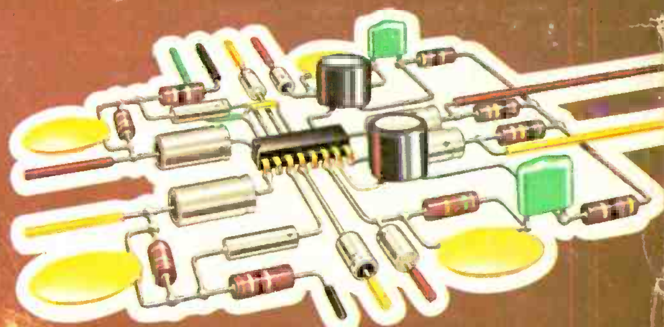
DXing The Lilli Marlene Stations

Electronics ILLUSTRATED®

CONSISTENTLY THE BEST IN HOBBY ELECTRONICS

NOVEMBER 1972 50c
By the Publishers of
MECHANIX ILLUSTRATED
06125

Build: Modu Meter for CBers
Build: Simple Phone Patch for Hams
Build: All-Electronic Transistor Tester
Build: All-Electronic Bongo
Special: How to Fix Broken Cassettes



Build Our Stereo Mini-Fi Amplifier... So Small It Fits in a Turntable Base!

Discover the ease and excitement of learning Electronics with programmed equipment

NRI Sends you

When you train at home with NRI, you train with your hands as well as your head. You learn the WHY of Electronics, Communications, TV-Radio the NRI pioneering "3-Dimensional" way. NRI training is the result of more than half a century of simplifying, organizing, dramatizing subject matter, and providing personal services unique for a home study school. You get the kind of technical training that gives you priceless confidence as you gain experience equal to many, many months of training on the job.

NRI—The Leader in Electronics Training for more than Fifty Years

APPROVED UNDER NEW GI BILL If you served since January 31, 1955, or are in service, check GI line in postage-free card.

Earn $5 to $7 an hour spare or full time in

TV-RADIO SERVICING

Color television sales are soaring. And so is the demand for trained repairmen. If you can service TV sets, portable radios, tape recorders, hi-fi sets, phonographs and auto radios, you'll always be in demand. It's one of your best routes to spare-time earnings, a good paying job or a business of your own. NRI trains you quickly and expertly, showing you how to get started in servicing soon after you enroll, earning as you learn. NRI trains you in today's method of installing and repairing all electronic equipment for the home —including solid state Color TV. You even build, experiment with and keep to enjoy your own solid-state radio plus your choice of black-and-white or the new 25" solid state Color TV receiver NRI developed from the chassis up for training. Like thousands of others, you can soon be earning good money in your spare time . . . the easy NRI way.

There's money and success awaiting you in

BROADCASTING—COMMUNICATIONS

The experience you gain from intensely practical NRI training in Complete Communications equals as much as two years of training on the job. With NRI, you can train for a choice of careers ranging from mobile, marine and aviation radio to TV broadcasting and space communications. You learn how to install, maintain and operate today's remarkable transmitting and receiving equipment by actually *doing* it. You build and experiment with test equipment, like a VTVM you keep. You build and operate amplifier circuits, transmission line and antenna systems, even build and use a phone-cw transmitter suitable for transmission on the 80-meter amateur band. Whichever of five NRI Communications courses you choose, you prepare for your FCC License exams, and *you must pass your FCC exams or NRI refunds your tuition in full.*

Move ahead in America's fast growing industry as

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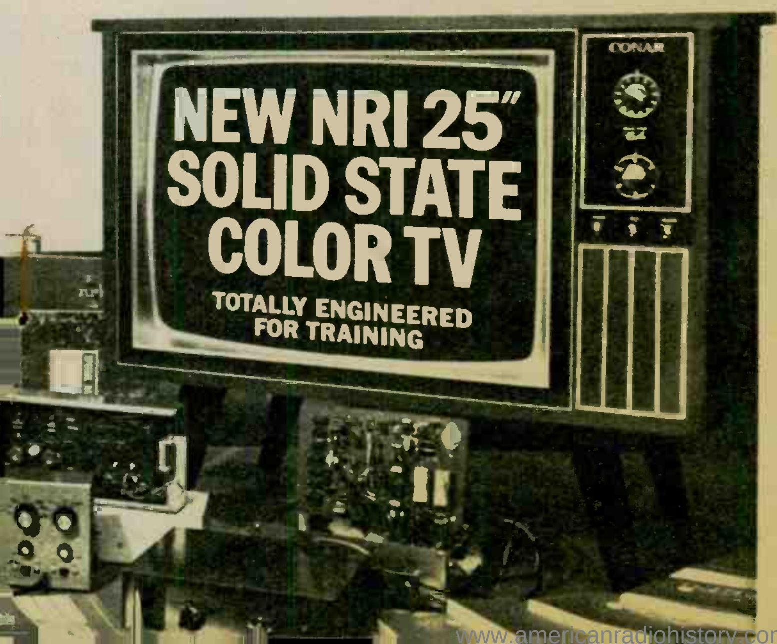
Electronics touches everyone's lives. This vast field of opportunity is open to you with NRI training. Industrial/Military Electronics training—like all NRI courses—prepares you quickly, thoroughly the practical "hands on" way. You build with, and learn to understand the functions of, today's miracle solid-state components like printed circuits, diodes and transistors. You build and experiment with Electronic circuitry used in automation, data processing, ultrasonics, telemetry. Bite-size texts make studying easier. Whatever your interest in Electronics, NRI training can fill your needs. Prove to yourself what nearly a million NRI students could tell you . . . that you get more for your money from NRI. Check the postage-free card and mail it today for your FREE NRI Color Catalog. NO SALESMAN WILL CALL. NRI Training, 3939 Wisconsin Ave., Washington, D.C. 20016.

YOU GET MORE FOR YOUR MONEY FROM NRI



NRI Kits and Equipment

Dollar for dollar, you get more value from NRI training kits, because they are designed as educational tools. In the TV-Radio Servicing Course, for instance, the end product is a superb 25" color TV your whole family will enjoy. The set is designed so that, while building it, you can introduce and correct defects . . . for trouble-shooting and hands-on experience in circuitry and servicing. The kits include, at no additional cost, a wide-band service type oscilloscope and color crosshatch generator, and other valuable equipment that will let you start earning money in your spare time making repairs . . . even before the course is completed.

Electronics ILLUSTRATED

A Fawcett Publication

November 1972 Vol. 15 No. 6

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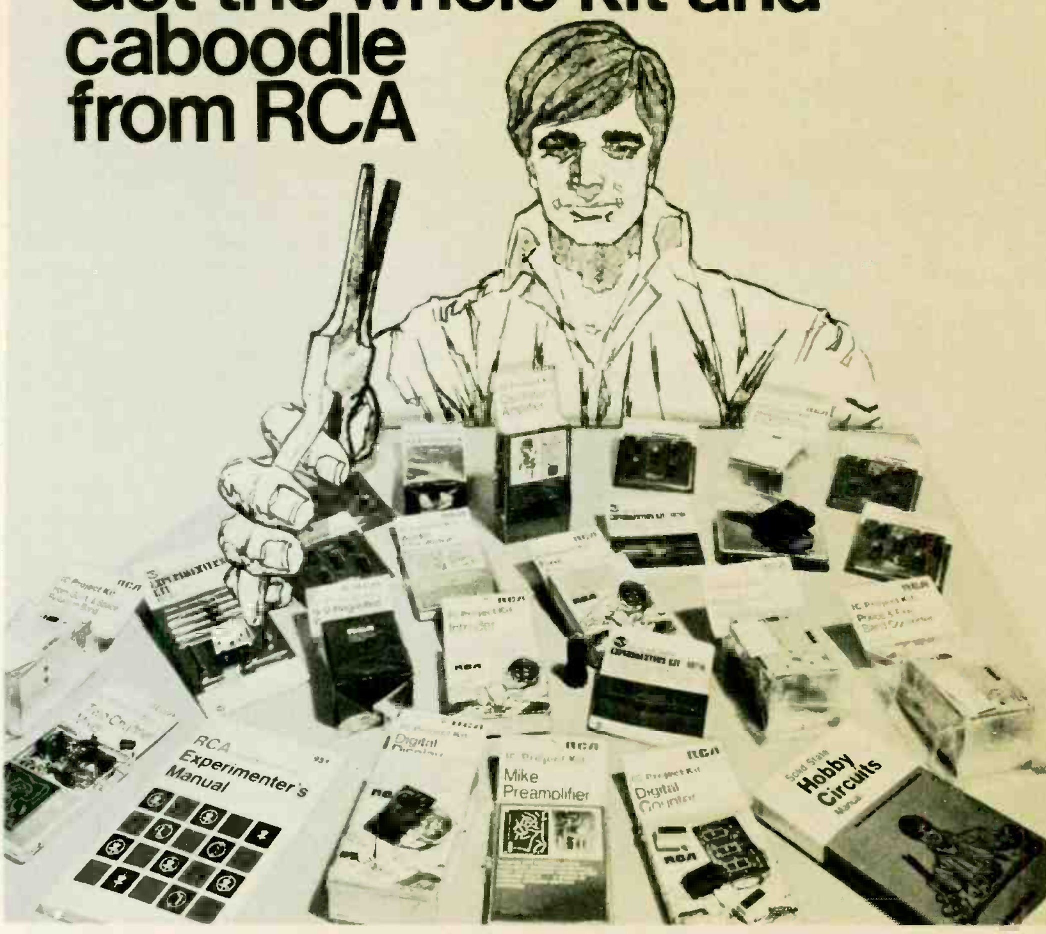
Illustrated by Eugene J. Thompson

A SPECIAL ANNOUNCEMENT

Beginning with our next issue, Electronics Illustrated will be combined with our companion publication, Mechanix Illustrated. See page 85 for the details.

Get the whole kit and caboodle from RCA



Now available from RCA . . . a wide variety of solid-state components in convenient kit form to build interesting and useful projects. Each one gives you the essentials for getting the most out of your project . . . in enjoyment, knowledge and performance.

And with RCA's popular hobby and experimenter's manuals, you can expand your solid-state experience. For example, the 368-page RCA Solid State Hobby Circuits Manual (HM-91) has over 60 interesting circuits you can build, and the 136-page RCA Silicon Controlled Rectifier Experimenter's Manual (KM-71) has 24 more! See your RCA Distributor to buy the RCA Kits and Manuals of your choice.

RCA | Electronic Components | Harrison, N.J. 07029.

RCA Electronic Components

RCA IC Project Kits, Experimenter Kits, and Devices

Type	Description	Type	Description
KC4000	I C Microphone Pre-Amplifier Kit	KD2100	Silicon Control Rectifier Assembly
KC4001	I C Two-Channel Mixer Kit	KD2105	SCR Experimenter Kit
KC4002	I C Audio Oscillator Kit	KD2106	Add on Light Sensor Kit
KC4003	I C Power Amplifier and Oscillator Kit	KD2110	Add on Heat Sensor Kit
KC4004	I C Regulated Power Supply Kit	KD2117	I C Experimenter Package Basic Kit Contains 2 KD2114, 1 KD2115, 2 KD2116
KC4005	I C Intruder Alarm Kit		
KC4006	I C Fire Alarm Kit		
KC4007A	I C Converter Kit 118 136MHz Aircraft Band	KD2118	NPN Silicon Variety Pack (5 Units)
		KD2120	PNP Silicon Variety Pack (5 Units)
KC4008A	I C Converter Kit 134 150MHz Ham, Government, Space Research Band	KD2123	PNP Germanium Variety Pack (5 Units)
		KD2124	NPN Germanium Variety Pack (5 Units)
KC4009A	I C Converter Kit 148 164MHz Maritime Mobile, Police, Fire Band	KD2131	70 Watt IC Power Module
KC4010A	I C. Converter Kit 160 174MHz Police, Fire Band	3N128DP	MOS/FET Device in Display (Blister) Pack
KC4011	Digital Readout IC Kit	40214DP	18 Amp ¼ in Stud Silicon Rectifier Device in Display (Blister) Pack
KC4012	Digital Counter IC Kit		
KC4500	Kit Enclosure for use with KC4000, KC4001, KC4002, includes Input & Output Jacks, On-Off Switch and Hardware		

Electronics ILLUSTRATED

By the Publishers of MECHANIX ILLUSTRATED

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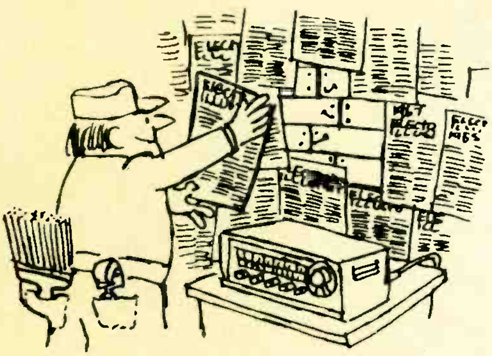
Feedback from Our Readers

Write to: Letters Editor, Electronics Illustrated, 1515 Broadway, New York, N.Y. 10036

● UP AGAINST THE WALL

I liked your 24-Hour Short-Wave Schedule and I have every one that you have ever published. They're all pasted to one wall of my shack and I'm grateful for your latest since it fills up the last space on the wall.

A. Johnson
Miami, Fla.



We're pleased to hear of your interest in our short-wave schedules. The torn-out pages have one or two other uses, you know.

● PENPAL WANTED

I am 15 years old and would like to correspond with a pen friend in the U.S. My main interest is in electronic sound effects. I am presently building a mini synthesizer and would like to share ideas with U.S. experimenters on the subject.

N. Hodgson
3 John St.
Frankson, Victoria,
Australia 3199

● SPEAKING UP

I'm planning on building a very sensitive microphone which can detect even the faintest signals from long distances away. Problem is, I really don't know where to begin.

J. Vyhnal
La Jolla, Calif.

You're looking for a device sometimes euphemistically called the Big Ear by electronics experts. Non experts know this device as a mother-in-law.

● 'E'S LOST IN SPACE

Your first Class-E project sure caught me by surprise! Since there aren't any Class-E CBers up at 220 mc. now, isn't it a lonely band?

D. Major
Yonkers, N.Y.

It all depends on whose version of the vast wasteland theory you accept. Hams finally realize the potential of the 220 mc. band after doodling around on the other VHF bands. CBers (and this includes manufacturers of CB gear) see this still proposed band as the next best thing to rediscovering the Klondike. Today the 220 mc. band is largely unoccupied, but it won't remain that way for long.

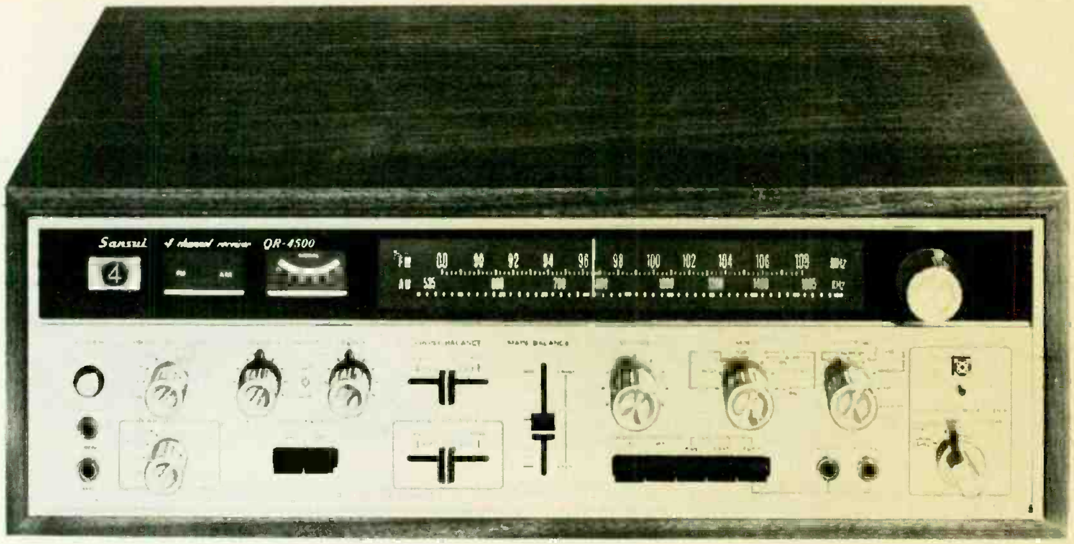
● HAVE DESIRE, WILL LEARN

I work full time and have been thinking of learning TV servicing as a new career. Can you tell me if home-study courses are a valid way of learning electronics and who gives lessons?

R. Pizzino
Allen Park, Mich.

Home study is an excellent way to learn TV servicing, or most other areas of electronics. But, you will have to find the time to work on each lesson without the distractions of your present job interfering. It also takes a certain amount of self-discipline in order to study theory, take tests and learn to use electronic gear in your spare time. The National Home Study Council has a booklet "Directory of Accredited Private Home Study Schools, 1972" available to interested parties. For a copy of this booklet, write to NHSC, 1601-18th St., NW, Washington, D.C. 20009.

WHICH WAY FOUR CHANNEL ?



THIS WAY

If the four-channel merry-go-round has you confused, you have lots of company. Discrete or matrixed. Compatible or non-compatible. This system or that one.

Now Sansui offers you total-capability QR Receivers that will transport you into the four-channel world to day and can handle every variation to the four-channel game that anyone's dreamed up for tomorrow.

Take the QR4500 AM/FM Two-Channel and Four-Channel Stereo Receiver-Synthesizer-Decoder-Amplifier-and-Control-Center. It can decode any compatibly matrixed four-channel recording or FM broadcast, or it can synthesize two rear channels from any two-channel source. Exclusive Sansui phase-shift matrixing prevents the sound dropouts and false dislocations that plague many matrixed systems. And exclusive phase modulators duplicate the live sound field.

It can handle any tape or other discrete source and accepts adaptors, converters or other accessories for any four-channel technique anyone's hinted at.

It boasts 240 watts of total IHF power (continuous power per channel of 38 watts at 4 ohms, 27 watts at 8 ohms) with less than 0.5% TH or IM distortion at rated output and normal response of 20 to 30,000 Hz ±1dB. In a walnut cabinet, $599.95.

You'll find the same universal four-channel versatility in all Sansui QR Quadphonic Receivers, including the QR1500, with 100 watts of total IHF power (20 watts continuous per channel at 4 ohms). With walnut cabinet, $299.95.

Sansui

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Electronic Marketplace

Live-In Speaker Hatches the Highs and Lows. The ultimate bachelor-pad speaker, it turns out, is an egg-shape, upholstered lounge chair equipped with a couple of Norelco or Magitran speakers mounted in the frame. Just imagine

yourself, comfortably ensconced in Audio Decor's Audio/Egg, enjoying the sounds of your hi-fi—or someone else—in this unobtrusive listening chamber. Built into this fiberglass lounge chair are volume controls (optional on some models) and universal connecting plate. Model 4000V (shown) costs about $350. Rotocast Plastics, Miami, Fla.

