaker, to prevent possible damage to the cone. (If desired, the speaker can be used in the cabinet supplied.) Mount the speaker cabinet near the radiator, facing outwards, and connect the speaker leads from the module to the terminals on the speaker cabinet.

The wiper contact on K1 is automatically grounded when the relay is mounted in the cabinet—the wiper contact is connected directly to the frame of K1.

While only a three-lug terminal strip is required if the speaker is mounted in the aluminum cabinet, we show a five terminal type in the photographs to illustrate the arrangement when an external speaker is used. The speaker would connect to the two terminals shown unused. To reduce the possibility of wiring errors, place the battery connections on opposite ends of TS1, as shown, with at least the switch terminal in between. Install the Auto Siren Sentry on any convenient surface under the hood. Just make certain the alarm doesn’t project above the hood line or you won’t be able to close the hood.

Installing The Switches. Any existing door switch automatically becomes part of the Auto Siren Sentry when the wire from terminal 2 of TS1 is connected to the cour-
ttesy light circuit. These switches are the self grounding type, always switching the ground lead of the courtesy lights: therefore, when you look at these switches you will see only one connecting wire. All other switches which may be added should be of the same type, self grounding, with their leads connected to the wiring of any of the original door switches. Additional switches for the hood, trunk or rear doors can be purchased from your car dealer at nominal cost.

The key switch should be installed so some smart "cooky" can't jump the terminals. If the switch is installed in the part of the fender that faces the tire anyone can reach under the car and jump the terminals, making the alarm inoperative. Install the switch on part of the double fender. Part of each fender, near the door, is shielded by the sides of the firewall, and access to the space between the fender and firewall is only through a small area which is exposed when the door is open. Place the switch so that its terminals are in the concealed space.

Positive Grounds. The circuit shown is for cars with the more common negative ground battery. If your car uses a positive ground battery simply reverse the connections to siren module terminals C and G.

6-Volt Systems. If your car uses 6-volts eliminate R1—use a direct connection from terminal 1 of TS1 and use the alternate 6-volt relay specified in the parts list.

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Wireless Lingo Lab

Latest thing in language labs may be the Class-Master 1 system by Dictaphone, which works as a closed-circuit radio setup. With the Class-Master 1, foreign language lessons on tape or disc can be broadcast from a transmitter to the classroom and received by the students through their headsets. They learn by listening to a foreign language phrase and then repeating the words into a lightweight earphone-type mike.

The teacher, who hears the lesson through her own headset, is able to provide individualized instruction by roving through the classroom and monitoring the response of particular students at will. Signals come from a single loop antenna hidden in the classroom.
Totally new concepts in the hi-fi field often turn out to be nothing more than improvements on a previous "totally new concept" which in itself was an improvement on a "totally new concept," etc., etc., ad nauseam.

It was therefore surprising to find that Euphonics' Miniconic line of phono cartridge really was totally new. Whereas the modern hi-fi cartridge is a precision refinement of a magnetic voltage generator, the Euphonics' Miniconic is essentially a resistor which develops an output voltage by functioning as a variable part of a series voltage divider. We have diagrammed these differences in the illustration below.

Standard magnetic cartridge and newer solid-state type do the same thing, but in entirely different manners. Stylus in standard cartridge moves magnet or coil to generate voltage output; stylus in Euphonics unit simply varies resistance of silicon bar to produce signal.

This and That. In a typical hi-fi cartridge the movement of the stylus varies the magnetic field around a coil of wire. Either the stylus moves the coil or it moves the magnet. Or it can simply vary the intensity of the magnetic field. Regardless of the mechanical operation, the end purpose is to generate a voltage by changing the strength of the magnetic field in relation to the coil. On the other hand, the Miniconic's element is simply a resistor—a bar of silicon—which, by itself, cannot generate an output voltage.

The movement of the attached stylus only varies the resistance of a silicon bar.

To obtain an output voltage it is necessary to make the silicon resistive element part of a voltage divider, as shown in the basic circuit diagram. As the stylus motion rapidly changes the resistance of the silicon bar, the voltage at the junction of the bar and the fixed resistor changes, too, varying above and below the no-movement voltage at the junction. Since capacitor Cx passes AC while blocking the DC at the junction, the voltage appearing between the output terminal of Cx and ground is the audio-signal voltage resulting from the motion of the stylus in the record groove.

Since the Miniconic cartridge is a stereo unit, it has two silicon bars—one for the left channel and one for the right.

Unless you're a skilled electronics technician there isn't much you can do with just the cartridge. By itself, the cartridge has no output signal.

Simplified circuit of Euphonics system shows need for DC power source and amplifier. Cartridge effectively serves as a voltage divider.

To make the Euphonics Miniconic cartridge as easy to install and to operate as a magnetic cartridge, Euphonics supplies...
the Miniconic cartridge as a complete kit—the cartridge with a power supply and phase-inverter equalizing amplifier—called the Power Source. The kit we tested consisted of the Euphonics Miniconic U-15-LS cartridge and the PS-15 Power Source.

**PS-15 Power Source.** Each channel has a one-transistor amplifier, but the left channel has, in addition, a phase inverter amplifier that inverts the phase of the left-channel signal for correct phasing. The output of each amplifier is fed to an equalizer network. When the switch on the PS-15 is set to the HI position the signal is fully equalized to the RIAA curve at an output level of 0.4-volt rms. This allows the Miniconic system to be connected directly to the high-level input of your amplifier with full equalization. When the switch is set to the LO position, the output level is reduced to 8-milli-volts rms, and the Miniconic can be fed into any standard mag phono input.

**Euphonics U-15-LS Cartridge.** The cartridge itself is extremely small and very lightweight—so light that the counterbalance on many arms will not compensate for the weight of the cartridge. To handle this problem, the U-15-LS is supplied with a set of weights and spacers which allows the cartridge to be balanced, and positioned so that the stylus is below the cartridge holder. While the Miniconic simply plugs into its matching arm with no weight or positioning problem, we chose to test it with a quality turntable-and-arm combination that is more or less a favorite with serious hi-fi enthusiasts. We found that positioning the weights and spacers was a bit troublesome, and it must be done very carefully and very slowly. Once the weights and spacers are correctly installed there’s no further difficulty.

While the Euphonics U-15-LS cartridge is designed to plug directly into its own arm, a special plug adaptor, which is supplied, must be used with arms other than the Euphonics. The adaptor just plugs onto the back of the cartridge while the arm connection plugs onto the adaptor pin. The combined length of the cartridge and adaptor is just slightly longer than the available head space on many arms. If you’re short of space, carefully bend the connecting lugs from the arm at right angles to the adaptor and rotate them so none short together.

**Is It Worth The Cost And Effort?** Since the Euphonics Miniconic system commands a premium price, and might involve some extra effort, the question is: “Is it worth it all?” Well, the answer depends on your own musical tastes. If they are as severe and critical as the editor’s, the answer is, “yes!”

We found the U-15-LS cartridge to have exceptionally smooth sound—soft and silky would be the best description. There was virtually no discernible distortion, nor could we hear, even with the amplifier set to an ear-splitting volume, any hum or noise contributed by the added power supply and amplifier.

Unlike some other cartridges, acclaimed for their hi-fi quality, which have a hard sound (slightly peaked at the high end), the Miniconic is soft. And at first it seemed that it lacked highs, even though a frequency run proved otherwise. After we became accustomed to the sound we started to notice a most excellent definition—a quality whereby the listener is able to easily distinguish one instrument when all are playing together.

For clarity, the frequency response shown in the graph is for the left channel only. The maximum deviation between the left and right channel was 3 db, at 12, 16, and 18 kHz (kc.). Separation was excellent, measured as 23 db at 1 kHz and 16 db at 20 kHz.

Both the frequency response and separation

(Continued on page 116)
"That's right, Joe, send the ambulance to... WHEEE... SCRAWWWWK... Will BATMAN meet his doom? Will ROBIN fly away? Tune in tomorrow! Same bat-time. Same bat-channel..." And the 10-33 message disappears into an indecipherable mass of mixed-up audio from all the low-frequency channels.

Has this ever happened to you? Perhaps not during an emergency—but the chances are great that you have been a victim of ITV at least once or twice.

**ITV**—interference from television—is the reverse of that ancient plague TVI. While in TVI, the Ham or CBer produces interference to the television picture, in ITV the reverse is true. The television set produces interference to the radio operator. Frequently the interference is so severe as to make continued operation impossible.

However, like all other forms of interference, ITV can be brought under control. The first step is to determine just what is happening, and most important, just which TV receiver is causing the interference.

**Spotting ITV.** ITV announces its presence in a variety of ways. One of the most prevalent is that used in our opening example—a mass of mixed-up TV audio, which effectively blanks out the band from one end to the other. Frequently this type seems to be strongest right at 27.000 MHz (mc), fading down somewhat as you tune away from the 27 MHz spot.

Another form of ITV shows up as a loud buzz. This kind usually isn't so all-blanketing as the audio type. Sometimes the buzz is accompanied by a single-channel audio signal a few kHz (kc) away and sometimes not. Frequently the buzz appears to be wandering over the band, either up or down. Normally in this case the direction will remain constant and the buzz will move at about the same speed for the duration of its existence.

Occasionally ITV appears simply as a single interfering CW signal having the appearance of an unmodulated carrier. This type is particularly hard to recognize, since it can just as easily actually be an unmodulated carrier. Fortunately, it's rare.

The really nerve-wracking kind of ITV makes its appearance as a mixture of all the other kinds. Usually one type will be strongest, but all the rest will be there too. This kind is most often a secondary effect of whichever kind is showing up strongest, and frequently disappears when the primary cause is cured one way or another.

**What Causes ITV?** While all these kinds...
of interference can be traced back to television receivers, each kind usually traces back to a different portion of the receiver.

The all-blanketing mass of mixed-up audio is usually caused by an oscillating sound-IF stage in the receiver. This effect is particularly prevalent with the newer designs of receivers, which use high-gain tubes in their IF stages—these suffer from oscillation.

Surprisingly, the oscillation usually can’t be detected by listening to the receiver itself; it has no effect on the TV sound. It does, however, spray out a potent signal at the sound-IF frequency of 4.5 MHz—and at all the harmonics of this frequency. That includes 9, 13.5, 18, 22.5, and 27.0 MHz. The mushy sound characteristic of this type of ITV is caused by two things—the frequency spread of the TV sound signal (which is FM in the first place), and the 6-time multiplication of the original signal.

The loud buzz is the TV video signal itself. This type of ITV usually is due to re-radiation from the tuner of the TV set, and normally can be heard only for a short distance from the offending set. The band-wandering is actually just that—frequency drift of the TV receiver. On the picture tube you don’t notice it because TV receivers are wide-band devices. When you hear the signal as re-radiated interference, the drift is obvious.

The unmodulated carrier signal is also tuner radiation, but it’s the tuner’s local oscillator rather than the re-radiated video. Sometimes mistaken for video buzz is a buzz-saw whine caused by sweep-circuit radiation. The sweep-circuit interference can be distinguished because it peaks in intensity every 15.75 kHz, while true video buzz has only one peak. Occasionally video buzz has peaks at varying spacings—depending upon the video content at any particular instant.

When all kinds of symptoms show up together, the problem is most likely a case of cross-modulation, due to the strongest of the interference sources. When the strongest source is removed, all the rest may disappear as if by magic. In any case, each source must be traced individually.

One type of cross-modulation, though, must be mentioned, since it’s particularly difficult to do anything about. This is cross-modulation between two local TV-broadcast signals which produce a difference-frequency interference signal.

This type of ITV is most prevalent in Ham bands. Two-meter operators in particular are plagued by it wherever local assignments place Channel 4 and Channel 13 in the same geographical area. These two channels are exactly 144.0 MHz apart in the spectrum, and the video of one mixes with the video of the other to produce one mass of signals at 144 MHz, while the two audio signals intermix in the same way to produce another component of the mass.

The only thing the operator can do about this is to pack up and move—any other measures are ineffective.

But most cases of ITV aren’t so undefeatable. Almost all of them can be cured
with patience and cooperating neighbors.

**Spiking the Offending Set.** Even after you have identified the type of interference you're suffering, your detective job has just gotten started. You still have to find the set which is producing it, and determine how to cure that set.

Start by checking off all sets to which you have ready access. Begin your checking with the interference present. While listening to the interference, have the sets switched one by one. When the offender is switched off, the interference will disappear.

Usually the interference-generating set will be located close to the affected receiver. Frequently, however, it won't be the closest set. In particular, some makes of TV's seem to give more trouble than others (probably due to design differences).