Lilliputian Drivers Swiftly Set the Screws. Every hobbyist has, at some time, cursed those miniature screws found lurking in most electronics gear. Xcelite has two sets of miniature-size

screwdrivers, each containing five drivers for slotted-head screws. Sizes fitted range from .040 to .100-in. wide. The basic set, model M50, is housed in a see-through pouch. The optional set, M60, also contains one size 00 Phillips driver and torque amplifier handle. $2.50 for the M50, $3.50 for the M60. Xcelite.

Uncle Tom's Corner

By Tom Kneitel, K2AES/KQD4552

Uncle Tom answers his most interesting letters in this column.
Write him at Electronics Illustrated, 1515 Broadway, New York, N.Y. 10036.

★ *Is there any way I can splice cassette tapes which have torn? I have some valued ones which need repair but don't know where to begin.*

George D. Wolf
Garibaldi, Ore.

I'm with you, George. I gave up trying to repair a number of damaged cassettes I had and went back to reel-to-reel. I didn't mind them tearing as much as I detested the job of unwinding several yards of recording tape from the gears of the tape deck. Anybody have any suggestions for George (and I) on repairing cassettes?

(Yes. Look further in this issue and you'll both find out how to fix those bum cassettes.—Editor)

★ *I notice that a number of surplus dealers are offering a rig described as "Royal Army model 46." The units are cheap and look nifty in the photos. Can they be put to any useful purpose?*

Ted Creighton
Welland, Ont.

The 46 is a crystal-controlled rig made for use by commandos. It flings out ½-watt on any given channel between 6 and 9 mc. If you're a commando who wants to communicate for a few hundred yards, this may be just what you've been looking for, Ted!

★ *What do you think about the possibilities of converting commercial 2-way communications gear for the 2 meter (144 mc.) ham band?*

Myron Gordon
Richmond, Calif.

It's a good idea! A considerable amount of used commercial units are floating around and if you do some shopping you can pick one up rather inexpensively. You'll find that the Motorola and GE-Progress rigs are rather expensive, but sets like those from Raytheon are well suited to a ham's budget. I picked up a Raytheon 21TR11A from a dealer who had taken it on a trade-in and almost gave it away. All it needed to get it perking on 2 meters was a slight modification, some small construction projects, and routine alignment. Puts out a healthy 20-watt signal.

★ *Here's an annoying mobile CB problem for you, Great Solver of problems. The receiver squeals when picking up strong signals. Your solution, sir.*

R. S. Dowdey
Yaphank, N.Y.

Sounds to me like the choke which runs from the antenna connector to the chassis is burned open. The coil will burn open if the DC plug (+) lead only is connected to the battery, and the unit is on the seat (ungrounded to car frame) with the power switch "on." As the antenna connector is inserted, DC will flow through the coil until the ground (PL-259) sleeve is attached—if an antenna using an auto-transformer winding is mounted on the car. Ground the rig properly and replace the choke and you're back in business.

★ *Do TV translator stations have callsigns? They never announce them, yet being licensed by the FCC it seems that they would probably be assigned some sort of ID.*

Harold Boeta
Chatsworth, Ga.

Indeed they do, and they look like odd ball ham callsigns. They start off with a "W" or "K" and then that's followed by their transmitting channel number.

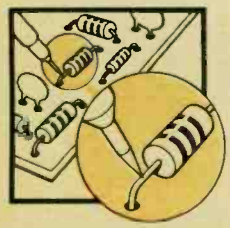
Service Tips

By Art Margolis

A SERIES of horizontal bars in your solid state TV's picture often appears at first glance to be filter capacitor trouble. Better test the power supply regulator transistor (sometimes called an *active power filter*) before digging for the capacitor. Chances are the transistor, and not the capacitor, is defective. Try spraying the transistor with one of the temperature-lowering chemicals. If the bars disappear, replace it.

—

Best general point to observe when troubleshooting miniature electronic equipment is to sharpen your probes. Most test probes supplies with stock VTVMs and scopes have blunt points which are too thick for proper use on tiny gear. File these points down to a sharper tip. Off-the-shelf needlepoint probes enable you to direct the probe to the lead of the component.



One of the tricks used to test transistor conduction is to short its emitter lead to base. This will cut off current flow in the transistor. When making conduction tests by this method, never short the base to the collector. Permanent damage to the transistor can result.

—

Ever want to know if you have successfully demagnetized a tape head? Play a bulk-erased blank tape through the machine. If little or no noise is produced, the head is properly demagnetized. A high noise level means degauss again.

—

A junction field effect transistor (JFET) can be tested like its bipolar counterpart with an ordinary multimeter. While the bipolar device is tested by taking forward and reverse resistance readings from emitter to base and then from collector to base, the JFET is tested from its source to gate and then from drain to gate. The multimeter should read higher in one direction than in the other.

—

Don't waste time in the shop by staring at power-dissipating resistors that look off-color. That slight charring from excessive heat means the resistor is defective. When you suspect a burnt, or out-of-tolerance resistor, replace it without further fuss.

—

The biggest problem with hand-held walkie-talkies stems from a run-down battery. To test battery condition, connect VTVM leads across the cell while it is still in the holder. Press the walkie-talkie transmit button. Little or no voltage change means the battery is still good. If the VTVM shows 30 percent or more loss, replace the cell.


The U.S. Department of Health, Education, and Welfare.
advertising contributed for the public

Electronic Marketplace

Simba, the Majestic One. Brute force, bone-crushing power is often the kind of RF socko you need on today's Citizens Band. Gladding's Simba SSB rig delivers 15 watts into the antenna to give you the communications edge on this busy band. With the Gladding Simba SSB you get full-feature front panel controls. Like variable modulation and a lighted digital clock

that turns the transceiver on at a pre-set hour. Simba's control line-up includes an RF Gain, SSB Clarifier and Squelch pot. Also found on the front panel is a Mode switch, Volume control, Calibrate setting and Mike Gain knob. Provisions are made for plugging headphones into a front-panel jack. Two meters help you optimize SWR and transmitted power. $429.95. Pearce-Simpson, P.O. Box 800, Miami, Fla.

Keep Both Eyes on the Screen. Color TV test jigs are time savers, as the service tech who is routinely faced with repairing thousands of different tint chassis models each year can attest. Recognizing the thousands of chassis made (and sold under more than 40 different brand names), GTE Sylvania is offering a color television test unit to the beleaguered tech. Called Chek-A-

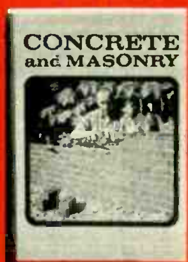
Color, the unit can test solid-state, hybrid, or tube-type TVs. Chek-A-Color's picture tube yields 14 viewing inches and can test both high- and low-focus voltage chassis. Sixty-one adapters or extensions are available. $172.50. GTE Sylvania, New York, N.Y.

WHEN THE EXPERTS TELL YOU...
YOU BETTER BELIEVE IT!

The All New Fawcett Practical Workshop Library Does Just That. These Handsome Hard-cover Books are Fully Illustrated, Indexed for Easy Reference to Hundreds of Money-Saving Projects and Ideas. Only $1.49 each, plus 25 cents per book for postage and handling.

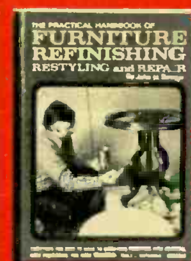
CARPENTRY 052 • This book takes the novice from the basic workshop to the building of frame houses. Step-by-step illustrations and charts supplement the easy to understand text. Topics covered include: use of tools, safety, planning and constructing your home workshop, buying your lumber, paneling walls, tips on furniture building, adding new ceilings, installing built-ins, storage, adding rooms, and more.

ELECTRICAL REPAIRS 055 • Filled with diagrams, pictures and easy-to-read charts, this is an indispensable guide to safe, simple ways to solve home electrical problems and to install new devices and wiring. Topics include: troubleshooting, repair of small and major appliances, safety, indoor/outdoor wiring and repair, installing light dimmers, fixing fluorescent lights, outdoor and indoor wiring, etc.



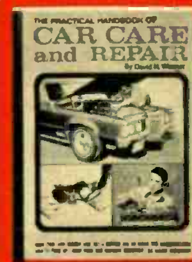
CONCRETE AND MASONRY 053 • Professional quality walks, drives, patios, walls, etc. can be made simply and inexpensively by using this handbook. It takes you through the rudiments of mixing and use of tools to the secrets of brick laying. Other topics include: the right way to use ready mix, mortar-making tips, beauty in stone, patching and resurfacing, casting footings, walls, floors, etc.

FURNITURE REFINISHING, RESTYLING AND REPAIR 057 • Contains valuable information on know-how and correct procedures for professional looking restoration and repair of furniture. Topics include: Repairing dressers, tables, chairs, beautifying odd pieces, use of varnishes, making wood satin smooth, minor repairs, matching woods, restoring antiques and picture frames, stripping old finish, etc.



PLUMBING AND HEATING 054 • This book helps you cut those costly bills by showing you how to do it yourself. It is filled with easy to understand drawings, charts and photos and contains a wealth of information. Topics include: saving heating dollars, disposal systems, learn your home plumbing system, waste and heating repairs, fixing a furnace, heating controls, necessary plumbing tools, etc.

CAR CARE AND REPAIR 058 • Top performance information, easy to follow and amply illustrated; that the average motorist will find extremely useful. Topics include: Paint and body work, basic tools every owner should have, buying parts, lubrication, tuneups, electrical system, smooth shifting, valve grinds, overheating, exhaust system installation, overhaul tips, suspension, foreign cars, etc.



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Greenwich, Conn. 06830

Circle nos. wanted below:

052	055
053	057
054	058

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ADDRESS ______________________

CITY __________ STATE __________ ZIP __________

Enclosed please find $ ______________________

New kits for every interest in

Kit AR-1214 **169^{95}***

(AJ-1214 Tuner & AA-1214 Amp, 89.95* each)

New Heathkit 50-watt Stereo Receiver

The new Heathkit AR-1214 AM/FM Stereo Receiver comes on with a great new look that's as practical as it is beautiful and the AR-1214 is a work of Heath audio excellence throughout. The amplifier section produces a clean 25 watts IHF, 15 watts RMS, per channel into 8 ohms. Two integrated circuits and two ceramic filters in the IF give this receiver a selectivity greater than 60 dB and superior amplifying/limiting characteristics. The phase lock multiplex demodulator gives 40 dB typical channel separation at less than 0.5% distortion. The preassembled FM tuning unit provides 2 uV sensitivity and a 2 dB capture ratio. The phono preamp section also uses integrated circuitry and has its own level controls so turntable volume can be set to coincide with tuner levels. All this in a money-saving kit project that's a pleasure from start to finish. Most circuitry mounts neatly on just three printed boards. The FM tuner is preassembled. Three evenings and just four simple alignment adjustments will have it all together. And the cabinet is included in the low price. Other features are: Black Magic panel lighting to hide the dial face when the receiver is off; flywheel tuning; stereo indicator light; headphone jack; speaker on/off button; built-in AM antenna. And there are complete tape monitor facilities so you can hear recorded material as it is committed to tape, make use of the many add-on components that use these jacks, or combine your AR-1214 with the matching AA-1214 Amp for a great sounding 4-channel system at a nice price. Stereo "separate" versions of the AR-1214 are also available: the AJ-1214 AM/FM Stereo Tuner at 89.95*; and the AA-1214 Stereo Amp at 89.95*. Both prices include cabinets. For a bold new sound in your listening room, order your Heathkit AR-1214, today. 16 lbs.

Kit AD-110 **129^{95}***

Heathkit Stereo Cassette Deck

The AD-110 Stereo Cassette Deck offers a typical frequency response of 30-12 kHz for full fidelity reproduction of all mono and stereo cassettes, including chromium-dioxide. The built-in record bias adjustment requires no external equipment, utilizes the front-panel meter and a built-in reference. Features include precision counter, automatic motor shutoff, preassembled and aligned transport mechanism. Compatible with any quality mono or stereo system. 12 lbs.

Kit SB-313 **339^{95}***

New Heathkit SB-313 SWL Receiver

Covers 9 switch-selected bands between 3.5 & 21.8 MHz; receives SSB, CW, and AM with professional quality. 5 kHz AM crystal filter supplied, separate SSB & CW crystal filters optional. Solid-state circuit including 4 MOSFETs. IC crystal calibrator provides markers every 100 kHz or 25 kHz. Plug-in boards & wiring harness simplify assembly. 22 lbs.

Kit HW-7 **69^{95}***

New Heathkit HW-7 CW QRP Transceiver

Work the globe on "flea-power" with this 3-band QRP CW transceiver featuring VFO & provision for xtal transmit operation. Covers CW portion of 40, 20, & 15 meters. Solid-state circuit. Sensitive Synchrodyne detector. Built-in sidetone & relative power meter. Operates from optional AC power supply (14.95*) or 12V batteries. 6 lbs.

See them all at your local Heathkit Electronic Center...or send for FREE catalog

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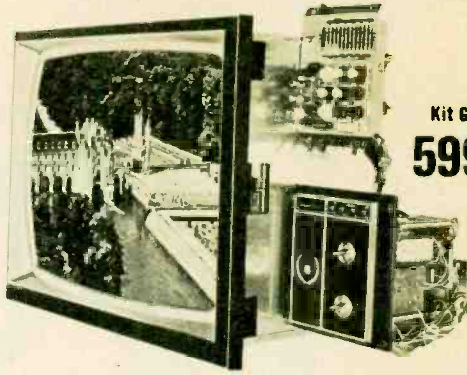

Kit GR-900
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A Really Compact Stereo You Can Build

By JIM WHITE, W5LET
and BUD WEISBERG, K2YOF

SMALL wonder the compact stereo system caught on like Topsy. When the apartment- or dorm-dwelling audiophile considers the amount of room he doesn't have for a rig loaded with extras, the compact looks like a genuine space- and money-saver. Hitch is, unless the stereophile grabs the largest and most expensive compact on his dealer's shelf, the sound reproduced by the so-called mini rig is often little better than that of an oversized table radio.

Most audio buffs who long for high quality sound, but can't break their bank accounts, simply forego the decent sound and reasonable flexibility offered by a good compact system. Our Really Compact Stereo is one answer for the audio enthusiast who wants a low-cost, component-quality system in a package not much larger than a turntable base.

Our compact is, in part, based upon a time-proven, dual-channel IC preamp circuit. This compact accepts the signal from any magnetic phono cartridge, as well as two high-level inputs like tape deck or FM stereo tuner. Input and output switching facilities needed by the average home listener are included, along with jacks for plugging in a four-channel decoder when the listener decides to upgrade his system with this accessory. In the meanwhile, this jack set serves the audiophile's tape monitoring needs.

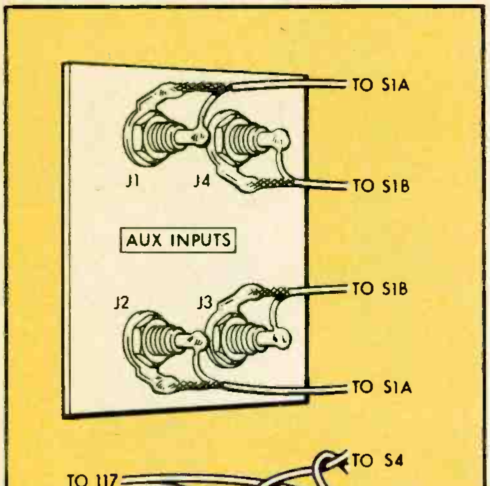
The output of our compact is built around a pair of hybrid integrated circuits. Each IC is capable of delivering 15 watts *rms* to a speaker . . . more than enough to drive today's high-efficiency, acous-

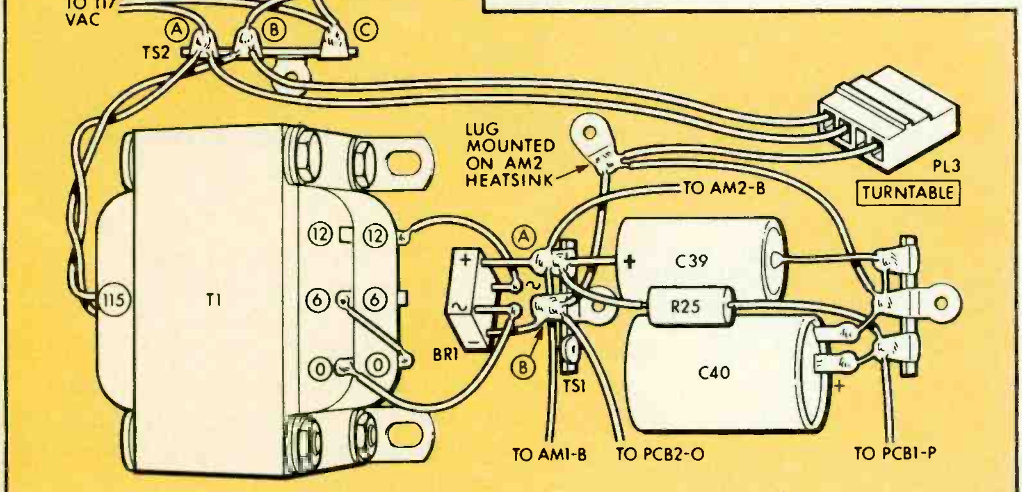
Really Compact Stereo

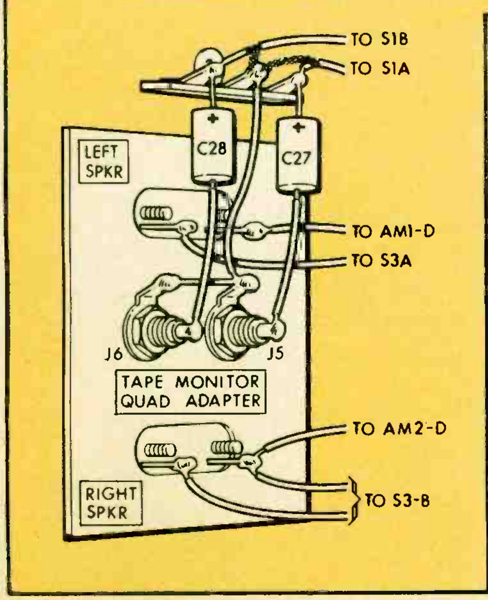
tic-suspension speakers. Overall cost of our compact stereo project can be kept down to about $100, if you shop for parts and raid the junk box for a resistor or two.

How It Works

Our entire stereo circuit is built around a couple of integrated circuits. Half of the first IC, labelled IC1 in the schematic, provides gain and equalization for a magnetic phono cartridge input signal. The other half of this IC, an RCA CA3048, boosts the high-level inputs connected to auxiliary inputs jacks J1-J4. These high-level inputs can be







from sources like an FM stereo tuner, tape deck or microphone mixer.