If the on-off test of all TV sets in your home doesn't locate the culprit, the next step is to go door-knocking. This can be either an interesting foray into good-neighborism, or a frightening venture into no-man's land. Much will depend upon past relations with neighbors and the situation regarding TVI (the non-reversed variety). Some astute ITV-hunters have impersonated TV rating services and called their neighbors. This will at least establish whether any individual's set is on the same time as the interference—but the channel information is of no use.

If all else fails, you can use a directional antenna and direction-finding techniques (like searching for a hidden transmitter) to zero in on the location of the offending set. However, if you have to resort to this, you probably won't be in any position to effect a cure even after you find the culprit.

**Curing the Condition.** Let's assume that you have located the offending set, and what's more, let's assume that it's your own set so you can do as you please to cure the trouble. (If the real culprit belongs to a neighbor, you can improvise.)

The oscillating sound-IF stage can usually be quieted down by a very slight (not over ¼ turn) adjustment of the associated IF transformer. Often, replacement of the tube in the oscillating stage is enough to effect a complete cure.

Tuner re-radiation can be cured by installation of a high-pass filter at the antenna connections of the tuner inside the receiver, together with proper grounding of the TV chassis. Be cautious when attempting to ground the chassis, however, since many sets use so-called hot-chassis circuits and an improper ground connection can either blow fuses or cause a fire. The proper way to ground a TV chassis, when chasing interference, is through a .01-mf, 500-volt ceramic-disc capacitor. This lets all RF interference flow straight to ground, but holds back the house current from a chassis.

Sweep-circuit radiation is hardest to cure. One method which has worked in many cases calls for complete shielding of the inside of the TV cabinet, using aluminum foil tacked or cemented to the cabinet interior. This foil should be grounded directly, and the chassis grounded to the foil through a capacitor as described above. In more stubborn cases, a power-line filter may also be required. However, sweep-circuit radiation usually is troublesome only to Hams working on the 160-M band, and to VLF devotees.
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Here's your chance to stop sitting on the sidelines while the rest of the go-go crowd passes you by. Latch onto a swinging electric guitar, learn a few low-down rock tunes, and you've got your passport to fun-fun-fun! You don't own a guitar, let alone know how to play one? No sweat! The new Harmony-by-Heathkit TG-46 electric guitar solves both problems in one stroke (or is it strum?).

The TG-46 is specifically designed for both the beginner who wants to learn, and the experienced strummer who'd like a professional-quality instrument that doesn't shatter his budget. Heath accomplishes both purposes by providing a quality Harmony guitar in kit form. Besides saving quite a bit of change with the kit purchase, the buyer also gets a tuning record, pick, connecting cord, cushioned red-leather neck strap, carrying case with deep-pile red lining, and a "VU tuner." (This last item is a special gadget that permits even a tin ear to tune up the guitar as we'll see shortly.)

From the top of the headpiece to the bottom of the tailpiece the TG-46 is all "pro." There are three pickups: one for melody (full range), one for rhythm (bass), and one for treble. Each pickup has its own on-off switch as well as individual tone and volume controls. Also each pickup has six adjustable pole pieces, one for each string, which permit the player to adjust the strings for relative loudness comparable to a standard guitar (or, for that matter, any loudness arrangement desired).

The tailpiece, which the ends of the strings are anchored on, is a professional Bigsby vibrato type. By pushing a handle (which varies string tensions) variable frequency effects such as slurs, slides, and vibrato are obtained.

To overcome the effects of moisture and aging, which often ruin a guitar by deforming the neck, the TG-46 has a steel shank running through the neck. The player can easily adjust a nut on the steel shank to make the neck perfectly straight without any bows.

The bridge is fully adjustable, allowing the player to determine the exact desired action. (In guitar lingo, action is the distance strings must be pressed by fingers on the left hand before they are fretted.) This is of advantage to the beginner who would prefer a greater spacing between the strings and frets to eliminate fuzzy sounds caused by strings vibrating against unused frets. An experienced player might prefer the minimum spacing to get a good "fast" action.

Is Assembly Difficult? Unlike some other guitar kits that give you a block of wood you're supposed to trim on a bandsaw, the Harmony-by-Heathkit TG-46 is supplied with a completely assembled body, made of quality, good-sounding rosewood and handsomely finished in gleaming, warm, lightly-

(Continued on page 118)

Each of the three pickups has its own set of tone and volume pots. Vibrato bar decreases spring tension for unusual musical effects.
Plug-in adaptor gives accurate readings at low RPM using your single-range tachometer.

by A. A. Mangieri

TACH STRETCHER

- Single-range transistorized tachometers having an 8000- to 10,000-rpm range are not suitable for engine idle-speed adjustments, air-fuel ratio tests and adjustments. Why? Because the engine rpm readings that are useful for these tests and adjustments are crowded into the lower five- or ten-percent of the meter scale.

The Tach Stretcher adaptor provides accurate, easily read full-scales of 500, 1000, and 2500 rpm. The Tach Stretcher plugs into and is operated by the tachometer now in your car. A long connecting cable allows convenient placement of the meter when in use. Removal of the cable restores normal operation of the tach.

In addition, for added utility, the Tach Stretcher adaptor optionally includes DC-voltage ranges of .5, 10, and 25 volts for checking circuit voltages. The .5-volt range is used to locate high-resistance ground connections.

The adaptor is used with pulse-driven transistorized electronic tachometers having a meter with a basic current sensitivity of 500 microamperes or more, typical of single wide range tachs. It operates with either positive or negative ground systems.

Two calibration procedures are detailed. Included is a precise oscilloscope method which additionally permits a more accurate up-scale calibration of the tach and a scale-accuracy test over the entire scale.

Circuit. The schematic diagram (next page) shows the Knight negative-ground tach circuit modifications. This circuit, with variations, is typical of all pulse-driven tachs. Short voltage pulses from the ignition points drive transistor Q1 into conduction. A voltage-regulated pulse of longer duration with a very steep rise appears across Zener diode D2. This pulse, when applied to a relatively-large capacitance (C2), rectifiers D3 and D4, and meter Mt, results in very-short current pulses through the meter. The meter responds to the repetition frequency of the input pulses and is properly calibrated by potentiometer Rt.

Phone jack J1 is added to the tach circuit and transfers the output of the tach circuit from meter Mt and pot Rt to the more sensitive meter in the adaptor just by plugging in the interconnecting cable. When the cable is removed from J1 the closed-circuit contacts restore normal operation of the tach.

Range switch S1 selects the rpm range—each provided with a calibrating pot (R1, R2, and R3). Resistors R7, R8, and R9 are voltage multipliers for the DC ranges. Fuse
TACH STRETCHER

F1 and diode D1 provide meter protection. Capacitor C1 prevents meter-needle vibration at very-low rpm.

Adaptor Construction. First, add 0-100 and 0-250 scale markings on meter M1. Scales were added to the meter face using Letraset dry transfers. Or, place the scales on the plastic meter front. The meter front can be removed by slightly wedging open four retaining snaps using caution.

A 6 1/4 x 3 3/4 x 2-in. plastic case houses all parts. Mount a 3 x 4 3/4 piece of perforated phenolic board on the meter terminals. Install fuse clips and push-in terminals. Drill holes to accept the pc type trimmer pots.

Tach Stretcher schematic diagram (above) is all you have to wire up to convert your present tachometer to read those very-low RPMs. Schematic diagram of tachometer (below) is for a Knight unit but method of adding the plug-in jack (J1) is typical of all the single-range tachometer accessories for high-performance autos.

PARTS LIST

C1—50 mf., 15-WVDC electrolytic capacitor
D1—Meter protector diode (Ohmite OMC7111 or equiv.)
F1—1/2-amp fast-action 8AG fuse (Littlefuse 361000 or equiv.)
J1, J2—Midget phone jack (Switchcraft 42A, Allied 47A4985 or equiv.)
J3, J4—5-way binding post (one red, one black)
M1—DC meter, 0-50 microampere (Knight 3 1/2 in., Allied 52A7201; Lafayette 1 1/2 in., 99C5049 or equiv.)
P1, P2—Midget phone plug (Switchcraft 750, Allied 47A1520 or equiv.)
R1—5000-ohm potentiometer (Clorostat U39, Allied 46A7970C or equiv.)
R2—1000-ohm potentiometer (Clorostat U39, Allied 46A7970C or equiv.)
R3—300-ohm potentiometer (Clorostat U39, Allied 46A7970C or equiv.)
R4, R5, R6—carbon resistor, 1/2 watt (see Table 1 for values)
R7—8060-ohm, 1/2 watt resistor, 1% (IRC CEC T-O or equiv.)
R8—200,000-ohm, 1/2 watt resistor, 1% (IRC CEC T-O or equiv.)
R9—499,000-ohm, 1/2 watt resistor, 1% (IRC CEC T-O or equiv.)
S1—1-pole, 12-position switch (Mallory 31112J or equiv., Allied 56A4301)
Misc.—Perforated phenolic board; 6 1/4 x 3 3/4 x 2 inch plastic case and panel; AWG-22 wire; fuse clips; push-in terminals; tie strips; wire, solder, etc.

Estimated Cost: $15
Construction Time: 4 hours

Radio-TV Experimenter
Internal view of the Tach Stretcher shows mounting of components on the circuit board. R1, R2 and R3 are calibration controls.

Depending on your engine, refer to Table 1 for R4, R5, and R6 values. Omit R1 and R4 for four-cycle, four-cylinder engines. If the DC ranges are not desired, omit R7, R8, R9, D1, F1, J3 and J4. Observe polarity of C1. Use only a ½-amp fast-action fuse for F1.

When wiring S1, skip three switch positions between the 2500-rpm range switch setting and the .5-volt position for easier panel labeling as shown. Connect a miniature phone plug, P1 and P2, to each end of an eight- to 10-foot length of AWG-22 microphone cable. Connect the outer shield to the sleeves of the plugs.

Tach Modification. The Knight electronic tachometer modification is shown here to illustrate the procedure—most other tachometers are similar. First, the high or ungrounded side of meter Mt (and its calibrating potentiometer Rt) is disconnected from the output of the tachometer circuit at point A in the schematic diagram. The closed-circuit contacts of jack J1 are wired to close the broken circuit at A to allow normal operation of the tach when plug P1 is removed.

For the tach shown, unsolder D4 from the soldering lug on the meter terminal bracket at Y (see below). Install a flea clip on the board at point X. Connect the disconnected end of D4 to the flea clip. Mount jack J1 on the back-plate as shown using fiber shoulder washers for insulation.

Run wire C from D4 to the long spring leaf of J1. Run wire B from the high side of meter Mt (and pot Rt) to the shorter contact leaf of J1. Finally, connect wire D from the remaining meter terminal to the frame of J1. If you wish to avoid drilling the tach case, run the three wires out of the grommet and locate J1 as desired.

For other tachometers, simply locate the high, or ungrounded side of the meter and its shunt calibrating pot. Disconnect them from the tach output circuit and reconnect to J1 as shown.

Calibration. First, with the plug removed from J1, run a bench test on the tachometer against the 60 Hz (cps) line frequency.

<table>
<thead>
<tr>
<th>TABLE 1. RANGE RESISTORS</th>
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<tbody>
<tr>
<td>Cylinders</td>
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<tr>
<td>-----------</td>
</tr>
<tr>
<td>R4</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>8</td>
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</tbody>
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Check instructions for your particular model tach. For the usual bench test, connect tach ground to earth ground, connect a 180K carbon resistor to the distributor lead wire, and connect the free end of the resistor to the hot side of the AC power line. Use a transistor radio battery in place of the car battery. With 60 Hz input, the tach should read 1800, 1200, or 900 rpm, respectively, for 4-, 6-, and 8-cylinder engines. If not, recheck wiring of J1.

Next, set S1 to 2500 and plug in the connecting cable. The tach meter should read zero. If M1 reads backwards, reverse the connections to J2. With a 60 Hz test signal, adjust R3 until M1 reads 1800 rpm for four-cycle, four-cylinder engines, 1200 rpm for sixes, or 900 rpm for eights. Set S1 to 1000 rpm and adjust R2 until M1 indicates 900 rpm for eightes. Further direct calibration is not possible at 60 Hz but two other methods are available.

For the first alternate method, reconnect the tach to the engine. Calibrate a lower range against any suitable operating engine speed as indicated on a higher previously calibrated range. For example, to calibrate the 500-rpm range for eight-cylinder engines, set S1 to 1000 and adjust engine speed to a steady 500 rpm. Then, set S1 to 500 and adjust R1 until M1 indicates 500. Two such steps calibrate the 500- and 1000-rpm ranges for sixes and one step calibrate the 1000-rpm range for four-cylinder engines.

The second alternate method uses an oscilloscope with a sawtooth-output terminal for calibration. Table 2 lists a number of frequencies and the corresponding calibration rpm for four-cycle engines. The table was calculated using the formula:

\[
CAL. \text{ RPM} = \frac{120 \times \text{Frequency}}{\text{Number of cylinders}}
\]

Use this formula if your line frequency differs from 60 Hz. For two-cycle engines, change the factor (in the above equation) 120 to 60.

First, feed a small AC voltage (at power line frequency) to the vertical input terminals of the scope for use in counting cycles on the scope screen. Voltage from a 6- or 12-volt filament transformer or the AC test-signal jack on the scope is adequate.

As an example, to calibrate the 500-rpm range for four-cycle, eight-cylinder engines (referring to Table 2,) we find that 30 Hz provides a calibration signal of 450 rpm for eight-cylinder engines. This frequency is available from the scope sawtooth output but may be of insufficient amplitude.

**Tach Driver.** If the signal amplitude is too low, wire up the tach drive circuit (below) to boost the drive signal. Open S2 and set the horizontal sweep frequency control to show two cycles of AC on the scope screen. Connect the tachometer to the drive circuit as shown. (For positive-ground tachs, reverse the connections to the 10K resistor and keep tach and scope grounds isolated.)

To check for sufficient drive signal, remove the plug from J1 and advance the horizontal gain control to increase the output. The tach should read 450 rpm for eightes and remain fixed at 450 with additional advance of the H-gain control. Set the control to give more than enough drive signal.

Next, insert the plug into J1, set S1 to 500 rpm and adjust R1 until M1 reads 450. Using the same procedure, calibrate the other ranges using the frequencies and rpm-calibration checkpoints listed in Table 2. Use the scope patterns to set the sweep frequency control as required.

At 15-Hz sweep frequency, the scope shows four stationary cycles on the screen. At 60 Hz, one cycle appears on the screen. At 120 Hz, two curved lines appear on the screen.

**TABLE 2: FREQUENCY vs RPM**

<table>
<thead>
<tr>
<th>Sweep Freq. (Hz)</th>
<th>Number of Cylinders</th>
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<tbody>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td>15</td>
<td>450</td>
</tr>
<tr>
<td>30</td>
<td>900</td>
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<tr>
<td>60</td>
<td>1800</td>
</tr>
<tr>
<td>120</td>
<td>3600</td>
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<tr>
<td>240</td>
<td>7200</td>
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<td>480</td>
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</tr>
</tbody>
</table>

(Continued on page 117)
To many audiophiles, no true hi-fi installation is complete without a tape deck. For without the tape medium, how can anyone enjoy the advantages of prerecorded tapes, or preserve the like-new sound of quality disc performances?

Unfortunately, a semiprofessional or professional tape deck (a complete recorder except for power amplifier and speakers) often represents nearly the total cost of all the other equipment—tuner, amplifier, turntable and, sometimes, speakers.

From all appearances, the Sony TC-350 Tapecorder was intended as a moderate priced answer to the need for a tape deck which would meet the performance requirements of the serious audiophile—hi-fi quality at slightly more than budget prices.

The Sony TC-350 electronics are all solid-state (transistorized), providing either stereo or 4-track mono recording. As with all semipro machines, three heads are used, allowing simultaneous recording and playback monitoring.

Features. Among the standard features are line-level input and output jacks, a single control for selection of either 7.5 or 3.75 ips speeds and their matching frequency equalization, separate recording-level meters for each channel, single lever to select the FF, FR, Forward and Pause modes, a resettable tape-travel counter, and an automatic shut-off switch that stops the capstan motor after the end of the tape has passed through the heads.

Line input and output jacks are provided in addition to a combined-signal DIN (European type) jack. If you have one of the imported amplifiers or receivers which provide for both tape-in and tape-out signals at a single DIN jack, you can connect the Sony to this jack through a single multi-conductor cable. Otherwise, you use the standard phono-type line-in and line-out jacks. The microphone jacks, which are mounted along with the L- and R-record volume controls and the record interlock under a hinged cover on top of the deck, are the mini type. The TC-350 does not accommodate the standard phone-type microphone plug.

Unique Switching. A useful feature is the individual L and R source-tape switching of the line output jacks. When the L or R mode switch is set to the Source position both the VU meter and the line output signal are switched to the source (incoming) signal; this allows the operator to establish the correct recording level while simultaneously monitoring the input signal. When the mode switch is set to the tape position, the VU meter indicates the playback level at the output of the playback amplifier, and the playback signal from the third head is fed to the line-out jack(s).

A rather unusual feature is the SOS, or

Snap-open door on top left conceals the 350's mike jacks and record level controls. Two mode switches are directly below heel of hand.
Sound-On-Sound control that is located on the rear apron. When the SOS control is rotated to the off position the TC-350 operates like any other stereo recorder. As the control is advanced whatever signal is recorded on the left channel is automatically fed to the right channel; the volume level being determined by the setting of the SOS control. This arrangement permits you to obtain multiple effects. For example, you might sing melody and record it on the left track, and then automatically re-record the melody (while singing harmony) on the right track. The final result (melody with harmony) would appear on the right track.

A stereo-headphone monitor jack, which accommodates high-impedance headsets, is mounted on the front panel.

The Greatest. A rarity in this age, the Sony TC-350's instruction manual is also a service manual intended for other than 9-year olds. The manual shows how to dismantle the recorder for custom installation, has a recommended lubrication procedure, and a real honest-to-goodness schematic diagram.

Test Results. In terms of noise and distortion the Sony TC-350 we checked was notably good. At maximum recording level (as indicated by the VU meter at maximum scale) the combined noise and total harmonic distortion was slightly less than 1.5%. The noise level, below normal recording volume (not peak volume which is referenced at 3% THD), checked out at -42 db. This would be equivalent to slightly better than -50 db if the higher 3% THD reference level was used. Surprisingly, the high-pitched hiss generally prevalent on solid-state recorders was absent from the TC-350's output.

Microphone input sensitivity was very high, less than 0.1 mv. for normal recording level. The microphone input circuit is designed to accommodate microphone impedances from 250 to 1000 ohms.

The line-level (auxiliary) input impedance is 100,000 ohms with a sensitivity of 68 mv.

The output level for a maximum recording level as indicated on the VU meter was 0.8 v.

The frequency response (for both channels, at both speeds) is shown in the test curves. The recording medium was Sony type PR-150 Professional Recording Tape. As shown, while the frequency response measured less than the limits claimed by Sony (±3 db 50-15,000 Hz at 7.5 ips and 30-14,000 Hz at 3.75 ips) they are well within the accepted hi-fi range. We assume there would be some variation in the frequency response depending on the brand and type of tape used.

While there is an unusual "double peak" at the extreme low end of the 7.5 ips response curve, the lower peak falls outside the referenced lower limit of 50 Hz. Even allowing for a response down to 20 Hz, the lower peak is still within the ±3 db specification.

Want One? The Sony TC-350 tape-recorder lists at $174.50. The deck is supplied mounted on a walnut base. A rigid "soft" dust cover is provided, along with a complete set of cables and a take-up reel.

For additional information, write to Consumer Products Div. Sony Corporation of America, Dept. MG, 580 Fifth Avenue, New York, N. Y. 10036.

Curves show overall record/play response at both 3½- and 7½-ips speeds for Sony 350 tape recorder (the identical tape deck, mounted in a carrying case for portable use, is also available as the Model 350C). Note that response actually extends to a low 20 Hz at the faster 7½-ips speed.
Opportunity knocked; I answered. The moon, meanwhile, beamed brightly on.

We left Anne’s cousin’s place in Rochester around 1:00 a.m. By 1:30 we were on the thruway and headed for home. A cold clear night with full moon. Anne fiddled with the car radio.

“What are you looking for?” I held the speedometer at a nice steady 70.

“Some jazz or blues—something like that.” Anne lighted briefly on a Miami station with an open-line type program. Some refined lady was phoning from her yacht to complain about too much raucous music on the air. Anne made a face and moved on.

“Try WCFL on 1000. Their lady DJ plays jazz and blues all night.” (I harbored secret hopes the 1000-spot might see me snag my latest pet DX target, ZET, the one that could make me a really big man in the radio world.)

Anne eyed me suspiciously. “Where’s that from, Honolulu or Hong Kong?”

“Chicago. And it usually comes in real good this time of night.”

She found WCFL on the first try. Not only S9 but playing her favorite record, too.

Anne adjusted the tuning knob a little to make sure we were right on station. WCFL brought forth “Night Train.”

I had already verified that call, ZET, up on 2966 kHz when it was assigned to the Kingston, Jamaica Aeradio. But when Jamaica became independent, Kingston Aeradio had been issued a new call, 6YK. Then someone reported in a radio club bulletin that ZET had been reassigned to a broadcast station on 1000 kHz—a certain Radio Rum in Rum Cay, Bahamas. Those two different
ZET-QSLs would make a real prize package for my collection. And nobody else in the club had the original ZET, so I was the only member who could bring off this DX coup.

Mantovani gave way to Percy Faith. A little stronger now, and Anne noticed the interference during the last few bars of Night Train. "Isn't there anything you can do about that?"

Shook my head. According to the club this new ZET catered to the Florida yacht trade. Slowed down slightly and listened a little harder.

Anne, suddenly wary, straightened up. "Are you listening for some DX?"
"Only if it comes in on WCFL's frequency."
"And what weird station are you after this time?" Set her mouth.
"ZET." I watched traffic as we passed a tractor-trailer.

Anne put her hand on her hips. "You've already got something from ZET!"
"That was from Jamaica. Now they're in the Bahamas." My DX treasure lost ground and was temporarily buried under Count Basie. "If I can QSL that same call from both locations, it would be a real wild combination." I daydreamed. "Make me a real wheel in the Atlantic Radio Club."

She gave me the you-don't-exist sign.
I decided to try psychology. "It's like that song goes, honey, you got to make it when you can."

"Make what?" Sarcastically.
"Maybe president of ARC." During a WCFL beer commercial my target reappeared. "All it takes is a few really spectacular QSLs to make yourself a reputation." Under a jazz piano played softly, I could hear "Golden Violins" being dedicated to a gal in Sarasota. Knew I had made. Ahead there was a rest area and I pulled off into it, confident I had made a kill.

"Now what are you doing?"
"Got to make some program notes." I reached across to the glove compartment, came up with a pencil and scratch pad. Checked my dashboard clock, scribbled down the time of that Sarasota request.
Anne said, deadpan, "And this is going to make you president of the Atlantic Radio Club?"

WCFL's lady DJ put on a jazz version of "Slaughter on Tenth Avenue," but "Golden Violins" was really holding its own.
"Could be." I tensed a little waiting for that crucial ID. Outside the moon had completely disappeared and rain had begun to fall. The noise level was almost nil.
"What do you want to be president of a radio club for?" Anne drummed one finger on the seat.
"Don't do that. It makes it harder to hear."
She sat still. "What do you want to be president for?"

Suddenly my prize was on top with an outboard motor commercial. I laughed. "Everyone wants to be president of something."
"Even if it's just a radio club?"
I sang a few bars of her favorite song.
"Minor league man, gotta make it when you can."

By this time WCFL was completely buried. "This is the great voice of Floriham Radio Rum, coming to you with 50,000 watts from Rum Cay, Bahamas."
I held my breath. Anne looked disgusted.
Still almost S9. "We are now using our new call letters, ZRUM . . ."

I felt sick.
"... which suit us much better than those call letters they first stuck us with last month."

Shell shock. In a moment, WCFL and ZRUM were about even.
Anne switched off the radio. "Well, minor league man, you just struck out." She reached over and started my motor. "Drive."
It was going to be a long drive home.
Whether you use this intercom to eavesdrop on the children tucked away in the pickup camper or use it between the kitchen and garage, playroom or nursery, you can talk back-and-forth or use it as an extension speaker to hear your favorite AM or FM radio programs!

There are several camper-to-cab intercom units on the market but you can save a few dollars converting one to our Camper Intercom. Just add a few features to a small low-priced commercial intercom and the results are the same. To modify a $9.95 transistor intercom unit all you add are a Zener-diode network and a toggle switch.

Modified, the Camper Intercom is no longer powered by a small, internal battery. Power is taken from the pickup truck's own 12-volt battery. Your favorite radio programs can be piped to the camper with a flip of a switch. Simply run a pair of wires from the radio speaker to the master unit of the Camper Intercom. Two wires to the small remote speaker are parallelled across the radio speaker terminals. With this hookup the remote unit works just like a rear-seat speaker in a sedan.