The second integrated circuit is the audio power amplifier. Actually, it's not an integrated circuit in the true sense of the term, but instead, an encapsulated amplifier made up of specially selected components. The name most suitable for IC2 or IC3 is *hybrid* integrated circuit, because of its unusual construction.

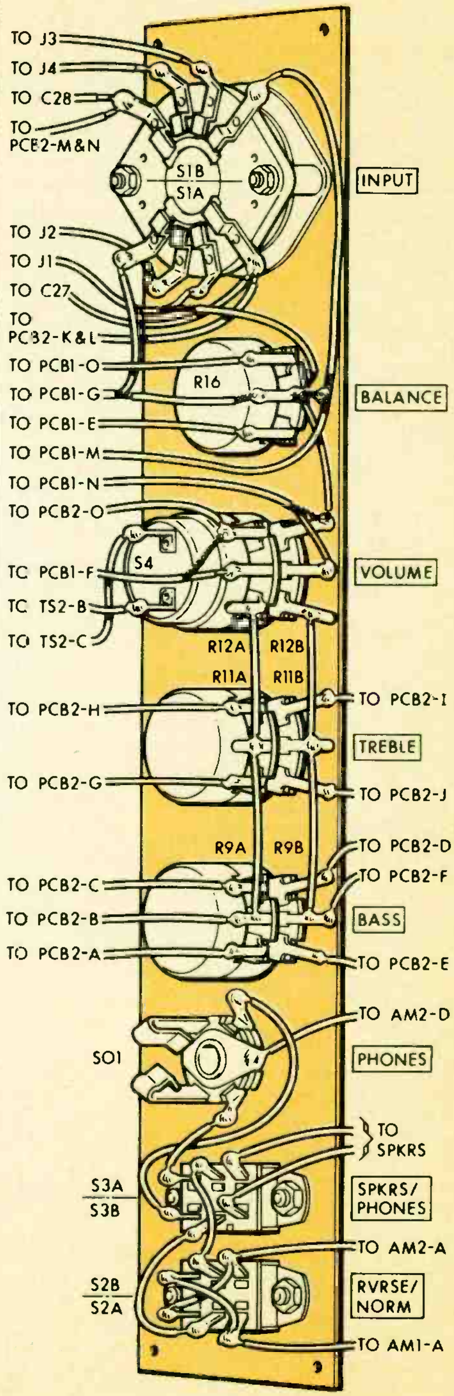
The entire preamp built on PCB1 and associated tone control components wired on PCB2 are a direct adaptation of an RCA design. Both pc board assemblies form the heart of a preamp which can deliver a rea-

Auxiliary Input, Tape Monitor panels mount on rear panel on either side of power supply parts.

PARTS LIST

BR1—Bridge rectifier: min. rating: 100 PIV @ 3 A
Capacitors: all 12VDC electrolytic unless otherwise noted
C1,C2,C9,C10,C19,C20—1 μf
C3,C4—100 μf
C5,C6—0.1 μf, 50V disc ceramic
C7,C8—0.05 μf, 50V disc ceramic
C11,C13—0.022 μf, 100V mylar
C12,C14—0.22 μf, 100V mylar
C15,C17—0.01 μf, 50V disc ceramic
C16,C18—0.068 μf, 100V mylar
C21,C22—10 μf C23,C24—5 μf
C25,C26—0.0033 μf, 50V disc ceramic
C27,C28—5 μf, 15V electrolytic
C29,C30—22 μf, 5V electrolytic
C31,C32—5 μf, 40V electrolytic
C33,C34—2,000 μf, 30V electrolytic
C35,C36—50 μf, 30V electrolytic
C37,C38—0.05 μf, 50V disc ceramic
C39—2,200 μf, 50V electrolytic
C40—5,000 μf, 50V electrolytic
IC1—Integrated circuit (RCA type CA 3048)
IC2,IC3—Hybrid integrated circuit. Available from Electronic Associates, Inc., 185 Monmouth Parkway, West Long Branch, N.J. 07764. $13.95 each. (See note)
J1-J6—Phono jacks
PL1,PL2—Phono plug and cable assembly (see text)
PL3—Plug to mate with turntable power socket (see text)
Resistors: ½ watt, 10% unless otherwise noted
R1,R2—100,000 ohms R3,R4—47 ohms
R5,R6,R17,R18—1,500 ohms
R7,R8—12,000 ohms
R9,R11—100,000-ohm, linear-taper dual pot
R10,R13—1,000 ohms
R12—50,000-ohm, linear-taper dual pot with SPST switch
R14,R15—39 ohms
R16—100-ohms, linear-taper pot
R19,R20—1,000-ohms, linear-taper miniature pot
R21,R24—470 ohms R22,R23—22 ohms
R25—680 ohms, 1 watt
S1—Two-pole, three-position shorting rotary switch (Centralab PA-2002 or equiv.)
S2,S3—DPST slide switch
S4—SPST switch (on rear of R12)
SO1—Open-circuit, panel-mounting stereo phone jack (Calectro 30-541 or equiv.)
SO2—Closed-circuit, panel-mounting stereo phone jack (Calectro 30-541-1 or equiv.) see text.
T1—Power transformer: primary winding: 115 VAC, secondary winding: 0-6-12-18-24V @ 2 A. Available from Barry Electronics, 512 Broadway, New York, N.Y. 10012. Order stock No. 24-2. $8.03 plus postage.
1—4 x 4½-in. pc board (PCB 1)
1—2½ x 3¾-in. pc board (PCB2)
2—3 x 3-in. pc boards (AM1,AM2)
2—Heat sinks (6 x 6 x ⅛-in. aluminum plate)
2—Mounting straps for IC2, IC3
1—2½ x 11-in. piece of 16 ga. aluminum
2—2½ x 3½-in. pieces of 16 ga. aluminum
1—Record changer (BSR model 510. See text)
Misc.—5 knobs, AC line cord, 4 rubber feet, ¾-in. plywood, single-conductor shielded audio cable, 2-terminal, barrier-type screw connectors, terminal strips, hardware, dry-transfer lettering, solder, wire, etc.
Note: All components comprising AM1 and AM2 are available in kit form from Electronic Associates, Inc. Cost of each basic amplifier kit is $22 plus postage.

Front-panel components. See text for SO1.

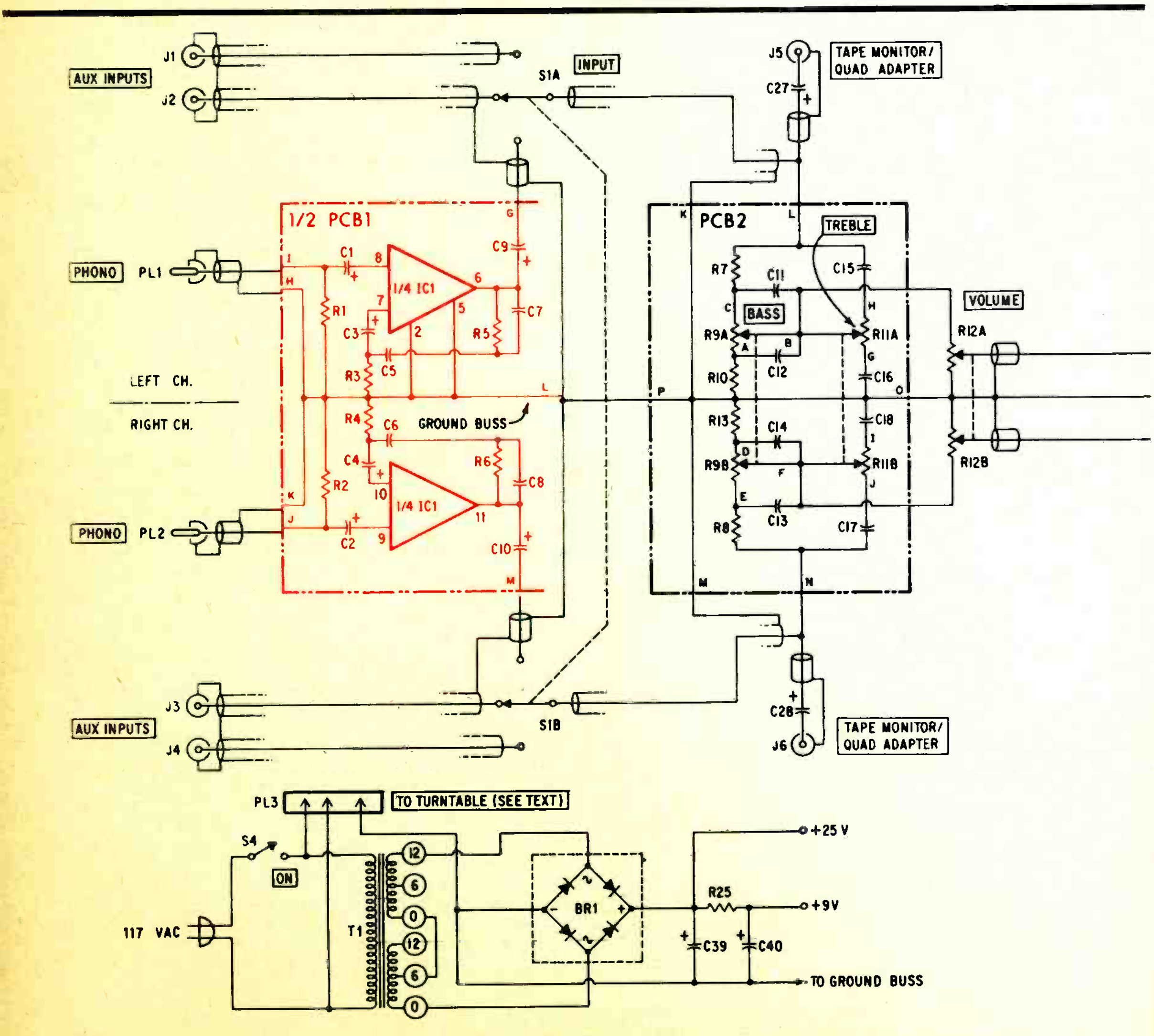


sonable level of performance without a lot of external circuitry adding to the overall cost and complexity of the project.

The Class-B, quasi-complementary power amplifiers can feed full power—30 watts peak-to-peak per channel—into a load continuously. Though it would take a bit of negligence on the part of the builder to destroy these thick-film hybrid ICs, the manufacturer offers the IC with complete short-circuit protection for $15.80 each. If you plan to experiment with each amplifier circuit before mounting them in the compact, this IC with optional short-circuit protection would be worth the additional $1.80.

Note that besides the usual array of Input, Bass, Treble, Volume and Balance controls in our circuit, the compact also utilizes a speaker reversing (S2) and speaker/headphone switch, S3. Switch S3 can be omitted if a self-switching headphone jack (SO2 in the schematic) is substituted for SO1. All other wiring of the output stage remains the

Phono and auxiliary inputs, plus tone control wiring indicated below. Wire ground buss as shown.



shown in the schematic.

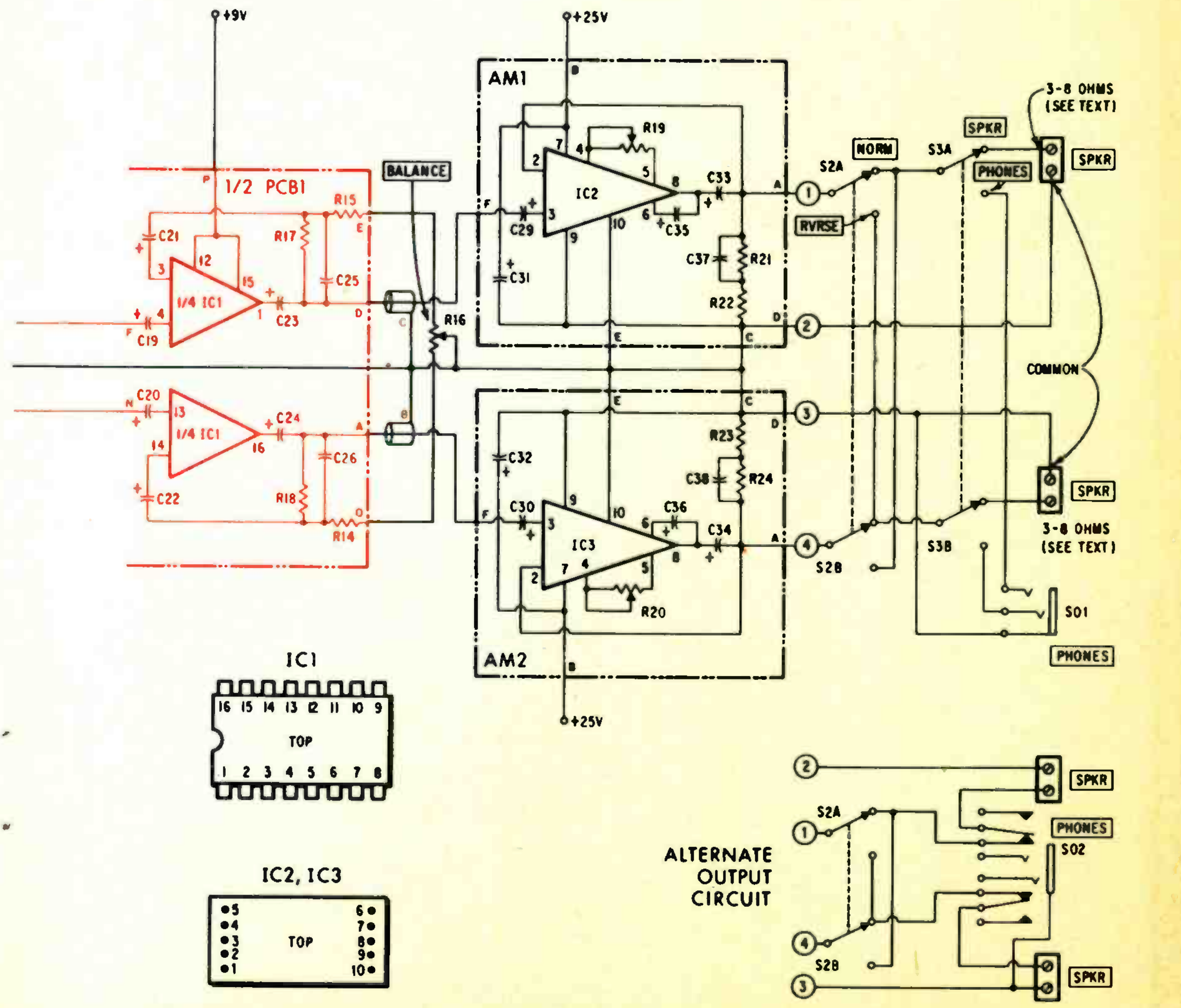
Building the Really Compact Stereo

Begin construction by preparing the plywood cabinet. The prototype measures 16 x-12¾ x 3⅝-in. The turntable mounting plate was cut out for a BSR McDonald model 510 changer. The plastic base usually sold as an accessory to the 510 won't work because the printed circuit boards and power supply components must be bolted to the cabinet bottom. This bottom piece is cut from ¼-in. plywood and is attached to the cabinet sides with wood screws. Four rubber feet are secured to the bottom plate, one at each corner.

The top plate is also a piece of ¼-in. plywood. Overall dimensions are the same as the bottom's. Cut out an opening as directed by the 510's mounting template, or that of any other record changer you are going to use. Mounting templates always accompany instructions packed with a new changer mechanism.

Do not mount the record changer to the top yet. Arrange the various sections of the

Though pin 9 connects to pin 10 on IC2 and IC3, do not jump terminals together on circuit board.



system on the bottom plate to keep them from interfering with the mechanical movements of the changer. If the BSR 510 is employed, follow the layout shown in the photos and pictorials.

Wiring the Compact. Each power amplifier, labelled AM1 and AM2 in the schematic, is built on a printed circuit board. After wiring each board, mount them on a 6 x 6 x-1/8-in. aluminum plate. It serves as a heat sink for the hybrid ICs. If you purchase the complete amplifier kit from EAI, an aluminum plate is included. Follow their instructions closely.

Whether you buy a kit or prefer to roll your own, two precautions must be observed. Apply a liberal coating of silicone grease between the hybrid IC and heat sink. Also, solder the IC to the pc board with a minimum of heat. A pencil iron is the recommended soldering tool—25 to 50 watts capacity will do. When both of the power amplifiers are wired, put them aside.

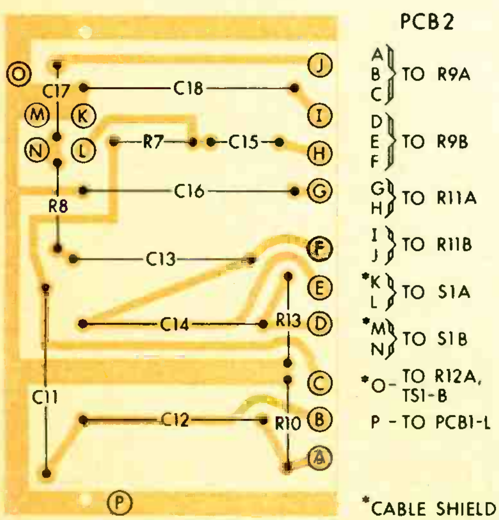
To simplify construction, preamplifier components are mounted on two pc boards. One, labelled PCB2, contains parts associated with the tone controls. The other is for the remainder of the preamp parts and IC1. Layouts for both boards are shown.

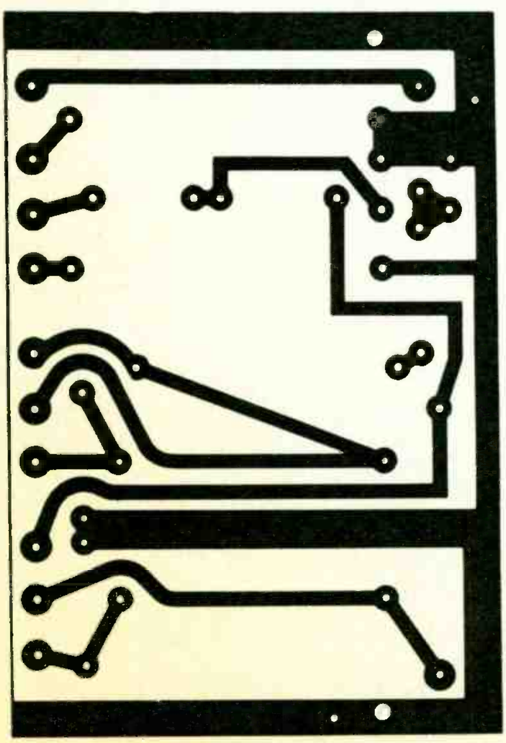
Once you prepare both pc boards, solder the parts in place as shown. IC1 can be soldered to the board directly. If you prefer, solder an IC mounting socket to PCB1, eliminating the danger of heat damage to IC1.

Note the indicated polarity of electrolytic capacitors and mounting tab on IC1. Be sure all polarity-sensitive components are mounted correctly.

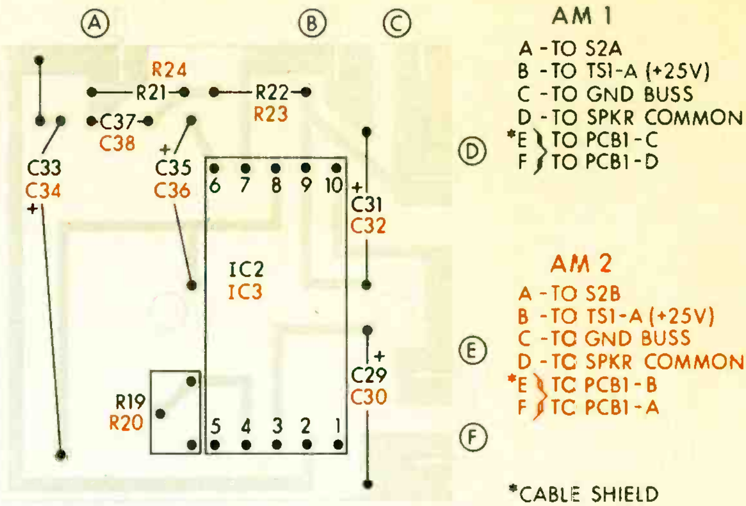
All four control pots plus the three switches are mounted on a 2½ x 11-in. aluminum plate. A 2 x 10½-in. cutout is first made in the front of the cabinet before mounting the aluminum plate over it. Some of the control panel wiring can be finished at this time. Before mounting PCB2 to the bottom of the cabinet, attach angle brackets as noted in the pictorial. Then wire PCB2 to the tone controls via the shortest possible leads.

Input and output jacks are located on the rear panel of the cabinet. Both are mounted on aluminum plates, each measuring 2½ x-3½-in. After the control panel and the input and output jacks are installed, wire the

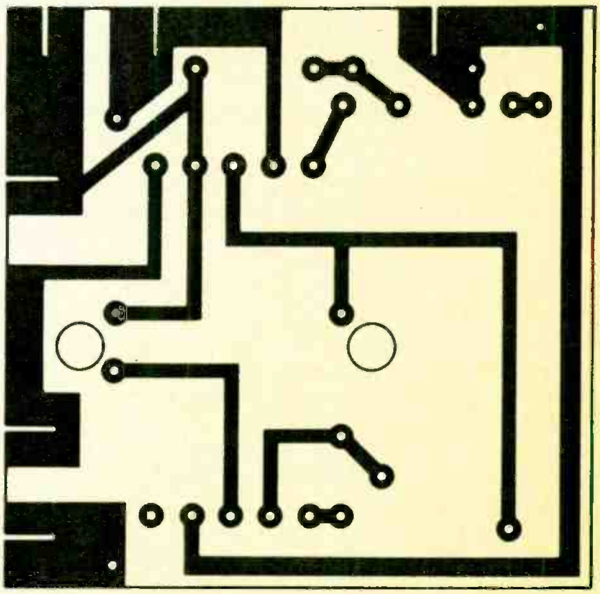




Tone control circuit board wiring above with full-size printed circuit board template at the right.



Output amplifier pc boards full-size below. If kit is ordered, ready-made board is included. Be very careful when inserting hybrid IC into mating board holes. Don't accidentally reverse integrated circuit.



speaker and headphone switches and output strips and jack.

The power supply is simple and straightforward. It delivers from 25 to 28 VDC at 2 A at the junction of components C39 and R25. Transformer T1, bridge rectifier BR1, filter capacitors C39 and C40 and resistor R25 are attached to the bottom of the base and interconnected via three-lug terminal strips. On/off switch S4 is mounted to the rear of the volume control, the leads of which are tightly twisted to minimize hum. Power supply wiring is point-to-point with No. 20 hookup wire as shown.

Pay close attention to the location of T1. A mounting location other than indicated in the pictorial may interfere with the operation of the changer, besides introducing hum in the amplifier boards.

Checking Out the Really Compact Stereo

After power supply wiring is completed check your work carefully. When you are sure that there are no mistakes, insert the line cord into 117 VAC and apply power. A voltmeter connected across capacitor C39 should read less than 34 VDC with no load connected to the supply. This is very important. Adjust final output voltage to this safe voltage level (if necessary) by utilizing a different tap on the secondary winding of T1.

After the power supply is checked for satisfactory operation, install the various pc boards in the base. Both power amps (AM1 and AM2) are mounted with No. 6 hardware in opposite corners of each heat sink. Preamp and tone control boards (PCB1 and PCB2, respectively) are mounted to the cabinet as shown in the photos.

Next interconnect all boards with stranded wire or shielded audio cable as noted in the pictorial. Connect AM1 and AM2 to their respective output and power supply connectors.

To set amplifier bias, connect a 470-ohm,

Really Compact Stereo

1-watt resistor and a VOM in series between the junction of components C39 and R25 and the terminal point labelled B on the amplifier under test. Adjust the bias pot (R19 or R20) to its minimum setting. Connect a 3.2-ohm load (a 10A watt wirewound resistor or speaker) to the output terminals of the amplifier. Be sure that these output connections are not shorted. If they are, the hybrid IC can be destroyed.

Again, turn the power on. If everything is working properly, the VOM should read from 2 to 4 ma. Adjust the bias pot so that the meter reads between 6 and 8 ma. Switch the power off and remove the 470 ohm resistor. With the power turned on again, retrim the bias pot so that the meter again reads 6 to 8 ma. After you have carefully set the bias for both amplifiers, the preamps can be interconnected.

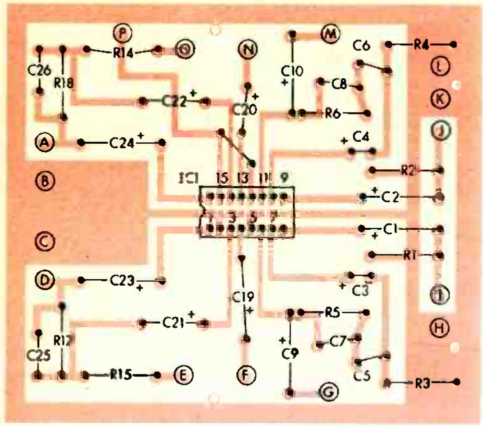
Final Assembly and Checkout

With all wiring chores completed, install the record changer. Connect the two previously shortened and trimmed AC leads and ground wire from appropriate points to plug PL3. Be sure to ground the frame of the changer to the power supply negative terminal. Cut the shielded audio cable assembly (supplied with the changer) in half and wire one of the halves to the appropriate terminals on PCB1. Plug these audio leads, designated PL1 and PL2 in the schematic, into the appropriate jacks on the changer and set the mechanism in place. Make sure that the wires to the changer do not interfere with the mechanism.

Any good magnetic pickup compatible with the changer can be used with our stereo. The value of resistor R1 may have to be changed from that listed in the Parts List to one recommended by the pickup manufacturer.

High-level sources with built-in amplification can be connected to either of the two pairs of auxiliary input jacks. Make sure, though, that the output lead of each high-level source is internally connected to input switch S1 via a DC blocking capacitor or interstage audio transformer.

Speakers having an impedance higher than 3.2 ohms will work. A lower output power (10 watts rms per channel) will be the result if 8-ohm speakers are connected to the amps.



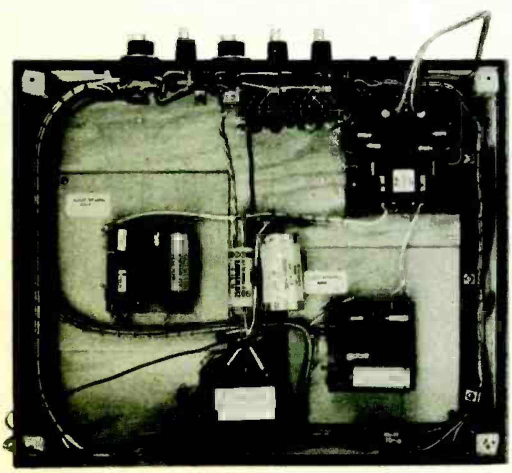
PCB1
A } TO AM2-F
•B } TO AM2-E
•C } TO AM1-E
D } TO AM1-F
E - TO R16
F - TO R12A
G - TO S1A
•H } I } TO PL1
J } •K } TO PL2
•L - TO PCB2-P
M - TO S1B
N - TO R12-B
O - TO R16
P - TO C40, R25
•CABLE SHIELD

Wiring side of PCB1 shown above. Note lead jumping pins 12 to 15 plus mounting tab on IC1.

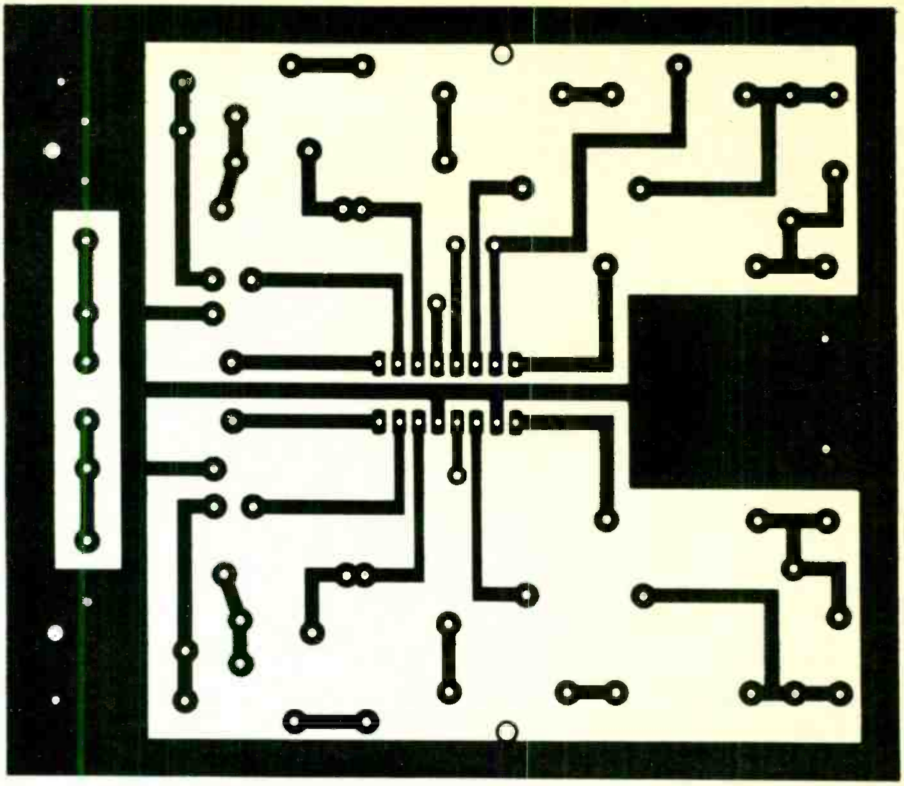
Again, this precaution: *never* short together—even momentarily—the output terminals of the power amplifiers noted in the Parts List.

Further Notes

As mentioned earlier, the headphone jack can be either open- (SO1) or closed-circuit (SO2) depending on which output circuit you

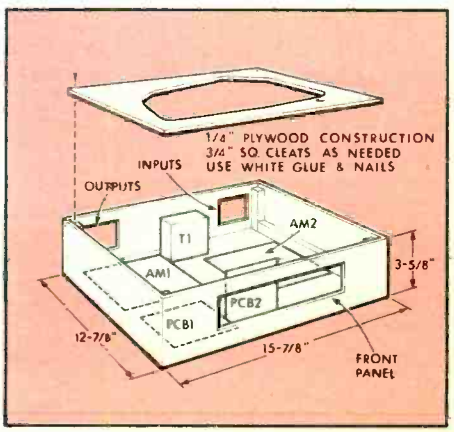


Overall view of pc boards and power supply placement on cabinet. PCB2 mounts vertically.



Full-size template of PCB1, the preamplifier. Don't change ground foil pattern of board.

choose to follow. If the closed-circuit version is chosen, then it becomes apparent that switch S3 (*Speaker/Phones*) can be dispensed with and a pilot lamp substituted in its mounting place.

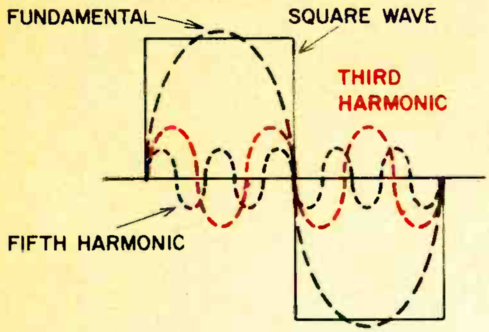


Overall dimensions of compact base. Cut out top plate according to turntable template.

Not just any pilot lamp will do, though. Hum can be induced into the circuit if a pilot lamp assembly that operates via 117 VAC is installed near switch S2. By choosing an assembly that operates from 28 VDC, the hum problem can easily be eliminated. A suitable 28-volt pilot lamp assembly is available from Burstein-Applebee, 3199 Mercier St., Kansas City, Mo. 64111. Order stock No. 12A4160. After mounting this lamp assembly to the front panel, connect the leads to lugs A and B of terminal strip TS1.

The prototype stereo was not built with built-in fuse protection. Each output integrated circuit should be individually protected, as well as the remainder of the stereo circuit. EAI recommends that each IC be fused for 1.5 amps. Do not think that a single 3-amp fuse can adequately protect both output ICs—one hybrid IC can easily destroy itself without this fuse breaking the circuit.

The primary winding of the power transformer can be adequately protected with a ¾-amp fuse. Again, care should be taken not to overfuse the circuit.



Square wave—called a pulse—is composed of harmonics (multiples of fundamental frequency). The more harmonics, the more perfect the square wave.

Harmonics —Good Guys in Black Hats!

By LEN BUCKWALTER

HARMONICS are the Dr. Jekyll and Mr. Hyde of electronics. The contradictions resulting from their split personality invade almost every circuit. For instance, the rich, dynamic sound of music is built upon harmonics, but two percent more than necessary (distortion) fatigues the ear.

A thrifty ham can squeeze harmonics from a crystal to gain extra frequencies on the upper bands but the higher harmonics from that same rock will tear the neighbor's TV picture. Harmonics also are the building blocks of square waves that computers thrive on—yet these same pulses can fly out of a television set and put birdies in nearby radios.

Since harmonics are a kind of periodic motion (found everywhere in nature) they are studied in all physics courses and scientists can subject them to advanced mathematical analysis. Yet, even a simple examination of harmonics can show the relationship that exists between different electrical circuits.

The schizophrenic life of a harmonic begins with the purest of all signals, the sine wave. Since it's the starting point (lowest frequency), it's called the fundamental. Any frequency that is an exact multiple of a fundamental becomes its harmonic. For example, the fourth harmonic of 1,000 cps is 4,000 cps. The 50th harmonic of 50 mc is 2,500 mc, and so on.

An example relating to the audio spectrum, middle C on the piano, is 264 cps, which is followed on the harmonic scale by a twice-higher C at 528 cps. In music, harmonics are also called *overtones*; this term often is applied to frequencies generated by quartz crystals operating in electronic circuits.

That's simple enough. However, a trick question about harmonics that you might get on an FCC exam could run something like: "What is the second harmonic of a fundamental on 600 kc?" The unwary person might answer 1,800 kc, believing the fundamental to be 600, the first harmonic to be 1,200 and the second 1,800. The pitfall here is that the fundamental is also the first harmonic—the second harmonic of a 600-kc fundamental is 1,200 kc.

Harmonics are created by tampering with the purity of a sine wave. They can be acoustically created, as in a musical instrument, or electronically brewed—say by an audio oscillator. In each instance a sine wave is the raw material.

A flute produces a near-sine wave because its air column vibrates almost exclusively at a single frequency. This is the acoustic equivalent to the pure sound of an audio oscillator. But if you add harmonics to these pure waveforms the sound is vastly modified.

The sound of an oboe playing the same note (fundamental) as a flute, for example, is different because the instrument's physical structure generates many overtones (harmonics). In an electronic circuit, this would be like changing the sine wave into some other waveform. Any time the sweep and symmetry of a sine wave are distorted, you can bet harmonics are present.

One of the quickest ways to generate harmonics electronically is to drive any amplifier with more signal than it can handle. This causes *clipping*—the effect of which is shown in Fig. 1, where an excessive signal is being applied to the grid of a vacuum tube. When the input signal goes highly positive, it drives the tube into saturation (point where more gain is impossible) and the top part of the output signal is sliced away. Next, when the input signal goes highly negative and drives the tube beyond its cutoff point, the lower part of the output signal is lopped off. In a hi-fi rig this clipping sounds terrible—but it's sweet music to a ham.

Just how the distortion of a sine wave causes harmonics can be shown in a few simple diagrams. In Fig. 2 you can see a fundamental frequency and its second harmonic being added together. The result is no longer a pure sine wave but a distorted composite. By pouring on many more harmonics this is carried to the ultimate degree in the square wave (see lead illustration). This valuable waveform consists of a huge number of odd-order harmonics (1, 3, 5, etc.) which meld together to form the special shape.

Since the square wave is a combination of different frequencies it can be a hi-fi tester's dream, as we'll see. Creating harmonics is not especially difficult, and any distortion in the operation of a hi-fi amplifier causes them to appear in profusion. A square-wave test signal shows which frequencies are being distorted.

Here's another instance where harmonics can do either good or evil. As mentioned earlier, music is rich in harmonics and a hi-fi amplifier should precisely track them to re-create the original recording. The trouble begins when the amplifier makes its own waves.

This shows up as one of hi-fi's most important performance specs: total harmonic distortion (THD). Expressed as a percentage, THD in a good amplifier is usually below 1 percent. Distortion that reaches 2 percent starts to grate on the ear. THD is measured by feeding a pure tone from an audio oscillator into the amplifier. After amplification, the tone is fed to an instrument called a distortion analyzer which filters out the original tone, plus hum and noise, and then reads what is left. These are harmonics spuriously created within the amplifier. The cause may be poor design, inadequate component size and quality, or any factor which causes non-linear—less-than-faithful—amplification.

One branch of hi-fi where harmonics are welcomed is a sophisticated form of bench-testing that uses square waves to analyze an amplifier. As you may recall, a square wave consists of a large number of harmonics. When a technician applies a square wave to an amplifier, he sees a panoramic view on an oscilloscope of just how the circuit is treating many different frequencies.

If the amplifier is deficient in low-frequency response it will remove low-order

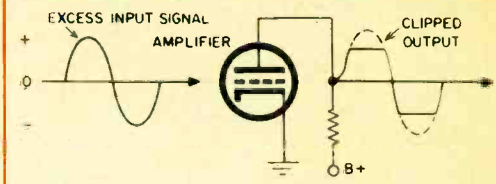


Fig. 1—Any amplifier generates harmonics if it is driven with too large a signal. This is called clipping. It may be helpful or deadly.

harmonics from the square wave and the resulting waveform will tilt (see Fig. 3). The same is true for poor high-frequency response, only a different portion of the square wave is affected. Obviously, this technique makes for much faster troubleshooting than if you were to apply a large number of individual sine waves one after the other.