9 Volts from 12. Since the small intercom is designed to operate from a nine-
Camper Intercom

Simple two-component circuit drops output of 12-volt automotive battery to 9 volts. Be sure to watch polarity when connecting the Zener diode and leads between intercom and battery.

Radio. Too! To provide music to the remote unit, both wires going to the radio speaker must be wired to the intercom circuit. Check to see if one of the speaker wires or one side of the radio’s output transformer is grounded. If this is the case, simply cut the lead from the ground terminal and wire directly to the radio speaker. In many auto and truck radios one speaker wire is grounded. By removing this ground both radio and intercom will operate without blowing a car fuse. Take a look at the speaker-hookup schematic diagram (below).

Modification. Before attempting to rewire the intercom drill all necessary holes in the plastic case of the master unit. Two ¼-in. holes are put in the right-hand bottom-end of the plastic case. One hole provides an entrance for the 12-volt leads. The other ¼-in. hole is for the radio speaker wires. At the top center of the master unit drill a 3/8-in. hole to mount the s.p.d.t. toggle switch.

Mount toggle switch S1 before wiring the unit. Remove the snap-on battery terminals from the red and black wires. The red wire is the positive terminal and the black wire is negative.

Most etched circuit boards have one to two small holes that the dropping resistor and Zener diode can be tied to. If not, drill two ¼-in. holes, side by side, at the top right hand side of the etched board. Use these insulated holes as tie points. Solder one lead of the resistor and Zener diode together (after they have been looped through the holes in the etched board) to hold them in place.

Parts List

- D1—9-volt Zener diode, 100-250 ma (Card-over 29, Motorola HEP-104 or equiv.)
- R1—100-ohm, 1-watt resistor (see text)
- S1—S.p.d.t. miniature toggle switch
- 1—Intercom (Fannon Electronics EG-2—Allied 24A9957; Burstein-Appleby 36A196; Lafayette 99C4578 or equiv.)
- 6 ft—Speaker wire.
- Misc.—Machine screws and nuts, wire, solder, lugs, etc.

Estimated cost: $12
Construction time: 1 hour

Only modification required to work intercom in camper is simple circuit shown above left. Radio listening is a bonus, but could be handled by separate wires and speaker.

Switch and jack make connections at master unit to feed radio audio to remote unit in camper at rear.

Radio-TV Experimenter
You can easily eavesdrop on the children in the camper while driving, via intercom, as well as control their choice of radio fare.

Mark the positive wire terminal (with a tied knot of thread or a dab of red paint), at both ends. This mark indicates the hot or lead coming from the 12-volt battery. Most new American-built trucks and autos have a negative ground electrical system. It is very important that the positive battery terminal go to the red-marked wire of the small intercom master unit. Damage to the small transistors will result if the polarity is reversed.

Solder R1 in series with the +12 volt lead wire and the red wire that went to the built-in battery terminals. Run the black lead directly to ground. Shunt the Zener diode across the red and black built-in battery leads. After these leads are soldered into the circuit, either tape them up or slip a large piece of spaghetti over the exposed connections. Be sure the positive terminal of D1 or the metal body of the diode goes to R1. Recheck your wiring.

Wiring to the Radio. Remove the red lead from one side of the small remote speaker jack (J1) at the top of the master unit. Leave the black lead soldered to one side of the remote jack. Solder one lead coming from the radio speaker to this black terminal. The other radio lead is soldered to one side of the toggle switch. Take a piece of hook-up wire from the center switching terminal of the toggle switch and solder to the open terminal on the speaker jack. Solder the red lead from the etched board to the remaining lug of SI. Recheck radio-speaker wiring.

A three-foot length of flat speaker wire should be used to connect the intercom to the radio speaker. Both the power and speaker leads should be long enough to go under the dash and then can be cut to exact length.

Most small intercom units are provided with 50 feet of interconnecting cable. Cut off the excess wire when plugging into the remote station. Since the cable is very small and lightweight, tape or place a large piece of spaghetti over the connecting cable upon entering the camper and truck body. Do not staple the small cable at any point unless protected with tape. Vibration may cut the insulation of the wires, shorting out the remote unit.

Master Unit Mounting. The master intercom unit must be secured to the dash of the panel truck with metal screws. Several mounting holes are in the back plastic cover just for this purpose. To prevent the master unit from vibrating out of the plastic back when traveling, run a long machine screw clear through both units and through the front of the metal dashboard.
Connect the speaker wires from the master unit to the radio speaker terminals. Solder and tape them where necessary. Be sure one of the speaker leads is not grounded to the speaker or radio chassis as stated before. Run the hot lead of the intercom to accessories terminal on the ignition switch or to a fuse-block terminal. It is best to have the intercom unit powered through the ignition switch so that the intercom will turn off with the ignition key. Run the negative lead to a grounding screw or a body bolt under the dash panel.

**Using the Intercom.** Plug the interconnecting cable into the master and remote unit. Rotate the volume knob about halfway—you are now ready to call the remote station. Press down the talk-listen switch and speak into the master unit. You do not need to bend over to talk directly into the unit as there is plenty of pickup volume. Remember, you must press the switch down while you talk into the master unit. Adjust the volume for desired loudness.

The remote is non-private and replies, to a call from the master unit, can be made without touching any switch. As conversation proceeds the person at the master unit manipulates the switch—always pressing to talk and releasing to listen.

Someone in the camper can call the master unit by pressing the call switch when the master is turned off. When the call switch is pressed a tone is heard at the master station—indicating that the remote is originating a call. The master unit then answers the remote by turning the volume knob to on and pressing down to talk.

Note that the remote station uses the call switch only when originating a call to the master unit and the master unit is off. Once the master station has replied, the operator at the remote need not use the call switch when the master is on.

The master station power switch must be in the off position when the radio music is piped to the remote unit in the camper. Just flip the toggle switch to radio with the radio operating in the front cab or pickup truck.

**Eliminating Hash.** Excessive auto motor noise can be eliminated with distributor suppressor and capacitor. Check to see if the center distributor cable has a noise suppressor in series with it. Also tie a .5 mf capacitor from the ignition switch to ground. Under extreme cases noise can be eliminated by running a shielded cable from the master unit to remote in the camper.

Now you can enjoy music in the camper from the pickup-truck radio, communicate with persons while riding, or monitor the children in the camper itself. Many miles of conversation and music can be had for very few dollars.
CHECKING OUT THE CHAMP

EKG leads taped to Jan's chest recorded cardiac activity throughout a 220-minute-long match.

Jan Kodes, Czechoslovakia's crack tennis champ, may look a trifle weird wearing face mask and back pack, but the pair have been Jan's mascots for many a match. To pinpoint the cause of a cramp in his left thigh, doctors fitted Jan with a breathing mask to check respiratory frequency and EKG apparatus to monitor heart action. Both feed the back-pack transmitter.

—Robert Levine.

Outputs from breathing mask and EKG device were fed to miniature back-pack transmitter and ultimately recorded in normal fashion.

Though Jan has undergone tests aplenty, meds still lack an explanation for his ills.
The label on the shortwave receiver kit suggested “Do It Yourself”—so the nuns did! Following instructions inside the dusty cardboard box they discovered in the basement of their Motherhouse, the Maryknollers spent hours of their spare time assembling the receiver. That it worked and could actually receive signals from around the world astonished the Sisters—so much so they decided to become Hams in order to be able to send as well as receive.

When some Maryknoll seminarians heard of their interest and sent over additional gear, the Maryknoll Sisters at Maryknoll, N.Y., continued to “do it themselves” until they had constructed an entire station. And that’s how WB2UFZ had its beginning.

A small tower on the highest part of the
Motherhouse seemed an ideal place to install the equipment, so the Hams-to-be moved in. Once inside their shack, high above the Hudson River, the Sisters began part two of their project: learning Morse Code and radio theory. For months the staccato sounds of the code echoed through the fourth-floor corridors late every afternoon and evening until the Sisters had mastered their Morse.

Help in understanding radio theory came from Al LaPlaca, K2DDK, of nearby Long Island, and from Sister Anne Marie, science teacher at Maryknoll’s Mary Rogers College. With Al’s classes and Sister’s tutoring, they were soon ready to tackle the FCC exams. Sister Karen was the first to pass and to receive the coveted General license; Sisters Patricia, Mary Ellen, Carolyn, and Judith each earned a Novice license. Their celebration was simple: they officially went “on the air.” Ultimately, they hope to talk to their missionary Sisters stationed around the world.

“Mail takes the slow boat to China—and to every other Maryknoll mission,” explains Sister Karen with a smile. “Instant communication is our aim,” and instant communication the Sisters will have whenever WB2UFZ goes calling.

Messages received in code are immediately typed in English, thanks to Sister Carolyn’s excellent knowledge of Morse.

Putting a dipole atop Motherhouse proved an all-day job for the Sisters, but put it up they did (circular object at left is part of Maryknoll’s ETV equipment). At right, Sister Anne Marie, science teacher at Maryknoll’s Mary Rogers College, helps nuns cram up on theory for the FCC exam.
Up until now the rising sunspot count has been nothing but bad news for died-in-the-wool DXers, especially when it comes to logging prized European and African DX. In Europe such stations operate on 49 meters (where conditions are never any worse than fair on a year-round basis). But equally rare African stations operate primarily on 60 and 90 meters where conditions promise to be pretty rough the next few years. And during the summer low-band shortwave reception is even rougher because of a higher noise level.

Ironically, a development (produced by the increasing sunspot count itself) will now partially offset some of these barriers to rare DX. This will open 41 and 31 meters for Europe and Africa during most of the hours of darkness—to around 0500. These bands are high enough to escape most static.

Almost any condition can be used to DXing advantage (if you know how). During ionospheric disturbances (which will become more numerous with the increasing sunspot count) reception from Africa and Latin America will actually improve. Strength of the signals from these areas will remain relatively unchanged while QRM from stations in Europe, Asia and even North America will be almost wiped out.
Having trouble measuring the resistance of switches, transformers? Solve those mini-ohm measuring problems—build this little tester.

by Marshall Lincoln, W7DQS

"A little bit goes a long way" is literally true with this handy home workshop project. It's a Mini-Ohmer, designed specifically for measuring "little bits" of resistance—say in the neighborhood of a couple ohms or less!

The low-resistance measurements of this useful gadget take over where most ohmmeters leave off. Most ohmmeters don't measure much below 10 ohms with very great accuracy—and that's where Mini-Ohmer shines.

Readings of less than 10 ohms are relegated to a rather small portion of the meter face with almost all ohmmeters and, even then, their accuracy is questionable. Accuracy is often poor because of the normal characteristics of the ohmmeter circuit, the difficulty of setting the zero adjust control properly, or the chance that it may be mis-adjusted accidentally.

The Mini-Ohmer is designed to make low-resistance measurements with much greater accuracy. Its scale has been spread out electrically so that low resistances are easy to read. The space on the meter face devoted to just one ohm is equivalent to the space for several ohms on most ohmmeter scales.

You’ll find the Mini-Ohmer to be a very handy for measuring the resistance of IF and power transformer windings, chokes, switch contacts, and many other low-resistance electronics parts. It may even help you locate some faulty solder joints that otherwise have escaped detection!

**What Is It?** Essentially, the Mini-Ohmer is a “shunt-type" or slide-back ohmmeter—with a slightly modified circuit, and a special calibration technique.

There are two basic types of ohmmeters—*series-type* (Fig. 1) and *shunt-type* (Fig. 2).

---

**Fig. 1.** Basic ohmmeter circuit is the same as that in most VOMs. Short clips and set ohms adjust for zero indication.

**Fig. 2.** Slide-back ohmmeter circuit isn't suitable for high-resistance measurements and isn't added to most VOMs for low-ohms.

Generally speaking, the series type is better for measuring high resistance while the shunt type is better for measuring low resistances. However, even a good shunt-type
ohmmeter may not give you as high accuracy as you'd like in low-resistance values—down around a half dozen ohms.

So, the Mini-Ohmer takes things a step further by adding a simple component to the standard shunt circuit—a 15Ω resistor! This resistor, of very-low resistance itself, is added in parallel with the meter (and in parallel with the resistance being measured), as shown in Fig. 3.