Harmonics also pay contradictory roles in ham radio, Citizens Band and other areas of communications where transmitters are used. They're often a boon to hams, thanks to the FCC's system of allocating harmonically-related bands: e.g., 3.5 mc (80 meters), 7 mc (40 meters), 14 mc (20 meters) and 28 mc (10 meters). This means a crystal cut for 80 meters can be used not only on 3.5 mc, but also on several higher bands. Sometimes a crystal's harmonics even are strong enough to drive a transmitter's output tube. More often, however, there are doubler stages to give the harmonic a boost.

These multiplier circuits are nothing more than radio-frequency (RF) amplifiers operating in a condition of high distortion. Any

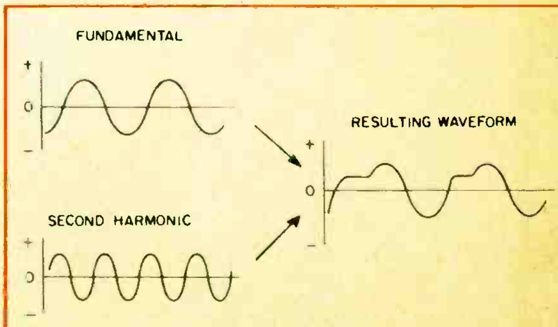


Fig. 2—Harmonics are created when sine wave (fundamental) is distorted. By adding more and more harmonics, different complex waveshapes are made. Human speech is a complex wave.

condition that distorts a wave, as we've seen, encourages harmonics—only now it's intentional. The same principle is exploited in the 100-kc crystal calibrator found on many communications receivers (see photo). It generates hundreds of harmonics every 100 kc on the dial to furnish accurate calibration points as high as 30 mc.

In CB and other forms of two-way radio, harmonics are the only way you can achieve frequency stability via crystal control. As your communications frequency increases, the slice of quartz used by the manufacturer of the crystal shrinks until it becomes much too fragile for fundamental operation beyond 15 mc. For this reason, a CB rig working 27 mc uses a third-overtone crystal whose fundamental is actually down at 9 mc. By means of special cuts, the crystal is encouraged to produce a vigorous third-harmonic signal in the oscillator. Police, fire and other two-way services at higher frequencies of 50 mc, 170 mc and even 460 mc also gain the advantage of crystal control through a combination of overtone operation and doubler stages in the transmitters.

Amid all these benefits lurks the specter of harmonic interference. Such interference is the bane of CBers and hams whose transmitters are rich in harmonics that reach up to TV-channel frequencies. The classic CB example is a second harmonic on 54 mc which falls on the frequency assigned to TV

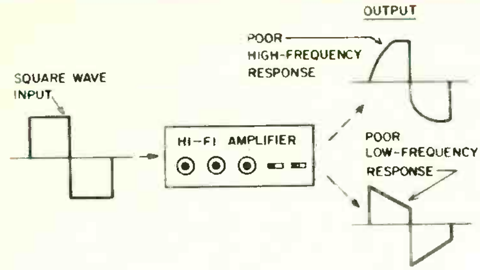
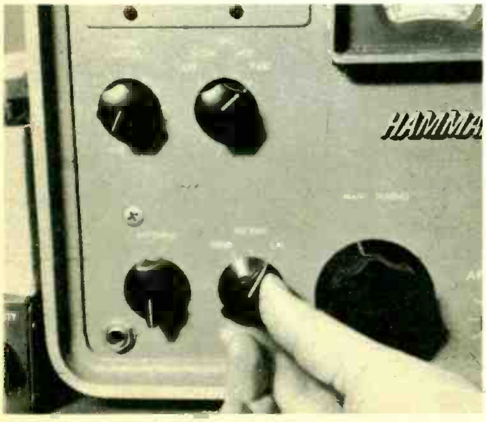


Fig. 3—Square-wave generator can test amplifier's frequency response. Amplifer will remove harmonics and affect shape of waveform.

Channel 2. Hams often have a difficult time because their transmitting power is higher and harmonics from the 80- and 40-meter bands can fall into practically every TV channel. When a TV receiver is close to a ham rig, even the transmitter's multiplier stages can emit troublesome harmonics.

The cure for harmonic radiation is usually a strict regimen of TVI-proofing. The transmitter must be completely shielded, fitted with bypass capacitors and possibly with a low-pass filter in the transmission line. This filter is a collection of coils and capacitors which form a tuned circuit that passes ham frequencies below 50 mc to the antenna but cuts off harmonics above that frequency.

Why not kill harmonics early in the transmitter stages and solve the problem there? Often it's not practical to avoid harmonic generation. A conventional RF amplifier is



Crystal calibrator of communications receiver generates harmonics every 100 kc. The signals are used to check tuning accuracy up to 30 mc.

Ted Mack seems to be suffering from beat pattern (from signal close to video frequency) caused by harmonic interference from ham or CB transmitter.

driven hard into the region of high distortion to achieve greater efficiency. (An RF amplifier can produce almost three times more signal than an audio amplifier having the same power. Audio stages trade efficiency for fidelity.)

Not all harmonic interference arises directly from higher multiples of the carrier frequency. TVI also occurs when the ham's fundamental signal, which is far below the TV channels, strikes an ordinary TV antenna system. If there's a poor electrical connection (at the antenna terminals, for example) the joint can rectify the signal. Harmonics are generated in the process and they can appear on the TV screen. This is how subtle the whole business of harmonics gets.

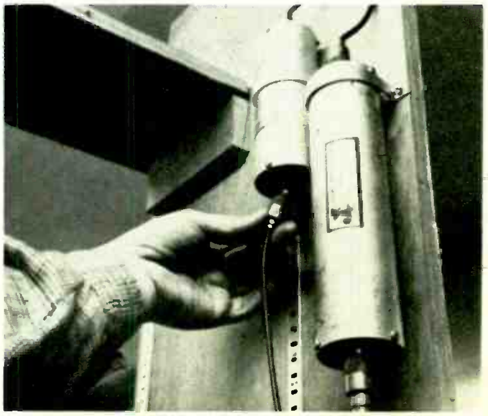
TV receivers spew harmonics, too. Large electromagnetic coils placed around the neck of the picture tube swing the electron beam across and down the screen in a scanning action. The current which flows into the coils to produce the horizontal sweep rises in a linear fashion as the trace of light moves from left to right.

When a line is completed, the current flow drops quickly to zero so the trace can return for the next scanning line. The result is a tortured-looking sawtooth wave that abounds in harmonics.

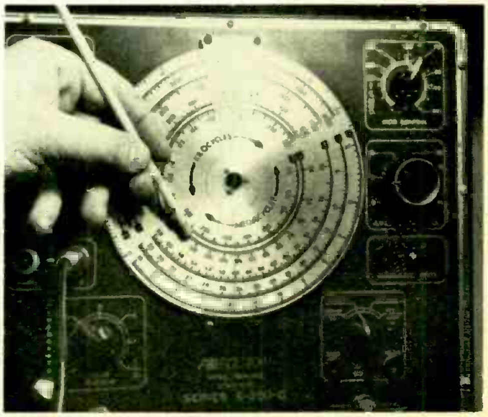
This waveform generates a fresh harmonic every 15.75 kc—up through 30 mc—and wrecks reception on nearby communications and broadcast radios. The easiest remedy is to move a receiver as far from the TV as possible—you can also use a line filter in stubborn cases. Some people go as far as lining the inside of the TV cabinet with metal foil to contain the interference.

Sweep circuits in TV set generate potent harmonics. Loop of wire in front of set picks up these spiked pulses. Spikes are seen on oscilloscope.

Actually, whole books have been written about protecting electronic gear from the effects of harmonic radiations. However, as we've pointed out, they're often valuable. At UHF and microwave frequencies (300 to 12,000 mc) test signals are generated by means of weak harmonics obtained from the fundamental. All oscillations at high frequencies are difficult to sustain and without harmonics the job of testing multimegacycle gear would be impossible without these good guys in black hats.



One cure for harmonic radiation coming from ham or CB transmitter is addition of low-pass filter in antenna feed. This one kills harmonics over 50 mc.



Harmonics are created in test gear to extend coverage and reduce circuitry. In this RF generator, top bands—55, 110 and 220 mc—are all harmonics.

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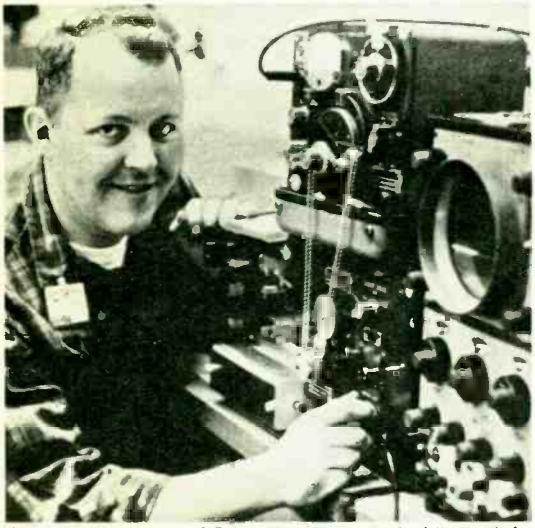
Harry Remmert decided he needed more electronics training to get ahead. He carefully "shopped around" for the best training he could find. His detailed report on why he chose CIE and how it worked out makes a better "ad" than anything we could tell you. Here's his story, as he wrote it to us in his own words.



Harry Remmert gives his CIE Electronics course much of the credit for starting him on a rewarding career. He tells his own story on these pages.

By Harry Remmert

"AFTER SEVEN YEARS in my present position, I was made painfully aware of the fact that I had gotten just about all the on-the-job training available. When I asked my supervisor for an increase in pay, he said, "In what way are you a more valuable employee now than when you received your last raise?" Fortunately, I did receive the raise that time, but I realized that my pay was approaching the maximum for a person with my limited training.

"Education was the obvious answer, but I had enrolled in three different night school courses over the years and had not completed any of them. I'd be tired, or want to do something else on class night, and would miss so many classes that I'd fall behind, lose interest, and drop out.

The Advantages of Home Study

"Therefore, it was easy to decide that home study was the answer for someone like me, who doesn't want to be tied down. With home study there is no schedule. I am the boss and I set the pace. There is no cramming for exams because I decide when I am ready, and only then do I take the exam. I never miss a point in the lecture because it is right there in print for as many re-readings as I find neccessary. If I feel tired, stay late at work, or just feel lazy, I can skip school for a night or two and never fall behind. The total absence of all pressure helps me to learn more than I'd be able to grasp if I were just cramming it in to meet an exam deadline schedule. For me, these points give home study courses an overwhelming advantage over scheduled classroom instruction.

"Having decided on home study, why did I choose CIE? I had catalogs from six different schools offering home study courses. The CIE catalog arrived in less than one week (four days before I received any of the other catalogs). This indicated (correctly) that from CIE I could expect fast service on grades, questions, etc. I eliminated those schools which were slow in sending catalogs.

FCC License Warranty Important

"The First Class FCC Warranty* was also an attractive point. I had seen "Q" and "A" manuals for the FCC exams, and the material had always seemed just a little beyond my grasp. Score another point for CIE.

*CIE backs its courses with this famous Money-Back Warranty: when you complete a CIE license preparation course, you'll be able to pass your FCC exam or be entitled to a full refund of all tuition paid. Warranty is valid during completion time allowed for your course.

"Another thing is that CIE offered a complete package: FCC License and technical school diploma. Completion time was reasonably short, and I could attain something definite without dragging it out over an interminable number of years. Here I eliminated those schools which gave college credits instead of graduation diplomas. I work in the R and D department of a large company and it's been my observation that technical school graduates generally hold better positions than men with a few college credits. A college degree is one thing, but I'm 32 years old, and 10 or 15 years of part-time college just isn't for me. No, I wanted to *graduate* in a year or two, not just *start*.

"When a school offers both resident and correspondence training, it's my feeling that the correspondence men are sort of on the outside of things. I wanted to be a full-fledged student instead of just a tag-a-long, so CIE's exclusive home-study program naturally attracted me.

"Then, too, it's the men who know their theory who are moving ahead where I work. They can read schematics and understand circuit operation. I want to be a good theory man.

"From the foregoing, you can see I did not select CIE in any haphazard fashion. I knew what I was looking for, and only CIE had all the things I wanted.

Two Pay Raises in Less Than a Year

"Only eleven months after I enrolled with CIE, I passed the FCC exams for First Class Radiotelephone License with Radar Endorsement. I had a pay increase even before I got my license and *another* only ten months later.

"These are the tangible results. But just as important are the things I've learned. I am smarter now than I had ever thought I would be. It feels good to know that I know what I know now. Schematics that used to confuse me completely are now easy for me to read and interpret. Yes, it is nice to be smarter, and that's probably the most satisfying result of my CIE experience.

Praise for Student Service

"In closing, I'd like to get in a compliment for my Correspondent Counselor who has faithfully seen to it that my supervisor knows I'm studying. I think the monthly reports to my supervisor and generally flattering commentary have been in large part responsible for my pay increases. My Counselor has given me much more student service than "the contract calls for," and I certainly owe him a sincere debt of gratitude.

"And finally, there is Mr. Tom Duffy, my instructor. I don't believe I've ever had the individual attention in any classroom that I've received from Mr. Duffy. He is clear, authoritative, and spared no time or effort to answer my every question. In Mr. Duffy, I've received everything I could have expected from a full-time private tutor.

"I'm very, very satisfied with the whole CIE experience. Every penny I spent for my course was returned many times over, both in increased wages and in personal satisfaction."

Perhaps you too, like Harry Remmert, have realized that to get ahead in Electronics today, you need to know much more than the "screwdriver mechanics." They're limited to "thinking with their hands" . . . learning by taking things apart and putting them back together . . . soldering connections, testing circuits, and replacing components. Understandably, their pay is limited—and their future, too.

But for men like Harry Remmert, who have gotten the training they need in the fundamentals of Electronics, there are no such limitations. He was recently promoted, with a good increase in income, to the salaried position of Senior Engineering Assistant working in the design of systems to silence submarines. For trained technicians, the future is bright. Thousands of men will be needed in virtually every field of Electronics from two-way mobile radio to computer testing and troubleshooting.

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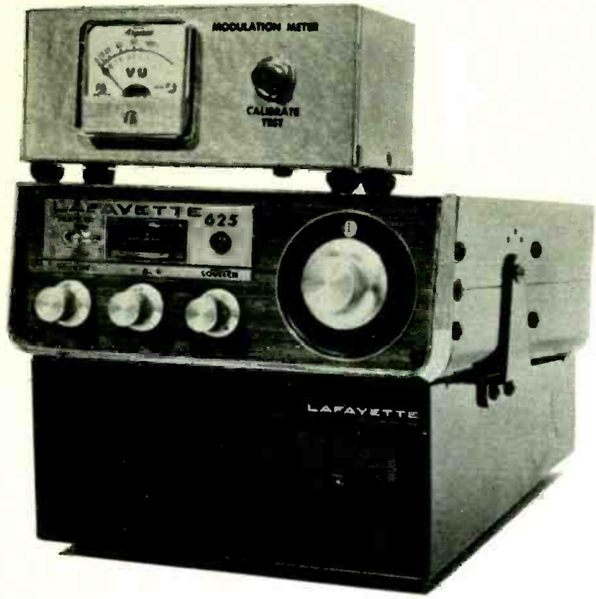
Build a Mod Meter for CB



By HERB FRIEDMAN, KBI9457

UNDER ideal conditions, just about every CB signal sounds like Gangbusters. Truth is, the combination of a well-modulated transmitted signal and low noise level at the receiving end means you're going to be heard, no matter what. But let the modulation (that's the ability of the rig to impress your speech or other intelligence upon a carrier signal) drop below 85 percent and part of your message dies in the QRM.

A few CBers still think that if they modulate more than 100 percent the received signal will sound loud. The received signal, indeed, appears to sound loud, but signal distortion generated by the transmitter immediately masks parts of the message. The overmodulated signal also tweaks the ears of the guys who mail out violation notices at the FCC.

In order to maintain a properly modulated signal, CBers rely upon talk-power amplifiers, compressors, or audio modulation processors to doctor their speech. Whether realized or not, these guys are only relying upon an amplifier to boost and maintain their rig's modulation between 85 and 100 percent. Unfortunately, the CB enthusiast is placing too much faith upon this type of add-on accessory to correct his poor microphone technique.

By monitoring its output with our self-calibrating, in-line modulation meter, you can adjust your rig for optimum modulation. Our Mod Meter [or Modu Meter, if you prefer] is permanently connected between transceiver and antenna. It can monitor the output of all amplitude-modulated CB rigs. And a simple calibration procedure utilizing the transceiver's RF output as the reference level lets you adjust the Mod Meter's circuit to work with any transceiver/antenna combination or SWR ratio.

Building the Mod Meter. Assemble the project with the components specified. For best results, buy the meter indicated in the Parts List. While other VU meters may provide equivalent accuracy, the specified meter yields best overall performance in this project.

The modulation meter is built on the U-shape section of a 2¼ x 2¼ x 5-in. aluminum cabinet. Both coax connectors, J1 and J2, are located on one side while meter M1 is on the other. For least circuit interaction, do not place the connectors directly behind M1.

Pot R3 (*Calibrate*) is a miniature 10,000-ohm type. It's shown in the pictorial minus a knob for good reason. The small size of the shaft and lack of knob reduce the possibility of brushing against the control and changing the meter's calibration. An acceptable substitute pot would be the screwdriver-adjust variety.

VU meter M1 is supplied with either four of five solder terminals. Two of these terminals (the meter-movement connections), are closest to the center of the meter body. One terminal has a plus symbol next to it.

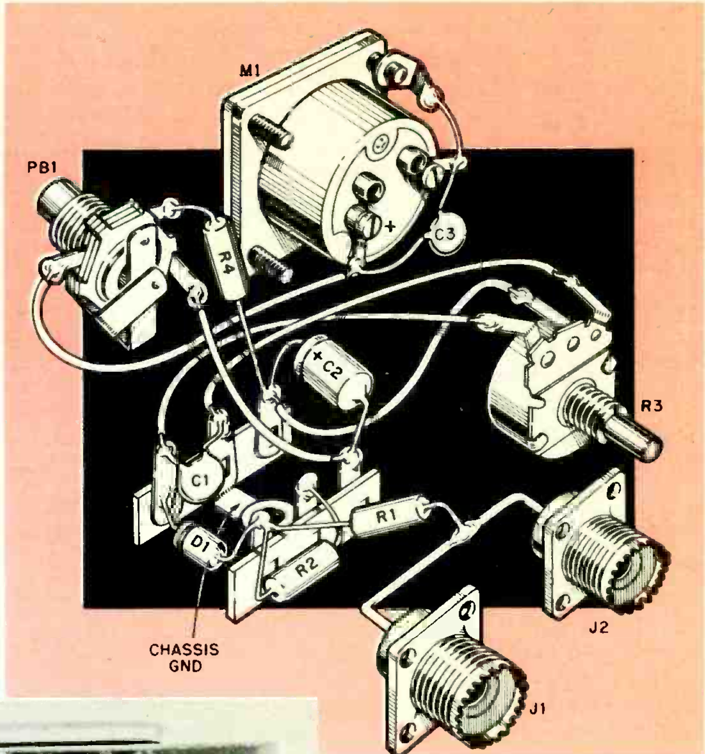


Fig. 1—Two unused screw terminals on M1 connect to dial lamps inside meter. See text for hookup of dial lamps.

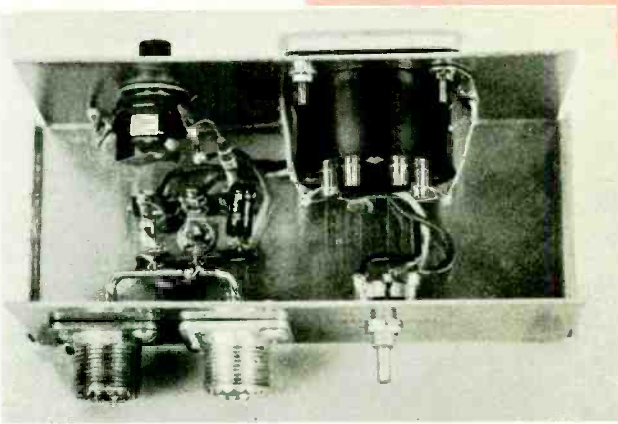


Fig. 2—Follow component layout for best results. Mount coax connectors J1 and J2 with 1¼-in. center-to-center spacing between inner terminals.

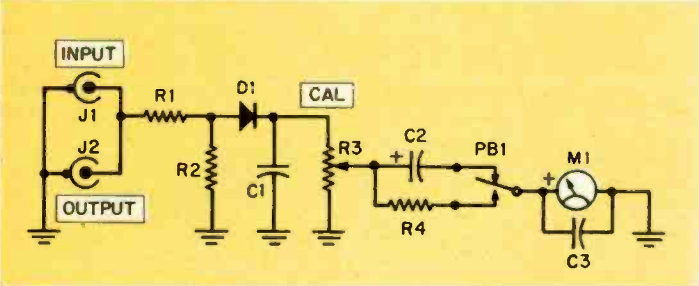
The remaining two (or three) terminals are for internal dial lamps. These lamps can be used in a mobile installation. Simply connect them to the car's dashboard lighting switch. If you opt for this feature, route lamp wiring as far from J1 and J2 as possible. This reduces the possibility of ignition noise being induced into the receiver via coax.

Connect the inner terminals of J1 and J2 together with a short, straight length of No. 18 or 16 solid copper wire. Connect one end of resistor R1 to this wire midway between J1 and J2 and the terminal strip closest to J1/J2 using the shortest possible leads.

To prevent damaging diode D1, trim its leads so they are at least ½ in. long. Install D1 correctly with regard to polarity. The end with the black band is connected to the junction of capacitor C1 and pot R3. Similarly, observe C2's polarity markings before soldering the positive end to the pot's wiper lug.

Checking out the Mod Meter. First set R3 fully counterclockwise. Connect your rig to either J1 or J2. Attach the antenna coax to the remaining jack. Turn the volume control on your transceiver to the lowest setting and

Fig. 3—RF voltage developed across R2 is detected by D1 and filtered by C1. Pot R3 taps off portion of rectified signal and routes it to M1 via capacitor C2 or resistor R4. Capacitor C3 bypasses stray RF signals around VU meter M1.



Build a Mod Meter for CB

turn the transmitter on. Depress test switch PB1 and adjust R3 until the VU meter needle just reaches 100 percent. Release PB1 and return the volume control to its normal position. As you speak into the mike, the meter indicates percentages.

How to use Mod Meter. To check overall transceiver modulation or to adjust the output of a talk-power booster, first press PB1 and advance pot R3 until the meter indicates 100 percent. After the switch is released the Mod Meter gives a direct indication of percent modulation as you talk into the mike and simultaneously adjust the talk-power booster's level control.

If your transceiver comes equipped with a range booster or speech compressor, the meter should read between 85 and 100 percent with both low and high voice levels. This indicates that the speech processor circuit is working correctly. CBers who rely on a compressor or talk-power booster should speak into the mike in a normal voice and adjust the compressor's output control for about 85 percent modulation on speech peaks.

Remember, any time the Mod Meter needle swings above 100 percent, a severe distortion is generated by the transmitter. Even if a station reports that your signal level is great, distortion may drown out part of the message. You will give better, cleaner reception with a somewhat weaker signal with a modulation level maintained close to 85 percent.

Beginning CBers oftentimes are tempted to plug a home tape recording microphone into the mike jack on their rig, thinking that this expensive device will make them modulate the signal better and therefore sound cleaner on the air. Nothing can be further from the truth. Besides the fact that mike impedances are mismatched, frequency response of the audiophile mike is far too broad for the CB rig. The best microphone for your transceiver is the one originally supplied with it. The frequency range of a communications mike is purposely limited to the voice range. All other frequencies outside this range tend to require more RF spectrum space at both the transmitter and receiver. Result is, if you modulate a transceiver with a broad-response mike, the signal generated will splatter into adjacent channels. Your signal will simulate that of an overmodulated rig, without even reaching 50-60 percent modulation.

PARTS LIST

Capacitors: 500 V disc ceramic unless otherwise noted
C1—0.005 µf C2—10 µf, 15 V electrolytic
C3—0.001 µf
D1—Germanium diode (1N60 or equiv.)
J1,J2—Coax cable connector type SO-239 (Radio Shack 278-201)
M1—VU meter (Lafayette 99R 50247. See text)
PB1—SPDT spring-loaded push button switch
Resistors: ½ watt, 10% unless otherwise noted
R1—1,800 ohms R2,R4—4,700 ohms
R3—10,000-ohm, linear-taper pot (See text)
1—2¼ x 2¼ x 5-in. aluminum cabinet
Misc.—No. 18 or 16 solid copper buss wire, No. 6 mounting hardware, two 3-lug terminal strips, four rubber mounting feet, wire, solder, etc.

Fig. 4—Leave knob off calibrate pot R3's shaft.

CB Corner

By Len Buckwalter, KQA5012

CB, Kiwi-Style

A FAR-AWAY reader of this corner is a New Zealander named Keith Ramsay. He has a complaint about American CBers. Seems that scores of Americans visit Down Under and say, "Where are all the CBers?"

The Yanks go away without the slightest notion that Keith's country is a hotbed of operators. The reason the Americans think CB is as extinct as the moa is that there's nary a signal to be heard on any U. S. channel. When Keith meets an American he explains there's CB aplenty in Kiwi-land (see QSL) but it's on seven channels *below* the U.S. band.

Though we can't electronically resonate, Keith urges any traveler from the States to ring him (899-506) upon arriving in Wellington, the capital. He fondly recalls friendly ties between our nations and says the New Zealand Citizens Band Radio Club will happily play host to visiting CBers from Stateside.

Each year sections of our country are hit with apocalyptic assaults of fire, flood, earthquake, tornado and hurricane. But as the debris settles, the stricken areas are invaded by mobile units of the American Red Cross bearing emergency relief. It was a surprise to learn that though the organization saturates the country with more than 3,000 chapters, it's remarkably short on communications.

Only a scant 5 percent of Red Cross chapters (about 150) can boast two-way radio. The reason, of course, is cost. Their rigs operate in the Special Emergency Radio Service where outfitting a single vehicle can cost $2,000. This accounts for a long-standing alliance between hams and the Red Cross. Both are volunteers charged with a public-service mission. Now, CBers are getting into the act—and their services could prove invaluable in disaster-prone regions of the country.

What can a CBer do? I asked that question of a Red Cross communications official in Washington. He sees a CBer's role in this way: First, there's a need for point-to-point communications to handle instructions between a central Red Cross office and units in the field. Then there are mobile canteens to be dispatched around a disaster area and it's best done by two-way radio. There's also need for radio links between disaster headquarters and temporary field shelters. All are generally short-distance hops that can exploit CB's limited range.

This is when teams of CB-equipped volunteers can truly rise to the occasion. By setting up a communications network between the central Red Cross command post and individual field units, a coordinated search effort can take hours instead of days.

A dramatic use of CB in time of emergency arises from what this official calls health & welfare messages. When disaster strikes, radio and TV stations flash the news over the country and arouse the concern of thousands of distant relatives and friends. Vast numbers of inquiries pour into the troubled area to overload commercial lines.

This happened not long ago during earthquakes in the Los Angeles area and, more recently, floods in South Dakota. The Red Cross attempts to answer all such queries by a house-to-house search. A friendly CB mobile is of great help in getting the message back to headquarters, and to anxious relatives. If you want to get in on the action, contact your Red Cross chapter.

Kiwi CB? Yep, there's such a thing in New Zealand. Keith Ramsay of Wellington sends us this QSL.

DX Guide to Armed Forces Radio

Old-soldier tricks never die. Lilli Marlene and her crowd are still brightening up isolated outposts to boost our boys' morale.

By DON JENSEN

RADIO broadcasts to the armed forces in words and music tell the dogface that his girl is waiting for him (our guys) or that she isn't (their guys). In World War II, Lilli Marlene became ragingly popular in Germany, then came here and finally was used by us to discourage the Nazi in a record. The song is a kind of touchstone for this particular kind of station

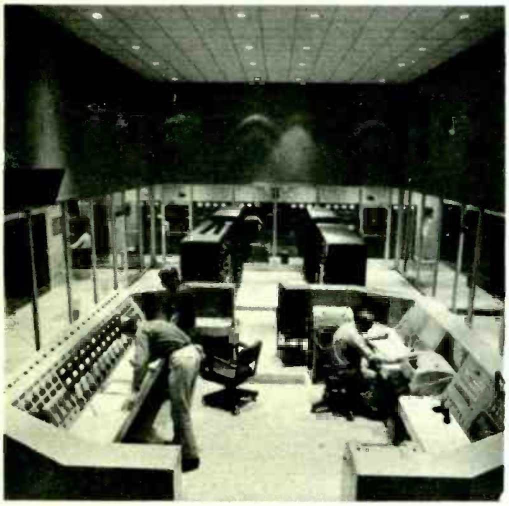
Since then, in Korea and in Vietnam, radio programs have played a major role in supporting our fighting men. While the Voice of America—and also, Radio Free Europe—broadcasts American programming to people living behind the Iron Curtain, there is a special Government radio network, the American Forces Radio and Television Service (AFRTS), which broadcasts programs to troops stationed in the U.S. and abroad.

Fact is, our boys get much of the gravy when it comes to major sporting events and other fat-cat special events. Take, for example, the recent Joe Frazier-Muhammad Ali fight. That night Madison Square Garden in New York City was packed to the rafters with 20,445 boxing fans, some of whom had paid $500 for ringside seats for the fight. Elsewhere, at some 350 theaters, a million and a half more people forked over the green stuff to watch the heavyweight championship on closed-circuit TV.

But in many homes across the land there was outrage. The Fight of the Century was blacked out. In this land of the free, there was no live radio coverage and only pay TV.

Half a day and a half a world away, however, there were Americans who heard the fight. In bunkers and barracks throughout Indo-China, GI's glued their ears to transistor sets to hear the fight broadcast live via the American Forces Radio and Television Service.

Courtesy Voice of America



Transmitter facility of Voice of America, a branch of United States Information Agency, located at Greenville, N.C. Station broadcasts AFRTS Programs.

While the Stateside blackout shocked the folks at home, it came as small surprise to servicemen overseas that AFRTS carried the fight. For AFRTS always broadcast big sports events such as the World Series, Super Bowl, Stanley Cup playoffs, as well as the everyday games.

AFRTS — which until 1967 stood for the Armed Forces Radio and TV Service—is more than sports, though. It's information, education and news from home. It's Polka Party and PFC disc jockeys, command information messages and Chickenman.

It may surprise DXers, but AFRTS operates a worldwide string of radio and TV stations that rivals the major U.S. commercial networks. There are some 380 stations on the AM, FM and shortwave broadcast bands plus more than 70 television outlets. Most are low-power and are located in such out of the way places as Greenland, Guam, Eritrea and Eniwetok. Fact is, wherever you find a sizeable contingent of U.S. troops, you'll find an AFRTS station.

Over the past 30 years AFRTS has come a long way. It began as an entertainment medium at the height of World War II. But the military soon realized its potential value for troop information and morale building.

The first AFRTS radio station was an off-duty hobby of a handful of Navymen stationed at Adak, Alaska back in 1942. A more powerful operation began the following July in the cellar of the British Broadcasting Corp. studios in London. BBC transmitters and equipment were used. GI's with civilian radio experience were rounded up to man them. A number of today's top TV personalities and newsmen got their start in wartime AFRTS broadcasting.

In 1949 the various military stations were brought under a single authority, the Pentagon. The AFRTS New York center was discontinued in 1966 and was replaced by a new operation at Arlington, Virginia, located just outside Washington, D.C.

The bulk of the programs broadcast by local stations abroad are provided by two AFRTS centers in the U.S. AFRTS-Washington feeds newscasts, public affairs and live sports via shortwave and land-line cable. AFRTS-Los Angeles provides the stations' music libraries and entertainment programming, usually taped and decommercialized U.S. programs. These are mailed to the various stations.

AFRTS has grown into a broadcasting giant with $30 million worth of equipment, an annual operating cost of $12 million and a collective GI audience of a million and a half.

EI's Guide To AFRTS Broadcasts

Freq. (kc)	Station	Time (GMT)	Address
15430	Greenville, N.C. (VOA)	1300-2300	
15330 21500	Bethany, Ohio (VOA)	1200-0400 1330-2000	Worldwide Service American Forces Radio and TV Service 1117 N. 19th Street Arlington, Va. 22209
5965 9700 15410 21500	Delano, Calif. (VOA)	1030-1630 0600-0700 0000-0100; 0300-0800 2130-0430	
872	Frankfurt, W. Germany	After local midnight	American Forces Network APO New York 09757
3990 7215	Taipei, Taiwan	1000-1200 1000-1400	American Forces Network Taiwan Box 25 APO San Francisco 96263
3910 6155 11750 15260	Tokyo, Japan	1000-1200 1000-1400 0100-0200 0100-0200	Far East Network APO San Francisco 96267
780	Ramey AFB, Puerto Rico	Monday mornings	American Forces Caribbean Network Box 432 APO New York 09345
1040	Ft. Allen/Ft. Brooke, Puerto Rico	Monday mornings	
1200	Roosevelt Roads, Puerto Rico	Monday mornings	American Forces Caribbean Network FPO New York 09503
1340	Guantanamo Bay, Cuba	Monday mornings	
790	Ft. Clayton, Canal Zone	Monday mornings	Southern Command Network APO New York 09339
1420	Ft. Davis, Canal Zone	Monday mornings	

Young servicemen, including a number of DXers, compete for 1,750 AFRTS posts when they enter this relatively limited military career. After receiving training at the Defense Information School at Ft. Benjamin Harrison, Indiana, they are assigned to one of the many overseas AFRTS outlets.

Best known to shortwave listeners is the Worldwide Service of AFRTS-Washington, which uses Voice of America transmitters in the U.S. and the Philippines. Contrary to popular belief, this shortwave service is not the AFRTS that most GI's tune in. Its prime purpose is to act as a program relay—the equivalent of a network feed—to the overseas stations. All that is broadcast on shortwave is news, public affairs programs, play-by-play sports and certain ABC, CBS and NBC feature programs, such as Flair, Dimension and Emphasis.

To provide local AFRTS operations abroad with these current programs, the AFRTS shortwave facility transmits on a 24-hour-a-day basis to Africa, Europe, the Far East and the Caribbean. With some frequency shifting, the DXer can listen to AFRTS programs at nearly any hour of the day. Currently, the network uses VOA transmitters located at Greenville, N.C., Bethany, Ohio, Delano, Calif., and Tinang, the Philippines.

From dawn until about mid-day, Stateside DXers can find the Bethany station on 21,500 kc. During the afternoon hours, the Greenville transmitter broadcasts to Europe and North Africa on 15,430 kc. It's Bethany again after supper, with transmissions on 15,330 kc directed to stations in the Caribbean area. After midnight, the Philippines relay station on 15,155 kc is a possibility.

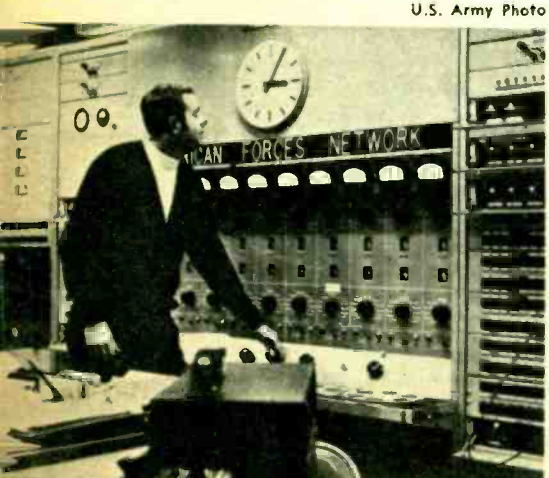
DX Guide to Armed Forces Radio

During the hours just before dawn and shortly thereafter, try the Delano station on 6,110 and 9,700 kc.

It's no secret that AFRTS enjoys an audience which extends beyond our military forces overseas. DXers, of course, have long enjoyed the sports and music programs. Listeners also include servicemen's dependants and civilian government employees stationed abroad. But foreign nationals also find AFRTS programs enjoyable to listen to. Newscasts are an interesting alternative to VOA broadcasts. While the VOA directs the thrust of its news at foreigners, AFRTS outlets speak to Americans about what's going on back home. The emphasis can be very different.

There are also various regional AFRTS networks around the globe. The granddaddy of them all is AFN, the Army-run American Forces Network in Europe. It operates from an ultra-modern, four-story, $2.5 million studio-control complex in Frankfurt, Germany. It feeds programs 24-hours-a-day to affiliated stations in Greece, Italy, Belgium, Holland and other Western European and North African countries. In Germany alone there are over 30 medium-wave and eight FM stations. The key operation is AFN Frankfurt, a 150-kilowatt transmitter operating on 872 kc. Occasionally, when conditions are right, it can be logged by BCB listeners in the eastern United States.

U.S. Army Photo



American Forces Vietnam Network is part of AFRTS and is headquartered in Saigon. Here, operator checks master control panel and program feeds.

Saigon is the headquarters and focal point of another AFRTS net, the American Forces Vietnam Network. Morale building is its main job. To do this it costs AFVN a quarter of a million dollars a year. TV channel 11, a 316-kilowatt station, offers comedy shows, shoot-'em-up westerns and sports programs. South Vietnam's president, Nguyen Van Thieu, is said to be a regular viewer of the 11 p.m newscasts, wrestling and Laugh-In.