![Fig. 3. Schematic diagram of Mini-Ohmer has only one difference from circuit in Fig. 2—R2 in shunt with meter. Meter indicates IR drop across R2 and unknown.](image)

**PARTS LIST**

- **B1**—1.5-volt C-cell
- **M1**—0-1 ma panel meter (Allied 52A7209; Lafayette 99C5040 or equiv.)
- **R1**—500-ohm, linear taper potentiometer
- **R2**—2.7-ohm, 1/2-watt resistor
- **S1**—S.p.s.t. toggle switch
- **T1**—6 3/4 x 3 3/4 x 2-in. plastic case (Allied 42A7885 or equiv.)
- **T2**—6 x 3 1/2-in. cover for plastic case (Allied 42A7887 or equiv.)
- **T3**—110-inch length #40 magnet wire (See Wire Calibration Table)
- **Misc.**—Knob, alligator clips, hook-up wire, test lead wire, battery holder, solder lugs, solder, etc.

**Construction cost:** $6.00

**Construction time:** 3 hours

**How It Works.** You may think of this resistor as loading the meter so that it is always looking at a very-low resistance. When you measure low resistance with this meter, you add a second low resistance in parallel with the shunt resistor in the meter circuit. The resultant resistance, formed by paralleling these two resistances, produces a very noticeable deflection of the meter needle. Medium to high resistances, when connected to the meter, produce no noticeable deflection, so they must be measured with a conventional meter. The Mini-Ohmer is a specialist—it handles very-low resistances only.

A 2.7-ohm resistor was selected as a reasonable compromise. A higher resistance would make the meter less useful when measuring resistances of only an ohm or so, while a lower resistance would limit the upper range of the low resistances measurable with this meter. However, if you're especially interested in measuring just one or two ohms, use a resistance lower in value than shown here for the permanent shunt in your meter.

**Build It.** Construction is easy and straightforward. A black phenolic box was used for the unit to give it a dressy appearance similar to commercially-made multimeters. A metal utility box, or even a chassis with a bottom plate attached, may be used. If you do use a metal box or chassis, be sure to use rubber grommets where the test leads pass through the panel.

The 0-1 ma meter used has a removable plastic cover, to make easier the job of installing a new meter scale. You must calibrate this custom scale yourself but that is surprisingly easy.

There's absolutely nothing critical about the parts layout (Fig. 4). Just drill the holes in locations to suit your own taste and install the few components shown in conventional manner. Pin jacks or banana jacks, for use with ordinary test leads, could be used with this meter, but greater accuracy in low-resistance measurements will result if you use short pieces of test-lead wire with clean, sharp-toothed alligator clips. These precautions will keep lead and contact resistance to a minimum as well as the chance of stray resistances within the meter circuit itself.

**Testing.** Once construction and wiring
have been completed, test the meter this way:

Be sure the test clips are not touching each other, flip the battery switch (S1) to on, and adjust the calibration control to produce exactly full-scale deflection of the meter needle. Then, connect a low-value resistor, say about 10 ohms, to the test clips. You will see the needle deflect downward a little ways. Then connect another resistor, of 3 or 4 ohms, and notice how much further downscale the needle moves.

Calibration. To calibrate your instrument, all you need is a length of AWG-40 wire. This very fine wire has a resistance of 1 ohm for each 11 inches at normal room temperature. So, by cutting appropriate lengths of it, you can calibrate your meter by connecting these lengths to the test leads. Handle the wire carefully. If you stretch the thin wire, its resistance will increase. If you are a fussy old dud that likes to fuss about exact calibrations, we must be honest with you. There are exactly 112 inches of #40 wire for ten ohms of resistance. Hence, 11.2 inches per ohm. If you do not have #40 wire in the junk box, then gander at the Wire Calibration Table. Wire lengths for standard wire sizes are given. If you don’t want to mess with tenths of an inch, round off to the nearest inch. Error introduced is less than 2% with #40 wire and decreases with lower numbered wire sizes.

First, though, turn off the battery switch, remove the plastic cover from over the meter face, and very carefully remove the regular meter face by removing the two tiny screws that hold it in place. Prepare a substitute face of heavy white paper (or typing paper glued to light pasteboard) cut to exactly the same size and shape as the regular meter face. Measure the zero and full scale positions on the old face and mark these positions on the new, blank face.

Install this blank face on the meter, leave the plastic meter cover off for the time being, and proceed to calibrate your Mini-Ohmer this way:

Set the meter to full-scale by flipping the battery switch on and adjusting the cali-

Use old meter scale (left) as template to make new scale or cement white paper on reverse of old scale and calibrate it.

bration control for exactly full-scale with the test clips empty and separated.

Now measure off 110 inches of AWG-40 wire, carefully scrape the insulation from each end, and attach the wire to the test clips. The meter needle will drop to the meter’s 10-ohm position. With a sharp pointed, hard lead pencil, mark this point carefully on the meter face. Cut off 11 inches from the 110-inch length of wire and repeat the process. This time, the meter needle will indicate 9 ohms.

Continue in this manner right down till you have only 11 inches of wire left. This will be one ohm.

Turn the meter’s battery switch (S1) to off. Carefully remove the hand-made meter face, and ink in the calibration points with India ink. Add the appropriate numerals, either lettering by hand or by using decals or transfer labels. Replace the meter face and then snap on the plastic meter cover.

Operation. Your Mini-Ohmer is completed, calibrated, and ready for use. In operation, flip the battery switch on and carefully adjust the calibration control to produce exactly a full-scale reading. Then connect the resistance to be measured to the test clips and read its resistance directly on the meter scale. Snap the battery switch off when the meter is not in use to conserve the flashlight cell.
Big cities—New York, say—are places where people all too often have to be introduced to even their next-door neighbor. They're also filled with single folk who would love to find a mate if only the cityscape didn't prevent compatible people from coming into companionable orbit. Now, a Datemaker Deluxe promises to break those barriers.

Mr. D.D., it happens, is none other than a computer programmed to help people meet the ideal mate. Called TACT (for Technical Automated Compatibility Testing), the service is rooted in logic, nothing else, and that logic is provided by the applicants themselves. Only single, professional, college graduates can apply, and they must be willing to tell the computer a great deal about their interests, tastes, personality, and temperaments.

From a questionnaire loaded with multiple-choice questions, Mr. D.D. assembles his info on a punched IBM card. This is fed into the computer, which singles out all compatible cards, then provides the names, addresses, and telephone numbers of the people they represent.

What happens when people who logically were made for each other do get together can be another story, of course, though our photographer followed one Gotham couple from start to finish (well, almost). If you'd like to give Mr. D.D. a whirl, check your telephone directory—there may be a TACT office in your town.
At TACT headquarters, card is fed into computer which selects six cards from applicants of opposite sex who seem best mate prospects. Names, addresses, and telephone numbers for six are then sent to original applicant.

A phone call, and voila—the prospective couple meet for the first time while each cautiously reflects on the computer's ability to play matchmaker.

Happiness is a friendship ring, say the smiles on the faces of this happy duo. Engagement ring may follow if couple decides they are really serious.
Panels....Shortcut to High-Class Panels......

Basic metal marking kit contains transformer and cord, a clip and hand pad, oxidation chemical, and strips of the stencil material.

Stencil is ideally cut on a typewriter, but a ball pen or a metal stylus can also be used. Clean, clear stencil works best. Type carefully!

Tape the stencil to the item to be marked with masking or other adhesive tape. Leave 1/2 in. of space around the symbol or mark.

Chemical supplied with kit is applied to hand pad, then the pad is pressed firmly against the stencil for a few seconds for engraving.

Finished result shows 6AQS tube designation "engraved" on the chassis. Kit is not suitable for use with anodized, coated metals.

Even coax connectors can be "engraved" with Lectroetch. 20 M on connector above indicates it feeds a 20-meter Ham antenna on other end.
The sure sign of an experimenter’s project is home-brew labels. You know the type, a strip of paper held on with sticky-tape that’s turned yellow and crinkly, grease pencil marks that rub off each time you handle the gadget, paper tags that pull off their strings. The list is endless, for even the experimenter who uses transfer labels finds that just the sweat of the brow is enough to float them off a panel.

Even if you’re willing to have your own personal gear looking like the Mongolian Creeping Crud, there are times you could use a good, professional-looking marking job. Examples? Suppose you build custom electronic equipment or custom hi-fi installations for friends, customers, or school or community groups. What could look more pro, or get you more business, than to have the tube or transistor numbers “engraved” directly on the chassis?

Similarly, think of having input and output or other connection notations “engraved” directly on the connectors. Best of all, why not have your name or your company name “engraved” right on the rear apron!

But if you steal a trick from the science/mechanics-type magazines, you can have professional looking engravings that are a lot more permanent—and a lot better looking—than paper nameplates or other cheap imitations.

There’s a gadget in the hardware stores—called the Lectroetch Metal Marking Kit (about $8) that every experimenter should own. It is used to engrave the user’s name on tools, knives, guns, etc. Total time to make the marking is about three minutes—maybe less. And just as one can easily mark his name, it’s just as easy to mark electronic symbols and names on connectors, chassis, panels, etc.

And even if a paper or grease-pencil label will do the job most of the time, there are times you could use a good professional marking job. Examples? Suppose you build custom electronic equipment for, perhaps, friends, or your school. What would look more pro than the tube- or transistor-type numbers engraved on the chassis? Or input and output engraved on the connectors? Or how about that rat’s nest of wires for the antenna farm out back? Which connector is what antenna after the grease-pencil marks wear off? Somewhere among your projects there’s a need for professional quality markings.

How It Marks. The Lectroetch Metal Marking Kit marks through the process of oxidation. First, a stencil is cut on a typewriter (or written with a ballpoint pen or standard stencil stylus) using the supplied stencil material. In our photographs we have cut the mark 6AQ5, which will be engraved on a chassis next to the matching tube socket. Then the stencil is cut away from the stencil material (the rest can be used later) and taped to the chassis with masking or sticky-tape.

The “ground” lead from the Marker is clipped to the chassis, the pad (attached to the positive lead) is saturated with the supplied chemical, and then the pad is held against the stencil.

The holes in the stencil (the symbols or letters) allow the chemical to flow from the pad to the chassis only where the symbols were cut. The electric current flowing from the pad, through the chemical and through the chassis causes an oxidation layer to be built up on the chassis; total time to build up the oxide is about 5 seconds. When the pad and stencil is removed, the marking appears as an “engraving” on the chassis; black if the metal you are working on is steel, clear or white on aluminum or chrome.

There is no way to change the color of the oxides. Steel comes out as black (with a slight brownish cast), and the white is white. You have no choice.

Markings can only be made on “raw” metal; you cannot mark painted or lacquered surfaces or an anodized aluminum surface (chassis are generally not anodized).

The only difficulty you’re likely to run across is a poor mark due to a poorly cut stencil. If you use a typewriter set the ribbon to the stencil position and use a relatively heavy stroke—as heavy as possible without cutting out the center of the symbols. If you use a ballpoint pen or stencil stylus make certain you really cut through. A little practice will make you a pro.

Don’t worry about running out of stencil material or the chemical—a replacement kit is available.
The sound of children laughing, the voice of a friend, the beauty and majesty of a great symphony, the noises of traffic, of wind whispering through trees—all of these play on our emotions. The ability to record these experiences and to share them with others, by duplicating sound, sets tape recording (and tape duplication) off as a creative and satisfying hobby.

There are many reasons for making tape duplicates, and these reasons make up a substantial part of the fun in having a good-quality, home tape-recording system.

Dubbing a good tape of the kids, for example, and sending it to their grandparents as a tape-recorded letter is one of the simplest and best reasons. And you know that if the tape is good enough to send through the mails, you'll want the original for your own tape library. Perhaps you might want to edit a tape to go along with a movie or slide show without chopping up the original tape... or perhaps you want to exchange tapes with a fellow audiophile... or because you want to experiment with a variety of sounds from a number of recordings in making a "montage" tape... or simply to preserve your early tape recordings on modern, more efficient sound recording tape.

Let's Begin. All you need to get started in duplicating your tapes is an additional tape recorder. If you don't already have a second tape recorder, borrow one from a good friend—you might even get together to help duplicate each other's tapes. However, you had better be careful about the quality of the second tape recorder you use. If it emits sounds similar to an old tin drum, so will your dubbed tapes. The quality of a dubbed tape depends on the quality of the dubbing equipment. Also, be very particular about the tape you use.

Because, at best, a dubbed recording is still a second generation tape, make sure both
tape systems are in the best possible condition. This may seem obvious to you, but remember the dubbed tape will combine all the deficiencies present in your original tape recording, in the playback recorder, and in the dubbing or re-recording equipment. Therefore, read instruction books for both machines carefully, and then clean the heads with one of the commercial preparations available. Another good hint, if you can lay your hands on a degausser, is to demagnetize the heads.