AFVN radio programs lean heavily to rock and country music, but the FM outlets, aimed mainly at older career soldiers—the lifers—lean toward old favorites and classical selections.

Other Far Eastern AFRTS chains include the 21-station American Forces Korea Network, and the hookup of a dozen or so medium-wave AM outlets operated by the Air Force in Thailand. An unusual aspect of the Korean net is that, unlike most other AFRTS operations, these medium-wave stations identify with offbeat call slogans. There's Radio Vagabond in Seoul, Radio Bayonet in Tongduchon, Radio Homesteader at Pusan, and—would you believe—Radio Kilroy, a linguistic relic of World War II, at Taegu.

There are local medium-wave stations dotted across the Pacific—at Kwajalein, Wake, Midway, Eniwetok and Johnston Islands, plus six more in the Philippines. The situation on Guam is unique in that the AFRTS station competes directly with a pop music commercial outlet aimed at the military audience.

Old hands at medium-wave BCB-DX will find little pleasure in trying to tune these mini-watt stations. Rarely, if ever, are their signals strong enough to make the big hop across the Pacific to the West Coast.

DXers have a better chance with the shortwave transmissions of yet another AFRTS network, the FEN in Japan. The Far East Network uses four shortwave transmitters which, while not easy targets, can be heard by American SWLs.

Best bets are the 10-kw FEN stations on 3,910 and 6,155 kc. Early mornings are best, as is the case with most low-frequency Asian shortwave stations. However, interference from other stations, particularly hams on 80 meters, can be rough. With some luck, you might hear FEN on 15,260 kc (which runs a measly kilowatt) around 0200 GMT; these signals take the long, darkness route around

[Continued on page 95]

Electronic Bongo

Tired of tapping the same old song? Our super bongo is drummer's dream.

By HERB COHEN

NO matter how inspired, amateur musicians have trouble getting much more than a dull thud out of a bongo, especially if it's the non-tunable kind. The more accomplished musicmaker does produce some variations in his instrument's voice but, even so, the mechanical limitations of the conventional bongo are quite real.

Our Electronic Bongo, on the other hand, generates note structures that are rich in harmonic content. Even the neophyte can produce sounds of depth and interest. It's also possible to imitate the sounds of other percussion instruments and even to turn out some sounds you've never heard before.

The secret of our instrument lies in the ability of its circuitry to produce square waves. This kind of wave pattern can give bass notes a distinctly twangy sound while mid-range notes and the highs pick up a slight fuzz that gives them body.

Though the bongo usually comes in pairs we are speaking of it in the singular. We suggest you build just one to see what it can do for you. If it's not enough you can go through the cycle again and come up with bongos.

Our Electronic Bongo is housed in a conventional bongo drum body. Output cable of our instrument is plugged into the auxiliary input socket on your hi-fi or music amplifier. There are two controls on our bongo. One varies the tonal pitch, while the other controls the output volume. The entire circuit is powered by a 9-V transistor radio battery.

Heart of our bongo is transistor Q2, a programmable unijunction transistor. This device combines the best features of the conventional unijunction transistor and the silicon controlled rectifier. The programmable unijunction transistor, or PUT for short, is used as a sawtooth pulse generator in our circuit.

Ordinarily, no current flows from Q2's anode through the gate, which is fed by a voltage divider. Whenever the anode reaches a voltage level which is slightly positive with respect to the gate, the PUT fires like a conventional SCR and remains in its on state so long as power is supplied to the anode.

The conventional unijunction transistor also has the ability to conduct when one of its semiconductor layers becomes more positive than an adjacent layer. But the unijunction is usually not programmed to remain in its on state after it fires.

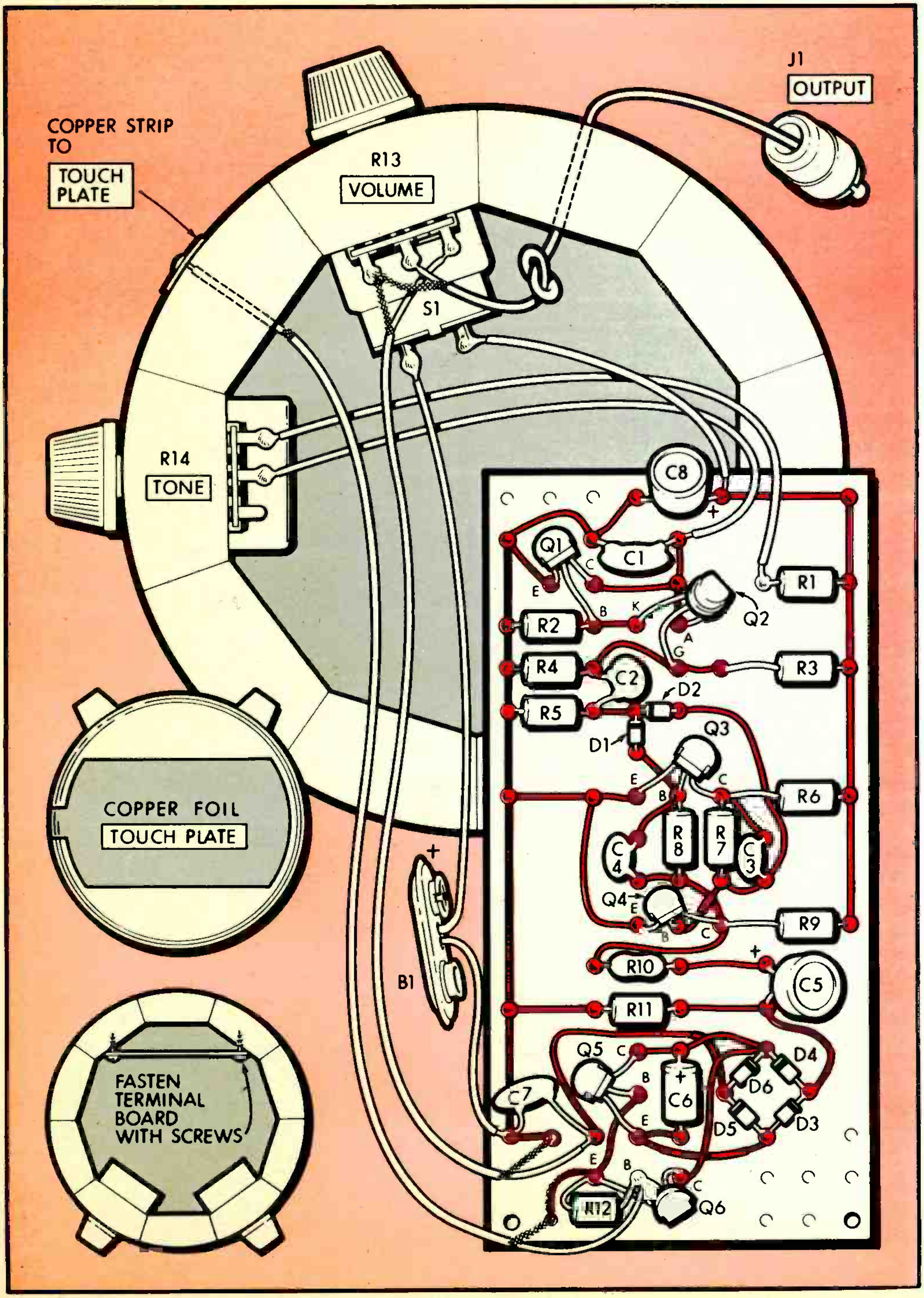
How It Works. Starting with PUT Q2, the device's anode is connected to capacitor C1, the collector of transistor Q1 and pot R14 *(Tone)*. The gate of Q2 is connected to the junction of resistors R3 and R4. This voltage divider supplies 7.5 volts to the gate of Q2. When S1 is closed, capacitor C1 charges up via resistor R1 and pot R14. The anode voltage of Q2 is, of course, raised as C1 charges.

When the anode voltage reaches 8.1 volts, it is more positive with respect to the gate of Q2. This 0.6 volt difference forces the PUT into conduction. Capacitor C1 now discharges through Q2 and the base-emitter junction of Q1. Frequency range of this relaxation oscillator circuit varies from 40 to 10,000 cps, depending on R14.

Transistor Q1 insures that the PUT does not remain in its conduction state. If it did,

Electronic Bongo

Fig. 1—Note that copper foil touch plate has tab which connects via shielded cable to Q6 on perfboard. After wiring is completed, fasten perfboard bongo side with two self-tapping screws.



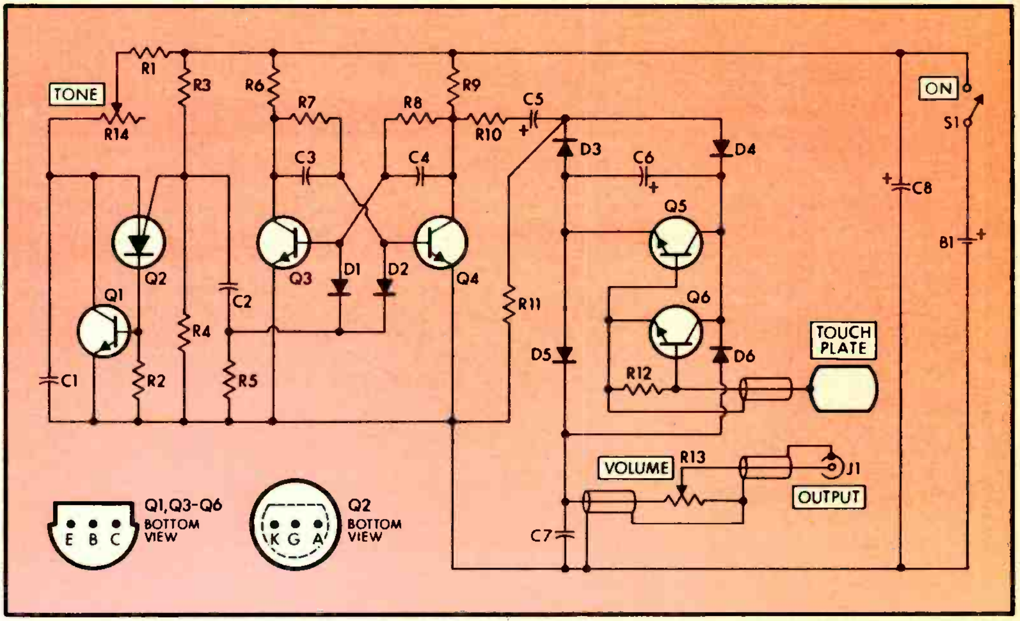


Fig. 2—Schematic of recently patented circuit. Transistor Q2 combines properties of UJT and SCR. See text.

PARTS LIST

B1—9-V transistor radio battery
Capacitors: 100VDC disc ceramic unless otherwise noted
C1—0.05 μf
C2-C4—200 μμf
C3—270 μμf
C5—100 μf, 15V electrolytic
C6—2 μf, 50V electrolytic
C7—0.1 μf
C8—20 μf, 15V electrolytic
D1-D6—General-purpose silicon diode (1N914 or equiv.)
J1—RCA phono plug
Q1, Q3-Q6—Npn transistor (2N4401 or equiv.)
Q2—Programmable Unijunction Transistor (Allied Radio Shack 276-119)
Resistors: all ½ watt, 10% unless otherwise noted
R1—1,000 ohms
R2—680 ohms
R3—6,800 ohms
R4—22,000 ohms
R5—10,000 ohms
R6,R9—3,300 ohms
R7,R8,R11—27,000 ohms
R10—6,800 ohms
R12—330,000 ohms, ¼ watt
R13—10,000-ohms, audio-taper pot
R14—500,000-ohms, audio-taper pot
S1—SPST switch (mounted to R13)
1—Non-tunable bongo drum
1—5 x 3-in. piece of sheet copper (see text)
Misc.—2½ x 5-in. perfboard, mounting eyelets, shielded audio cable, glue, knobs, battery connector, etc.

capacitor C1 would never have the opportunity to recharge. As soon as Q1 conducts, it shorts out C1 and the PUT, returning Q2 to its off state and ready for the start of the next oscillatory cycle.

Every time Q2 fires, the voltage supplied to the gate drops. This pulse produced across resistor R4 is used to trigger transistors Q3 and Q4.

These two transistors are wired in a bistable multivibrator circuit. If Q3 is conducting, then Q4 will be in its off state. And vice versa. The multivibrator supplies the square wave which gives our bongo its unique sound.

The symmetrical square waveform produced by Q3, Q4 and associated components has a frequency range which varies from 20 to 5,000 cps. Reason is that the bistable multivibrator divides incoming frequencies in half. Only one transistor is forced into conduction for each incoming pulse. You need *two* pulses to create *one* output squarewave.

Output from the multivibrator is fed via components R10 and C5 to a modulator circuit. If all components to the right of C5 are redrawn, it becomes apparent that this

[*Continued on page* 94]

Several campsites rely upon the Citizens Band to help make reservations and guide motor-home campers enroute.

CB in a Motor Home

By LOU RUBSAMEN

A NUMBER of years ago my wife and I drove down the eastern seaboard to Florida. We considered ourselves but one step beyond the armchair traveler and, as I look back upon that first journey, I think our luck on the road was uncommonly good. Though we got lost in a few spots, in general, we enjoyed our wanderlust.

Two youngsters and a toddler later, we again decided to hit the road—this time in a 28 ft. Winnebago motor home—and drive ourselves on a cross-country odyssey. A few extras like toys and baby food were added to our basic list of motor-home travel necessities. But the most important, as we discovered, was a CB transceiver.

Even in this day of dial-ahead camp site reservations and the general availability of a phone, a dependable CB transceiver in a motor home is definitely not just so much excess weight. The idea of getting lost in an out-of-the-way place, or worse yet, breaking down in the desert with three children aboard was reason enough to install a CB rig. Fortunately, we never found ourselves dialing channel 9 and punching the mike button to call for help. But, by using the rig, a Lafayette Telsat SSB-500, to its fullest advantage we saved precious time and energy by changing our route plan after talking to other CBers along the way.

Installing the transceiver in a motor home is no more difficult than adding a CB set to any other vehicle. Since the rig was on loan, I devised a semi-permanent installation. The transceiver DC power cord, for instance, was

Adjusting rig for maximum output power is an easy job. Adjust transceiver for maximum power by reading in-line wattmeter scale.

Antenna assembly was mounted on L-shaped bracket eventually located at front right vent window. See text.

After adjusting SWR meter in forward mode, flip mode switch to reverse position and take reading. Set rig for minimum indicated SWR.

terminated in an adapter plug so it could draw power from the dashboard cigarette socket. The whip antenna, model M-189 by Antenna Specialists, was mounted to the front right side of the body. Admittedly, this is, at best, a compromise position to install this kind of CB antenna. Though I found that the best spot on the motor home is dead-center on the roof, I didn't want to drill holes in it.

After holes were drilled under the dash for the transceiver mounting bracket, I proceeded to fasten the antenna to the vehicle's body and work my way back to the rig. An L-shaped mounting plate was attached to the side under the metal corner strip surrounding one of the window vents. Existing corner strip screws were used, again to eliminate the need to drill new holes. Make sure that a type M-126 spring (supplied with the antenna kit) is inserted between the antenna loading coil and whip. Do this by removing the whip adapter from the top of the coil and insert the spring. Some silicone grease should be daubed on all metal-to-metal connections before reassembly.

Next, I ran the coax through the window and down to the transceiver. The SWR indicator and wattmeter (supplied as separate items by Antenna Specialists) were connected together via short lengths of coax between the antenna and rig. While the antenna itself is factory-tuned, I adjusted the whip for optimum performance by varying its length.

Begin by cutting 2½-in. from the whip. This makes up for the length of the spring. You may not have to perform this step since my particular antenna originally was delivered minus the spring assembly. After cutting the antenna to the correct length, the tuning procedure consists of moving the whip up or down in its adapter. Do this after loosening the whip set screw.

Adjust for minimum SWR and maximum output power. The best way to check overall SWR performance is to set the transceiver to its transmit mode on channel 1 and check the SWR in the reverse mode. Now reset the

[*Continued on page* 103]

EI Kit Report

Heathkit IB-1101

A Lab-Grade Counter for the Hobbyist

THE winter of '71 turned a lot less bleak for the electronics maven who opened his then latest Heathkit catalog and beheld the IB-101, a frequency counter in kit form. Since this initial offering, a frequency scaler and two more counters have been added to Heath's catalog. While these most recent counter kits are direct descendants of the IB-101, the Heathkit IB-1101 is its closest relative in terms of cost and technical upgrading. The IB-1101, for the first time, offers the experimenter or service technician both the ability to measure frequencies into the VHF band without the need to resort to tricky frequency dividing techniques and a price he can afford to pay for such gear.

Since both the older IB-101 and its younger sibling, the IB-1101, share the same cabinet and readout system and almost bear the same front panel markings, it would be all too easy to make direct comparisons between these two kits. But outside of a possible identity problem between the IB-101 and IB-1101, no comparison is possible.

For instance, while we originally reported (in the September, 1971 issue) that the IB-101 had a frequency response of 1 cps to 21 mc., we simply can't be that sure of the actual upper-frequency limit of the IB-1101. This is the first time that a kit outclassed the capabilities of our own lab's test gear. We can only guess what the upper limit of the IB-1101 is. The counter could still display an input frequency even though our lab VHF signal generator feeding it reached its own frequency-generating limit. Therefore, we must report that the IB-1101 easily met its advertised frequency limit of 100 mc.

Before the digital era of probe-and-read electronics came to the hobbyist, anyone who tried to make an accurate frequency measurement had to juryrig half the gear in his shop together. Needed was an interpolation oscillator, scope, filter, and waveform analyzer. Also, all gear had to be solidly built. Frequency measurement was simply too expensive for all but the wealthiest hobbyist. Most of us resorted to less expensive beat-frequency measurement techniques, or chasing an over-moving lissajous pattern as it circled a scope screen.

Both methods, crude as they were, worked as long as the experimenter had time, patience and the ability to discard false readings caused by spurious signals or intermodulation products of reference and unknown-frequency signals. So it came as no surprise that the direct-reading, digital frequency counter was looked upon as Instant Karma by experimenters, CBers, hams and anyone concerned with RF measurements.

The IB-1101 measures 8¼ x 3⅜ x 9-in. and weighs 4½ pounds. Don't equate the physical size of the package with its electronic capabilities. For instance, counter accuracy is claimed to be plus or minus one digit ± the stability of the time base circuit. Claimed timebase stability, after a 30 minute warmup, is greater than ± 3 parts per million.

But the actual stability of the time base settles down even farther since it reaches 1 part per million per *month* after 30 days operation. After trying (somewhat in vain) to check the IB-1101 against certified lab frequency standards, we can report that our model definitely exceeds these stability claims made by Heath.