What Connections? Now you're ready to connect your two tape machines—the "master" and the "slave." To avoid adding the distortion of the master's power amplifier to your dubbing, take your output from the master machine at the pre-amp stage. For the input to the slave, you usually have a choice—one marked mike or high impedance (usually in the 50,000- to 500,000-ohm range), the other marked either radio, phono, tuner, tape or low impedance. You want the latter.

The touchiest area in dubbing is signal-to-noise. What you want is a tape that will give you the lowest noise level on the duplicate tape without lowered output—a tape such as Kodak type 34A High Output Professional Tape. This tape, for example, packs five or more decibels of undistorted output than the usual low-noise tapes, and it does this with no increase in print-through over general-purpose tapes. Because of its dynamic range, tape noise can be greatly reduced simply by lowering the record level.

Tape Differences. To show the effectiveness of this type of tape, let's compare it with a more conventional tape—Kodak 31A Standard Play Tape. The values in the table (see page 117) are in decibels at optimum bias settings using Type 31A as reference.

Why not use an ordinary low-noise tape for your dubbing? Well, designing a low-noise tape is somewhat like a woman trying to stuff a size-9 foot into a size-4 shoe. Cutting open the end of the shoe is a solution, but it lacks elegance. Tapewise, if all you do is use a low-noise tape, you end up with lowered output, i.e., a mighty short foot. And if you push up the gain, where's the low noise you were hoping for?

The art of low noisemanship requires a bit more finesse. Try this test: Listen to a "no signal" tape at high gain. Now turn down the gain until the hiss disappears. Now, silence lovers, wouldn't it be nice if you (Continued on page 117)
Flight Recorders Tattletales on In-Flight Mishaps!

Made to B U G an Airplane
by K. S. Mhatre

Over the years, aeronautical engineers have looked forward to having an electronic gadget on aircraft that would keep a continuous record of a flight, from the time of takeoff until the time the aircraft lands. If and when something went wrong, this gadget would tell the tale and pinpoint the cause of the trouble.

As each leap forward in aeronautical progress touched new frontiers of knowledge and airplanes grew bigger, faster and more complex, new problems of safety arose which made the need for such equipment more urgent than ever.

With rapid advances in electronics and metallurgy in the last few years it became possible to develop flight recorders which were fireproof and which would remain undamaged in the event of a crash.

Snoopy Gadget. A flight recorder is an aeronautical engineer’s delight, a gadget that provides him with the minutest detail of how the airplane behaved in flight, how it climbed and descended, how fast, high or low it flew, how many times it changed its course and the stresses and strains (“g” forces measured in terms of earth’s gravitation) it suffered. All this against a time scale.

A modern airplane is tested with impressive thoroughness during thousands of hours of test flying under the toughest possible operating and weather conditions; pilots go through a period of intense training on the new airplane to achieve the highest possible standards of efficiency. Even so, mishaps do occur. Engineers and operations personnel go to great lengths to determine the exact cause of the accident so that it can be eliminated from future operations. It would surprise many people to know the man-hours and the money spent in accident investigation by the airlines and governments in order to improve air safety.

It is seldom that all evidence on a particular accident is readily available at a given time. Therefore, the investigators must painfully piece together all the known facts. And it is here that a flight recorder can be of immense help, for it provides an accurate
Each Air-India Boeing 707 has a Lockheed Aircraft Service 109-C flight recorder mounted inside left-hand wheel well (left), close to center of gravity. The crash-proof spherical container has been tested to withstand temperatures up to 2,000°F and impact of 500g. Traces on tape (above) can be read easily with transparent scale placed over recorded tape.

record of the progress of a flight with every normal and abnormal airplane movement recorded faithfully. Before flight records became available a few years ago, it frequently happened that investigators could only guess at the cause of an accident, especially if the pilot's testimony was not available.

A Must. In November 1960, the Federal Aviation Agency of the United States made it mandatory that all US registered turbine aircraft above 12,000 lb. must carry flight recorders. A typical unit, Lockheed's Model 109-C, consists of five independently functioning systems which maintain a continuous record of course, altitude, airspeed, vertical acceleration and elapsed time. The information is recorded on a paper-thin foil nearly two inches wide which runs for 200 hours. A clockwork mechanism controls the speed at which the foil moves, so that a constant time scale is maintained. The trace on the aluminum foil appears in the form of a graph which can later be measured.

Exit Black Box. A layman thinks of a flight recorder as a "black box." In fact the LAS 109-C is neither black nor a box. It is spherical, approximately 13 in. in horizontal diameter, 15 in. along the vertical axis and weighs approximately 32 lb. Although the (Continued on page 113)
This is the third and last part of White's Radio Log, published in three parts twice each year. This format presentation enables the Editors of Radio-TV Experimenter to offer its readers two complete volumes of White's Radio Log each year, while increasing the scope of the Log and its accuracy.

In this issue of White's Radio Log we have included the following listings: U. S. AM Stations by Call Letters, U. S. FM Stations by Call Letters, Canadian AM Stations by Call Letters, Canadian FM Stations by Call Letters and the World-Wide Shortwave stations section. Also, we have added to White's in this issue a new listing—Major Broadcast Stations in Mexico and the Caribbean.

In the August/September, 1967 issue of Radio-TV Experimenter the Log will contain the following listings: U. S. AM Stations by Frequency, Canadian AM Stations by Frequency, U. S. Television Stations by States, Canadian Television Stations by Cities and the World-Wide Shortwave Stations section. In the event you missed a part of the Log published during 1967, you will have a complete volume of White's Radio Log by collecting any three consecutive issues of Radio-TV Experimenter published during the year. The three consecutive issues are an entire volume of White's Radio Log that offers complete listings with up-to-the minute station change data that are not offered in any other magazine or book.

If you are a broadcast band DX'er, FM station logger, like to photograph distant TV test patterns, or tune the shortwave bands, you will find the new White's format an unbeatable and up-to-date handy reference.

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Every effort has been made to ensure accuracy of the information listed in this issue of White's Radio Log, but absolute accuracy is not guaranteed and of course, only information available up to press time could be included. Copyright 1967 by Science & Mechanics Publishing Co., a subsidiary of Davis Publications, Inc., 505 Park Avenue, New York, New York 10022.
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**Radio-IV EXPERIMENTER**

96
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This is a partial list of radio stations in the United States, showing their call letters, frequencies, and locations. The full list can be found on the American Radio History website.
J(TOH Lihue, Hawaii
98 RADIO
KTOC
KTLD Tullulah,
KT1L Tillamook,
KUBC
KTDL
KTAE Taylor, Tex.
KAN Tucumcari, N.M.
KBBB Tyler, Tex.
KAM Austin, Tex.
KCDM Malibu, Calif.
KCR Minneapolis, Minn.
KFC Fort Smith, Ark.
KDO Teldeko, Oreg.
KE Idaho Falls, Idaho
KEL Walla Walla, Wash.
KKE San Angelo, Tex.
KTS Terrell, Tex.
KTF Tiffin, Iowa
KTD Topeka, Kans.
KTN Ketchikan, Alaska
KTH Tule Lake, Calif.
KTV Tucumcari, N.M.
KTM Tucson, Ariz.
KDL Tulalip, La.
KLN Denver, Colo.
KMG Fremont, Neb.
KLY Talkeetna, Alaska
KLU Rust, Tex.
KLD Hereford, Tex.
KTO Big Bear Lake, Calif.
KTB Bandon, Ore.
KAB Prescott, Ariz.
KGF Modesto, Calif.
KRC Santa Fe, N.M.
KRG New York, N.Y.
KTF Thief River Falls, Minn.
KTR Honolulu, Hawaii
KTRL St. Louis, Mo.
KTV St. Louis, Mo.
KTH Whitefish, Tex.
KBY Bastrop, La.
KSA San Antonio, Tex.
KSL Burnet, Tex.
KTM Trumon, Mo.
KTS Rota, Mo.
KSA Lompoc, Calif.
KTV Columbia, Nebr.
KDL Santa Ana, Calif.
KUAI Elec, Kauai, Hawaii
KUAM Santa, Guam
KUJ Montrose, Colo.
KUCB Wellington, Mo.
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**June-July, 1967**
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The Great DX Challenge. Okay you hot shot DX operators, here's your chance to dig 'neath the static and really hear some rough ones— or some that aren't so rough but are a bit on the rare or unusual side.

We'll list 'em, you try to hear 'em, then you score yourself. Scoring instructions are at the end of the challenge.

1. People's Liberation Army station, somewhere in Fukien Province, Communist China. Heard on 5900 kHz at 1130 GMT with Chinese dialog, singing, music.

2. Radio Tarawa, 4912.5 kHz, located in the Gilbert and Ellice Islands. Callsign is VTW2, runs only 2 kw into a poor antenna. Sked is 1845 to 2000 GMT Monday through Friday, and 0430 to 0600 GMT Monday, Wednesday, and Friday. On Sundays the station is on 0430 to 0630 GMT.

3. "The Voice of Righteousness," Taiwan, on 7198 kHz at 1200 GMT. Hard to pull through 40 meter Ham interference.

4. International Red Cross Radio, Geneva, Switzerland, on 7210 kHz. Station is on at 0600, 1130, 1500, and 2300 GMT from time to time during May, July, and September (about 3 days per month). Station runs 150,000 watts.

5. BBC station using sideband transmission with point-to-point (non-broadcast) transmission directed to Asia. Heard on 15912 kHz at 1330 GMT.

6. How many "spy" stations can you hear in one evening? These stations are usually found reading groups of numbers in Spanish or German on frequencies between 4 and 7 MHz. There's one station we've heard many evenings at around 0515 GMT on 5623 kHz with a real powerhouse signal. The bands bulge with these stations, believed to be in East Germany, Cuba, and possibly even the U. S.

7. How many countries can you log on 8837 or 6537 kHz? These are really swinging aeronautical channels used throughout the Caribbean area. Some of the countries to be heard include Haiti, Curacao, Puerto Rico, Jamaica, Trinidad, Cuba, Bahamas, Surinam, Colombia, Canal Zone, and Argentina.

8. Radio Gambia, on 4820 kHz at 2015 GMT. Gambia is the smallest nation in Africa (it's completely surrounded by another country and the ocean) and is not often reported by monitors.

9. Istanbul Police Radio, heard in Turkish each day on 6325 kHz from 0900 to 1000 GMT.

10. Radio Santa Cruz, in Santa Cruz de Quiche, Guatemala. A new station heard on 4872 kHz at 0000 GMT. Some say that this station operates only during religious holidays and festivals.

Scoring. Score 10 points each for Challenges 1 through 5, 8 through 10. On Challenges 6 and 7, you get 2 points for each station logged.

Results: 80 and above, you're a champ. If you got 70, you're a pretty sharp operator. A score of 60 indicates that you show great promise. For 40 to 59 we say, keep trying—all is not lost. For 20 to 39—either try harder or get a better receiver. Less than 20 means that maybe you might do better at stamp collecting.

We invite our readers to send in their loggings for inclusion in these listings. Be sure to include the following information for each station reported: approximate frequency, callsign and/or station name, and time monitored in Greenwich Mean Time (24 hour clock). Address your reports to DX Central, White's Radio Log, RADIO-TV EXPERIMENTER, 505 Park Avenue, New York, N. Y. 10022, U.S.A.

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The interior of the LAS flight recorder in which the two-inch-wide aluminum foil tape keeps continuous record of plane's course, speed, altitude and stresses and strains.

earlier models were black, the present ones are painted with a special orange-yellow paint to make them easier to locate after an accident.

Protected. The flight recorders on Air-India's 707's are mounted in the left-hand wheel well, near the aircraft's center of gravity, a location which is considered ideal for measuring aircraft acceleration. The FAA has recently recommended that flight recorders should be installed nearer the tail to ensure minimum impact and fire damage.

The container of the flight recorder is fireproof and can withstand temperatures of up to 2,000° F. The spherical cover has been designed to provide ultimate crush resistance and has been successfully tested against a simulated impact force of 500g.

Lots of Data. Although flight recorders were initially introduced as an aid to accident investigation, subsequent technological advances have resulted in development of recorders with hundreds of channels to monitor various parameters of engine, aircraft and other systems' performance to assist troubleshooting. It also serves as a valuable maintenance aid. During maintenance checks, engineers check the foil trace to see whether the aircraft has been subjected to undue strain such as a heavy landing which has gone unreported. If they find anything unusual they at once carry out a thorough inspection based on the clue supplied by the flight recorder.

Made to Bug an Airplane

Continued from page 93
LITERATURE

* Starred items indicate advertisers in this issue. Consult their ads for additional information and specifications.

LIBRARY

CB—AMATEUR RADIO
SHORTWAVE RADIO

121. Going CB? Then go CB Center of America. Get their catalog and discover the big bonus offered with each major product—serves all 50 states.

107. Get with the mobile set with Trim's XL-100. The new Titan CB base station, another Trim great, is worth knowing about.


93. Heath Co. has a new 23-channel all-transistor 5-watt CB rig at the lowest cost on the market, plus a full line of CB gear. See their new 10-band AM/FM/Shortwave portable and line of shortwave radio-electronics.

101. If it's a CB product, chances are International 

Catering to 2-way radio buffs for 30 years, World Radio 

*4. Electronics Measurements Corp. has a new catalog which includes the latest CB transceivers, etc. Quarterly fliers chock-full of bargains are also available.

115. Get the full story on Polyteltronics Laboratories' latest CB entry—Carry-Comm. Full 5-watts, great for mobile, base or portable use. Works on 12 VDC or 115 VAC.

50. Make your connection with Amphenol—tune in to the latest on CB product news with specs and pics on new gear. Keep informed on Amphenol's new products.

100. You can get increased CB range and clarity using the "Cobra" receiver sensitivity is excellent. Catalog sheet will be mailed by B&K Division of Dynascan Corporation.

*54. A catalog for CB'er's, hams and experimenters, with outstanding values. Terrific buys on CB's and mobile units from 27 MHz to 1000 MHz.

45. Catering to 2-way radio buffs for 30 years, World Radio Laboratories has a new catalog which includes the latest CB transceivers, etc. Quarterly fliers chock-full of bargains are also available.

115. Get the full story on Polytronics Laboratories' latest CB entry—Carry-Comm. Full 5-watts, great for mobile, base or portable use. Works on 12 VDC or 115 VAC.

50. Make your connection with Amphenol—tune in to the latest on CB product news with specs and pics on new gear. Keep informed on Amphenol's new products.

100. You can get increased CB range and clarity using the "Cobra" receiver sensitivity is excellent. Catalog sheet will be mailed by B&K Division of Dynascan Corporation.

*54. A catalog for CB'er's, hams and experimenters, with outstanding values. Terrific buys on CB's and mobile units from 27 MHz to 1000 MHz.

96. If a rugged low-cost business/industrial two-way radio is what you're looking for, be sure to send for the brochure on E. F. John- 

103. Squires-Sanders would like you to know about their full transceivers, the "23'er" and the new "555." Also, CB accessories that add versatility to their 5-waters.

46. A long-time builder of ham equipment, Hallicrafters will send you lots of info on the ham, CB and commercial radio-equipment.

KITS

*42. Here's a colorful 108-page catalog containing a wide assortment of electronic kits. You'll find something for any interest, any budget. And Heath Co. will happily send you a copy.

*44. EICO's new 48-page 2-color from catalog is just off the press. Over 250 products: Ham radio, CB, hi-fi—in kit and wired equipment illustrated. Also, discover EICO's new experimenter kit line.

ELECTRONIC PRODUCTS

66. Try instant lettering to mark control panels and component parts. Datak's booklets and sample show this easy transfer method.

108. Get the facts on Mercury's line of test equipment kits—designed to make troubleshooting easier, faster and more profitable.

67. "Get the most measurement value per dollar," says Electronics Measurements Corp. Send for their catalog and find out how!

92. How about installing a transistorized electronic ignition system in your current car? AEC Laboratories will mail their brochure giving you specifications, schematics.

109. Seco offers a line of specialized and standard test equipment that's ideal for the home experimenter and pro. Get specs and prices today.

ELECTRONIC PARTS

120. Tab's new electronics parts catalog is now off the press and you're welcome to have a copy. Some of Tab's bargains and odd-ball items are unbelievable.

117. Don't build that next project until you get your mits on Bigelow's 13th anniversary catalog. You've got to read this one to believe the buys.

1. Allied's catalog is so widely used as a reference book, that it's regarded as a standard by people in the electronics industry. Don't you have the latest Allied Radio catalog? The surprising thing is that it's free!


*4. Olson's catalog is a multi-colored newspaper that's packed with more bargains than a phone book has names. Don't believe us? Get a copy.

23. No electronics bargain hunter should be caught without the 1967 catalog of Radio Shack's catalog. Some equipment and kit offers are so low, they look like misprints. Buying is believing.

5. Edmund Scientific's new catalog contains over 4000 products that embrace many interests and fields. It's a 148-page buyer's guide for Science Fair fans.

*106. With 70 million TV's and 240 million radios somebody somewhere will need a vacuum tube replacement at the rate of one a second! Get Universal Tube Co.'s Troubleshooting Chart and facts on their $1 flat rate per tube.

*7. Whether you buy surplus or new, you will be interested in Fair Radio Sales Co.'s latest catalog—chuck full of surplus buys for every experimenter.

*8. Want a colorful catalog of goodies? John Mesha, Jr. has one that covers everything from assem- blies to zener diodes. Listed are government surplus radio, radar, parts, etc. All at unbelievable prices.

*6. Bargains galore! that's what's in store! Poly-Fox Co. will send you their latest eight-page flyer of the latest in available merchandise, including a giant $1 special sale.

10. Burstein-Applebee offers a new giant catalog containing 100's of big pages crammed with savings including hundreds of bargains on hi-fi kits, power tools, tubes, and parts.

*11. Now available from EDI (Electronic Distributors, Inc.) a catalog containing hundreds of electronic items. EDI will be happy to place you on their mailing list.

12. VHF listeners will want the latest catalog from Kuhn Electronics. All types and forms of complete receivers and converters.

HI/AUDIO

85. Need a tuner? Preamp? Amp? Tape deck? Then inspect Dynaco for kits or wired units. It's worthwhile looking at test reports Dynaco sends your way.

119. Kenwood puts it right on the line. The all-new Kenwood stereo-FM receivers are described in a colorful 16 page booklet complete with easy-to-read-and-compare spec data. Get your copy today!

15. Besides sending specs on their famous speaker systems and turntable, Acoustic Research would like to give you a copy of their new "Stylus Force" booklet—must reading for hi-fi bugs.

17. Discover how Cueing Control, anti-skating and other Garrard features in the Lab 80 offer top in audio listening. 32-page Garrard Comparator Guide will make you a wiser buyer—get it.

19. Discover how Electro-Voice has two new, pocket-size, four-color product guides for you. One covers speakers and components; the other, microphones and accessories.

21. Beire has made exceptional advances in speaker cabinet design you should read about. Also, Empire's successes in the turntable and cartridge fields are worth discovering.

24. Need a hi-fi or PA mike? University Sound has an interesting microphone section and audio fans should read before making a purchase.

27. 12 pages of Sherwood receivers, tuners, amplifiers, speaker systems, and cabinetry make up a colorful booklet every hi-fi bug should see.

95. Confused about stereo? Want to beat the high cost of hi-fi without compromising on the results? Then you need the new 24-page catalog by Jensen Manufacturing.

99. Get the inside info on why Accutone's solid-state amplifiers are the rage of the experts. Colorful brochure answers all your questions.

TAPE RECORDERS AND TAPE

113. Scotch is the product and it's made by Minnesota Mining and Mfg. Co. (3M). Get a packet full of facts and tape data from 3M and learn all about your tape recorder and the tape it needs.

116. All the facts about Concord Electronics Corp. tape recorders are yours for the asking in a free booklet. Portable, battery operated to four-track, fully transistorized stereo covers every recording need.

12. "Everybody's Tape Recording Handbook" is the title of a booklet that Sarker-Tarzian will send you. It's 24-pages jam-packed with info for the home recording enthusiast. Includes a valuable table of recording times for various tapes.

33. Become the first to learn about Norelex's complete Carry-Corder 150 portable tape recorder outfit. Four-color booklet describes new cartridge-tape unit.

34. "All the Best from Sony" is an 8-page booklet describing Sony-Super-scope products—tape recorders, microphones, tape and accessories. Get a copy before you buy!

35. If you are a serious tape audio-phile, you will be interested in the new Viking of Minneapolis line—they carry both reel and cartridge recorders you should know about.

91. Sound begins and ends with a Uher tape recorder. Write for this new 20 page catalog showing the entire line of Uher recorders and accessories. How to synchronize your slide projector, execute sound on sound, and many other exclusive features.

HI-FI ACCESSORIES

112. Telex would like you to know about their improved Serenata Headset—and their entire line of quality stereo headsets.

98. Swinging to hi-fi stereo headsets? Then get your copy of Superex Electronics' 16-page catalog featuring a large selection of quality headsets.

104. You can't hear FM stereo unless your FM antenna can pull 'em in. Learn more and discover what's available from Finco's 6-pager "Third Dimensional Sound."

SCHOOLS AND EDUCATIONAL

114. Prepare for tomorrow by studying at home with Technical Training International. Get the facts today on how you can step up in your present job.

59. For a complete rundown on curriculum, lesson outlines, and full details from a leading electronic school, ask for this brochure from the Indiana Home Study Institute.

61. ICS (International Correspondence Schools) offers 236 courses including many in the fields of radio, TV, and electronics. Send for free booklet "It's Your Future."

74. Join the troubleshooters! Let CIE (Cleveland Institute of Electronics) train you to keep our electronics world running.

105. Get the low-down on the latest in educational electronic kits from Trans-Tek. Build light dimmers, amplifiers, metronomes, and many more. Trans-Tek helps you to learn while building.

TOOLS

118. Secure coax cables, speaker wires, phone wires, etc., with Arrow staple gun tackers. 3 models for wires and cables from 3/16" to 1/2" dia. Get fact-full Arrow literature.

78. Need a compact screwdriver kit? Xcelite's 99PV and 99PV-4 consists of handle, 3 and 5 blades, respectively, in "see-thru" zipper case. Get Xcelite's catalog 166.

TELEVISION

70. The Heath Co. now has a 19" color TV to complement their 21" and 25" models. A new B&W portable model will be a hot seller for the mobile set. Get the facts today!

97. Interesting, helpful brochures describing the TV antenna discovery of the decade—the log periodic antenna for UHF and UHF-TV, and FM stereo. From JFD Electronics Corporation.
tion curves differed slightly from the individual curves supplied with the cartridge. This we attribute to the difference in measurement techniques. Instead of a "laboratory" test, we checked the Miniconic as if it would be used by the audiophile—on a quality turntable in a matching arm with the shielded lead length exactly as supplied by the turntable manufacturer. However, the manufacturer's curves are valid and honest.

While the U-15-LS cartridge is rated for a stylus pressure of 0.75 to 1.5 grams, best results were obtained at 1.5 grams. With less than 1 gram of stylus pressure a slightly warped record could not be tracked at all. Perhaps the Miniconic in its own matching arm could be used at the very light stylus pressures.

**Price Facts.** The CK-15-LS phono conversion kit, consisting of the Miniconic U-15-LS cartridge and PS-15 Power Source, is available for $55.00. Several other kits are available, some with tone arms, that range in price from $87.50 to $39.00. Euphonics has prepared a beautiful four-color booklet that explains all the possible options in a very clear style. For your copy write to Euphonics Marketing, Dept. LE, 173 W. Madison St., Chicago, Ill. 60602.

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**Infrared Communicator**  
*Continued from page 45*

The fact that the noise generated by the audio amplifier in the transmitter modulates the GaAs diode and is received by the solar cell in the receiver. Now you can focus the GaAs diode and the solar cell in their respective mirrors by simply listening for maximum sound (noise in this case) in the receiver.

After you have aligned the system, you can connect a mike or phono cartridge to J1 on the panel of the transmitter and you're ready to transmit sound over an invisible light beam!

For demonstration purposes, you may want to buy an infrared filter. A 53⁄8-in. diameter filter is available from Edmund Scientific for $2.00 (the part number is 60,033). This filter blocks out all visible light but lets through the infrared. When you insert the filter in the infrared beam between the transmitter and receiver, it will have little effect on the transmission of the beam. But insert your hand or a piece of cardboard in the path of the beam, and the transmission will be blocked.

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**Tornado Busting**  
*Continued from page 36*

in wastelands such as deserts, in open range lands, and like places.

Presumably the initial and major effort in combating tornados would be concentrated near highly populated areas in the midwest tornado belt. Highly mobile gun units would be deployed strategically so that they could reach all vulnerable areas quickly before the tornados are born rather than after the fact; this would only be possible if meteorological techniques are refined to the point wherein it will be possible to predict with reasonable accuracy just where atmospheric conditions are building up potentially dangerous electrical charges in the clouds. And it would not seem to be beyond the possible that eventually we may see permanent anti-tornado gun emplacements ringed around major metropolitain areas where they would be ready to go into action the instant a tornado appears.

![Fig. 11. Wires might be launched through charged area using coiled-wire projectile.](image-url)
Tach Stretcher
Continued from page 70

screen each of which is one-half cycle. At 240 Hz, four lines appear. At 480 Hz, eight lines appear, each of which is one-eighth of one cycle. These patterns tend to shift slowly or rotate but are unmistakable. Use a minimum of sync amplitude to lock in the scope patterns.

Use the high rpm check points in Table 2 to check the accuracy of the tachometer over its entire scale. If desired, you can recalibrate the tachometer precisely in the 2400 to 3600 rpm portion of the scale.

If you run out of pot adjustment during calibration, simply increase or decrease the value of R4, R5, or R6 as required. If the lowest rpm range cannot be brought into calibration, due to insufficient tachometer output at low rpm, delete that range. For this reason, the 500-rpm range is omitted for four-cycle, four-cylinder engines.

Application. Install the tachometer in the car. To use the Tach Stretcher adaptor, set S1 to the desired range and plug the connecting cable into J1. Remove the cable to restore normal operation of the tachometer.

For air-fuel ratio tests and adjustments, idle-speed adjustments and others, refer to the specifications for your particular engine. On the 500-, 1000-, and 2500-rpm ranges, each division mark on the meter respectively equals 10, 20, and 50 rpm affording excellent scale readability as required for these tests and adjustments.

When using the voltage ranges, always disconnect the cable. Use the 1.5-volt range to check high-resistance grounds by measuring the voltage drop across a grounded connection while it is carrying current. A good ground should indicate zero volts.

When the Tach Stretcher adaptor is not in use, set S1 to the off or transit position.

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Double Fun
Continued from page 91

could listen to the tape that way? Okay, what does all this mean? It means, obviously, that the solution is to select a tape you can put a lot on—while still being able to play it back at low gain . . . and low noise, naturally!

When dubbing on Kodak type 34A High Output Professional Tape, our example, set the recording level on your slave unit at 4 decibels over your normal level—if you set your level by a VU meter, that's just slightly higher than normal. Because you can put a lot of signal on this tape, you can play it back at lower gain—and, there's the secret of how you manage to get your low noise.

It is not necessary, however, when you're getting started in dubbing your tapes to hold off because all you have at home is standard sound recording tape. Go right ahead and use your regular tape. Get the "feel" of making tape duplicates first. As a matter of fact, you may even find such dubbed tapes perfectly satisfactory. And remember, Aunt Harriet—or whoever you're sending your duplicate tapes to—may not be quite as critical as you are. The important thing is to get right into it so that you can see not only how easy it is to dub a tape, but also how much audio fun you can get out of it.

What Else. One of the beautiful parts of dubbing tapes is that aside from borrowing a second tape recorder, you really need no special accessories other than those that almost every tape enthusiast already has. Kodak Presstapes, for example, are handy little gismos to have around. These are 1/4-inch pre-cut splices which can be easily applied to recording tape with none of the customary trimming—they are identical in width to the recording tape itself. Kodak also makes a leader and timing tape that's really useful to anyone who goes in for tape dubbing.

Duplicating your tapes, and thereby sharing your sound experiences with others, can be extremely rewarding. And, after all, isn't this what life is really all about—the sharing of experiences with others?
shaded cherry red. The player only assembles the hardware and electrical components: he does none of the woodwork. All wires and cables are pre-cut and pre-stripped. And since all holes in the body are pre-drilled, assembly consists of nothing more than fishing the wired components into the correct holes, tightening the strings, and then tuning up. It's a one evening project.

**Tune Up.** The VU tuner is about the handiest gadget we've seen, intended for beginners who can't tell an A-sharp from an E-flat. You place the tuner on the guitar's bridge, then adjust one string until the gadget (actually a miniature tuning reed) vibrates. Voila, the string is almost perfectly tuned and you can then easily tune up the remaining strings.

Unlike solid-body electric guitars which must be used with amplifiers, the TG-46 has an acoustic body which, by itself, produces a full-rich sound. (And since the guitar can be used in practice sessions without an amplifier, you're more likely to stay on good terms with your family and neighbors.)

The Harmony-by-Heathkit TG-46 guitar, complete with lessons and VU tuner is priced at $189.95. Less expensive electric guitars (also Harmony-by-Heathkit) are available at $94.50 and $88.50. And if you're planning on purchasing a guitar amplifier, Heathkit has a dandy. It's a 60-watt amplifier kit (model TA-16) with all the fixings, that sells for $129.95. For additional information on any of these items, write to the Heath Co., Dept. EB, Benton Harbor, Mich. 49022.

You strummers ready? A-one, and-a-two, and-a-three, and-a...

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**Banana Belt DX**

Continued from page 48

ragua which closely resembles Honduras, both politically and economically. When the CIA bombed Guatemala City, its planes flew from Managua International Airport. When the CIA's Bay of Pigs invasion fleet sailed, it sailed from Puerto Cabezas at the northern end of Nicaragua's Atlantic coast (the troops were actually trained in Guatemala). At that time Puerto Cabezas did have a broadcast station, R.Puerto, but it has since gone out of business. Another (YNVC La Voz del Puerto on 6075 kHz) has supposedly taken its place. To the best of our knowledge no DXer has ever reported hearing YNVC.

Probably the most widely logged Nicaraguan SWBC station is YNRC R.Zalaya, approximately 5950 kHz at Bluefields some 150 miles due south of Puerto Cabezas. Watch for this one around 0600-0700 EST and in the evenings. But, Nicaragua is almost as easy to log and QSL on the BCB where two potent Managua transmitters are often heard; government owned YNM Radiodifusora Nacional on 615 kHz, and YNOL Ondas del Luz (“Waves of Light”) 828 kHz, a religious station. Watch for them both during the evening.

**Costa Rica.** Next we come to Costa Rica. Along with Panama, it ranks as Central America's most prosperous, democratic and literate country. It is also the most easily logged thanks to world famed missionary station TIFC at San Jose. This one can be heard almost nightly on 9645 kHz. TIFC “Faro del Caribe” (Lighthouse of the Caribbean) also has a potent BCB signal on 1075 kHz. English is scheduled at 2200-2300 EST. In the event you are looking for a little stiffer DX challenge, try TIQQ R.Casino on 5955 kHz at Puerto Limon and TIBBG R.Reloj on 6210 at San Jose.

**Panama and Canal Zone.** Panama currently has only one SWBC station which is heard with any regularity, but happily for SWLs, it's up on 31 meters. This is HOF31 on 9685 kHz at Panama City and owned by Panama's largest network, Radio Programas Continental.

However, from time to time, there is considerable anti-American feeling in Panama over the Canal Zone on which the U.S. has a long term lease. Whenever there is a "Yankee go home" surge, it becomes difficult to QSL Panamanian stations.

Also, because of that long-term lease, the Panama Canal Zone counts as a separate country for DX purposes. However, it has no SWBC transmitters and its BCB stations are seldom heard at a distance. Best bet is Panama Aeradio (WHZ operated by the Federal Aviation Agency at Balboa, C.Z.) which is widely heard on all Latin American aeronautical channels—2966, 5619, 8820—to mention just a few. The station simply identifies as “Panama”.

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Heathkit Guitar

Continued from page 66

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JUST THINK HOW MUCH in demand you would be if you could prevent a TV station from going off the air by repairing a transmitter...keep a whole assembly line moving by fixing automated production controls...prevent a bank, an airline or your government from making serious mistakes by repairing a computer.

Today, whole industries depend on electronics. When breakdowns or emergencies occur, someone has got to move in, take over, and keep things running. That calls for one of a new breed of technicians--The Troubleshooters.

Because they prevent expensive mistakes or delays, they get top pay--and a title to match. At Xerox and Philco, they're called Technical Representatives. At IBM they're Customer Engineers. In radio or TV, they're the Broadcast Engineers.

What do you need to break into the ranks of The Troubleshooters? You might think you need a college diploma, but you don't. Whatever you need is know-how--the kind a good TV service technician has--only lots more.

Think With Your Head, Not Your Hands
The service technician, you see, "thinks with his hands." He learns his trade by taking apart and putting together, and often can only fix things he's already familiar with.

But as one of The Troubleshooters, you may be called upon to service complicated equipment that you've never seen before or can't take apart. This means you have to be able to take things apart "in your head." You have to know enough electronics to understand the engineering specs, read the wiring diagrams, and calculate how a circuit should test at any given point.

Now learning all this can be much simpler than you think. In fact, you can master it without setting foot in a classroom and without giving up your job!

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To keep up with the latest developments, our courses are constantly being revised. This year CIE students are getting new lessons in Laser Theory and Application, Microminiaturization, Single Sideband Techniques, Pulse Theory and Application, and Boolean Algebra.

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Two-way mobile work and many other types of troubleshooting call for a Government FCC License, and our training is designed to get it for you. But even if your work doesn't require a license, it's a good idea to get one. Your FCC License will be accepted anywhere as proof of good electronics training.

And no wonder. The licensing exam is so tough that two out of three non-CIE men who take it fail. But CIE training is so effective that 9 out of 10 of our graduates pass. That's why we can offer this warranty with confidence: If you complete one of our license preparation courses, you'll get your license—or your money back.

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The "EDU-KIT" offers you an educational and practical home radio course at a reduced price. Our kits are designed to train Radio & Electronics Technicians; make up for lack of home training; give your child a head start in electronics; or to learn the fundamentals of radio. You will receive the instruction in the form of instruction manuals, practice problems, and hands-on projects. This is a complete radio course in every detail. You will learn how to build, use, and understand radio equipment. You will work with the standard type of components used by professionals. The "EDU-KIT" is designed to provide you with a basic foundation in Electronics and Radio, worth many times the low price you pay. The signal alone is worth more than the price of the kit.

The progressive Radio "EDU-KIT" is the foremost educational radio kit in the world, and is universally accepted as the standard in the field of electronics training. The "EDU-KIT" uses the modern educational principle of "Learn by Doing." You will construct, learn schematics, study theory, and work problems. It is designed to provide you with a thorough knowledge of radio, so that you can learn the functions, wiring and theory of radio circuits. You will then learn the practical aspects of radio and trouble shooting. Then you build a simple radio, with the first kit you will be ready to build a complete radio. You learn theory, practice testing and trouble-shooting. Then you build a more advanced radio, learn more advanced theory, build and test it. You learn the basics of building and testing, and then you build a complete radio, you learn the basic construction of professional wiring and soldering on metal chassis, plus the new method of radio construction known as "Printed Circuits." You will learn how to operate your radio in the 600 house current.

The "EDU-KIT" is complete. Each kit includes all parts and instructions necessary to build two different radio and electronics circuits, each guaranteed to operate. Our kits contain tubes, tube sockets, variable, electrolytic, 500, ceramic and paper dielectric condensers, resistors, tie strips, hardware, tubing, printed metal chassis, Instruction Manuals, hook-up wire, solder, aluminum rectifiers, oils, volume controls and switches, etc.

In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "EDU-KIT" also includes Code Instructions and the Progressive Code Oscillator. In addition to F.C.C. Radio Amateur licenses, you will also receive an FCC license and the Progressive Code Oscillator. In addition to F.C.C. Radio Amateur licenses, you will also receive an FCC license and the Progressive Code Oscillator. In addition to F.C.C. Radio Amateur licenses, you will also receive an FCC license and the Progressive Code Oscillator. In addition to F.C.C. Radio Amateur licenses, you will also receive an FCC license and the Progressive Code Oscillator.

The "EDU-KIT" is designed to provide you with a thorough knowledge of radio, so that you can learn the functions, wiring and theory of radio circuits. You will then learn the practical aspects of radio and trouble-shooting. Then you build a simple radio, with the first kit you will be ready to build a complete radio. You learn theory, practice testing and trouble-shooting. Then you build a more advanced radio, learn more advanced theory, build and test it. You learn the basics of building and testing, and then you build a complete radio, you learn the basic construction of professional wiring and soldering on metal chassis, plus the new method of radio construction known as "Printed Circuits." You will learn how to operate your radio in the 600 house current.

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In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "EDU-KIT" also includes Code Instructions and the Progressive Code Oscillator. In addition to F.C.C. Radio Amateur licenses, you will also receive an FCC license and the Progressive Code Oscillator. In addition to F.C.C. Radio Amateur licenses, you will also receive an FCC license and the Progressive Code Oscillator. In addition to F.C.C. Radio Amateur licenses, you will also receive an FCC license and the Progressive Code Oscillator.