Input sensitivity (and coincidentally, trigger level) is set during the calibration procedure. Both specs are dependent upon the frequency of the input signal. Claimed sensitivity of the IB-1101 is 50 mVrms up to

50 mc. This figure decreases to 100 mVrms from 50 mc. to 100 mc. But measured sensitivity is 25 mVrms up to 50 mc. and 45 mVrms at 100 mc.

The input impedance of the IB-1101 is 1 megohm shunted by less than 15 $\mu\mu$f. Front-end circuitry incorporates protective devices which prevent damage to the counter by high-input-level voltages. The maximum permissible input voltage up to 500 cps is 140 Vrms. From 500 cps up to about 7 mc. the top limit on input voltage drops to 70 Vrms. Above this frequency input voltage is limited to 3 Vrms.

The IB-1101's internal timebase generator consists of a 1 mc. crystal oscillator and frequency-dividing circuit. Together they produce a dual-mode time base of 1 second or 1 millisecond. The only front panel switch present on the IB-1101 controls time base mode. It is marked Kc/Mc and selects either time base function.

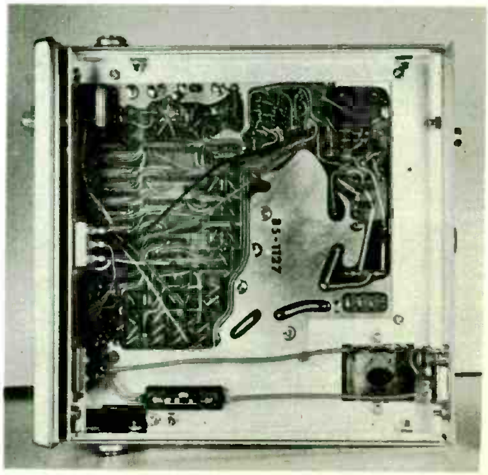
Just as the older IB-101 utilizes a cold cathode readout assembly, the IB-1101's readout displays numbers from zero to nine. The combination of the five digit readout and switch-selectable double timebase really gives the counter eight digit readout capability. The IB-1101 is no different from the IB-101 in this respect.

A group of incandescent lamps display operating modes to the user. One panel lamp indicates whether the timebase switch is set to the Kc. or mc. mode. An overrange lamp appropriately marked *over* glows when the input frequency exceeds the range of the counter timebase. And a panel lamp marked *gate* gives a visual indication that the time base circuit is operating and that the counter is ready to accept an input frequency.

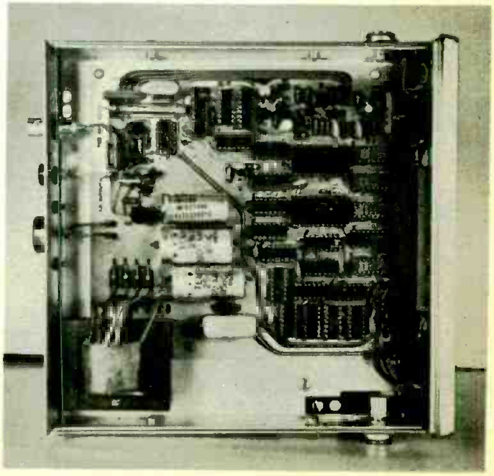
In terms of complexity, the kit, which contains 27 ICs and 11 discrete transistors, is for the mid- to upper-level hobbyist or service technician. Construction time ran about 10 hours. Most of the work consists of soldering components to a fiberglass pc board. All ICs are plugged into sockets. Both connectors and sockets are soldered to the pc board.

Alignment could have been a monumental task for the home constructor. But actual calibration is simple—like the IB-101 all that's needed is a broadcast band radio. By the term alignment, we mean zero-beating the IB-1101's timebase oscillator against a known frequency on a BCB receiver. That's it.

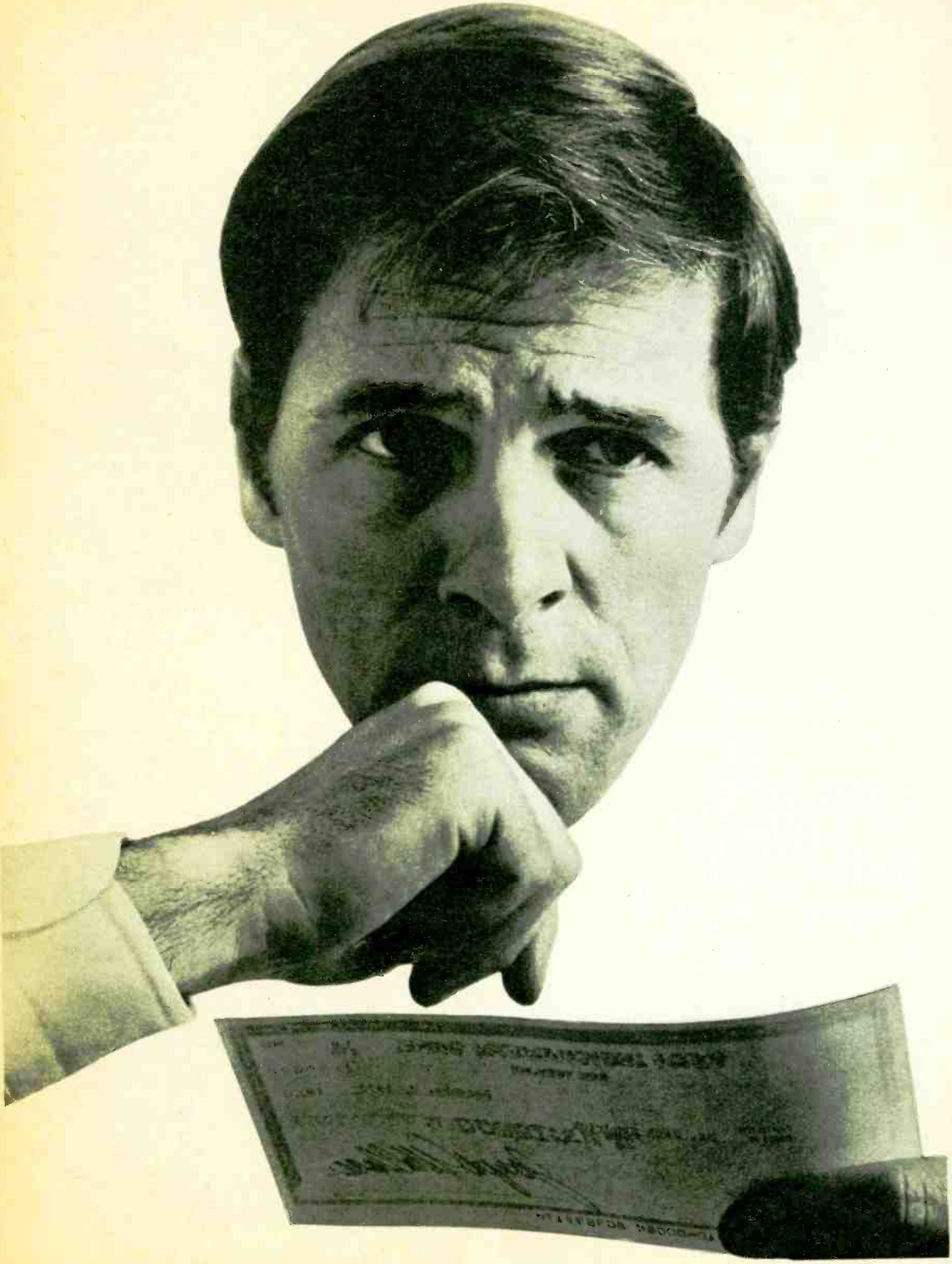
The overall cost of the IB-1101—$295—is not high when it is compared to other counters that offer comparable performance. Nor is the cost out of line for a service tech who considers the sheer time savings to be realized when working with the instrument. Looking at the range of frequencies spanned by the IB-1101 (the AM broadcast band, SWL, CB and ham frequencies and the lower VHF TV channels), a lot of hobbyists and technicians can find a job awaiting the IB-1101 on their bench right now.



Bottom view of IB-1101. Magnifying lens and pencil iron are needed to solder to pc board.



Visible at upper left corner are time base oscillator components. Readout tubes are at right.



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The EI Ticker

TREASURY is looking at the possibility of invoking a law that's been on the books for decades but has seldom been used to stop the influx of Japanese goods into the consumer electronics market. Treasury Department officials say they may order the use of countervailing duties to up the cost of Japanese-imported TV, radio and stereo equipment, thus cancelling out the advantages to manufacturers of Japanese export subsidies.

★ ★ ★

Buyers of new TV sets should keep a sharp eye on the accuracy of UHF tuning devices on sets manufactured later than January of this year. New FCC rules originally called for automatic UHF 70-position tuners with accuracies within ± 3 mc after that date. But a shortage of such tuners has led to appeals for waivers by most manufacturers for some sets in their lines. They include Zenith, Teledyne, Packard Bell, Admiral, Philco Ford, GTE Sylvania and Wells-Gardner Electronics. It means that for the time being, some sets on the market will have less than optimum accuracy in UHF tuning.

★ ★ ★

The U.S. electronics market totalled $27.1 billion in 1971, a gain of $200 million from the previous year, according to information compiled by the Electronics Industries Association. Consumer electronics reached $4.7 billion.

★ ★ ★

By 1985 world consumer electronics will soar to $35.6 billion, EIA adds in a new forecast. The total world electronics market should reach nearly $205 billion by that year, with a U.S. share of $81 billion.

★ ★ ★

First meetings of the new National Quadraphonic Radio Committee (NQRC) have been held in Washington. Purpose of the NQRC is to evaluate various approaches to multi-channel FM broadcasting and making the findings available to the FCC. The committee parallels the EIA's National Stereophonic Radio Committee of 1960, which pioneered in the area of FM stereo broadcasting.

★ ★ ★

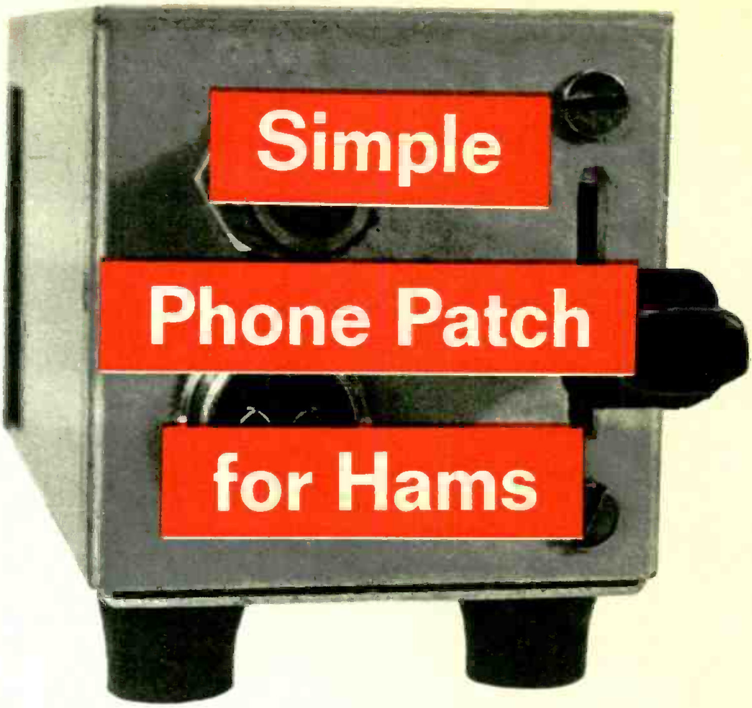
Calling the Coast Guard? The FCC has amended its rules to allow the use of the frequency 2670 kc by non-government ship stations. Ship stations are advised to establish communications with the Coast Guard on the calling frequency 2182 kc and then shift to 2670 kc. The Coast Guard does not listen on that frequency.

★ ★ ★

A chronology of consumer electronics highlights over the past half century and statistics is available in the 1972 Consumer Electronics Annual now available from EIA in Washington, D.C., for 50 cents.

★ ★ ★

The Federal Trade Commission is considering issuing complaints against various operators of computer schools for deceptive or unfair advertising. Companies involved include Control Data Institutes, Lear Siegler Career Centers and Electronic Computer Programming Institute. The FTC complaints allege that the companies induce students to pay substantial sums of money to purchase courses of instruction whose value in terms of future employment may be virtually worthless to the student.



Simple Phone Patch for Hams

By HERBERT S. BRIER, W9EGQ

HAMS sometimes find themselves checking out new projects under trial by fire. Take the situation faced by the builder of our phone patch W9EGQ.

He had just asked a station he was working for a routine signal report and by chance had our patch on line—so far absolutely unused. Information was being exchanged when a ham located in Central America broke in. His area had no long-distance telephone service, he said. One of his neighbors had to place a call to his brother in Wisconsin and in a hurry. Did anybody have a patch? Could anybody help.

In a flash, W9EGQ placed a person-to-person, long-distance call to Wisconsin. The fellow in distress told his brother about a serious automobile accident. One person was dead, other victims were in the hospital.

A harrowing experience for the Central American resident but quite a test for EI's newest ham project. Obviously . . . it worked.

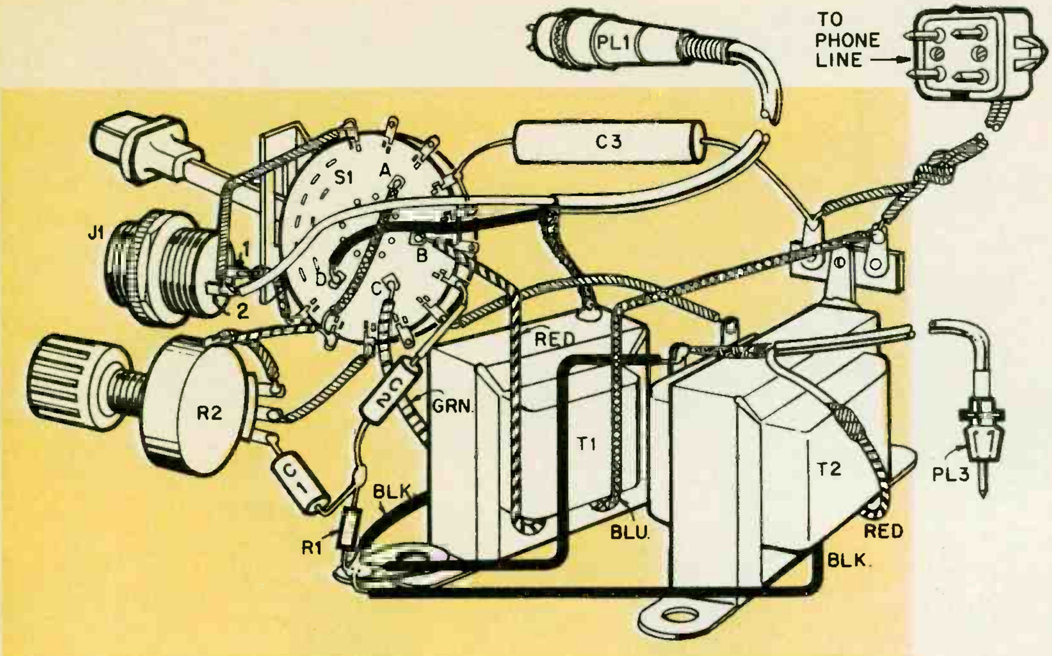
Our Simple Phone Patch for Hams retains a basic circuit devised several years ago by the author. Control-wise, however, it is more versatile, having only a pot and a single switch for all functions. Switch-controlled operation was found to be more dependable than more complicated hybrid voice-controlled transmit circuits.

Even on a piece of SSB gear having a built-in voice-control circuit, VOX does a poor job routing signals through patches plugged into noisy, low-level phone lines—especially when QRM is wreaking havoc on the bands. Also, when two parties not familiar with the rules of ham radio, and phone-patch etiquette in particular, are on the phone, both may try to talk at the same time. Neither party succeeds in getting through.

Remember that you are responsible for what is transmitted via your station. You can cut off any profanity with your finger resting on the phone patch Talk/Listen switch lever. You don't want to have to explain to the FCC why you allowed blue language on the air.

Always prepare both phone parties for this type of operation. Instruct them before you turn on the phone patch to say *over* when one wants the other party to talk, and not to answer the latter until he says *over*.

How It Works. In the listen mode, most patches are designed to work from a nominal 600-ohm source. But the audio-output terminals of many amateur rigs match only a 3.2- or 8-ohm speaker load. Too little signal is delivered to the phone line via the patch. Worse yet, the audio sounds tinny.



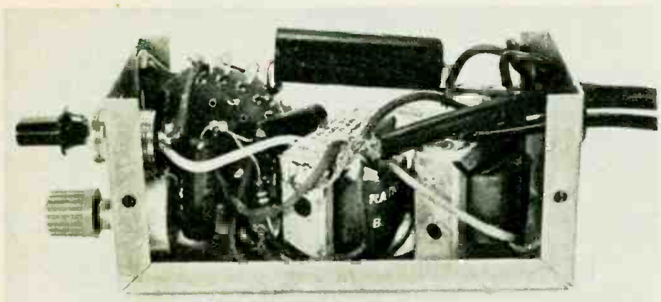


Fig. 1—A 2¼ x 2¼ x 5-in. aluminum Minibox should house all components nicely if you follow the layout (diagrammed above and shown at right). Mount switch S1 first, then potentiometer R2 and connector J1. Remember, you want to keep hum pickup to a minimum.

Simple Phone Patch for Hams

By matching the impedance of the phone line to our rig with a transformer you can sidestep the problem. The transformer may be cannibalized from a defunct AC/DC receiver or an inexpensive line-to-voice coil rig. This transformer, labelled T2 in the schematic, may be omitted if your set already has a 500- or 600-ohm audio output jack.

Capacitors C1 and C2 and resistor R1 located between transformer T1 and pot R2 (gain) form a simple low-pass filter. Frequencies below 400 cps are attenuated. The filter is another reason why our transmitter signal is crisp and clear. Audio processed by this filter contains less of the low-frequency hum often heard on many stations utilizing phone patches.

Building the Phone Patch. Assemble our phone patch in an aluminum cabinet for best

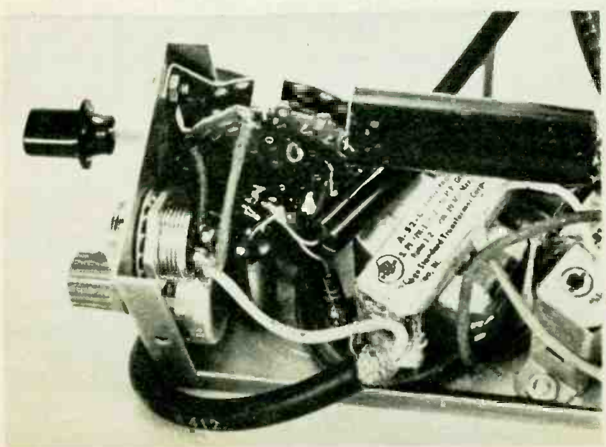


Fig. 2—Ground point for circuit is solder lug placed under foot of transformer T1. Two-terminal solder lug also is mounted on transformer T2.

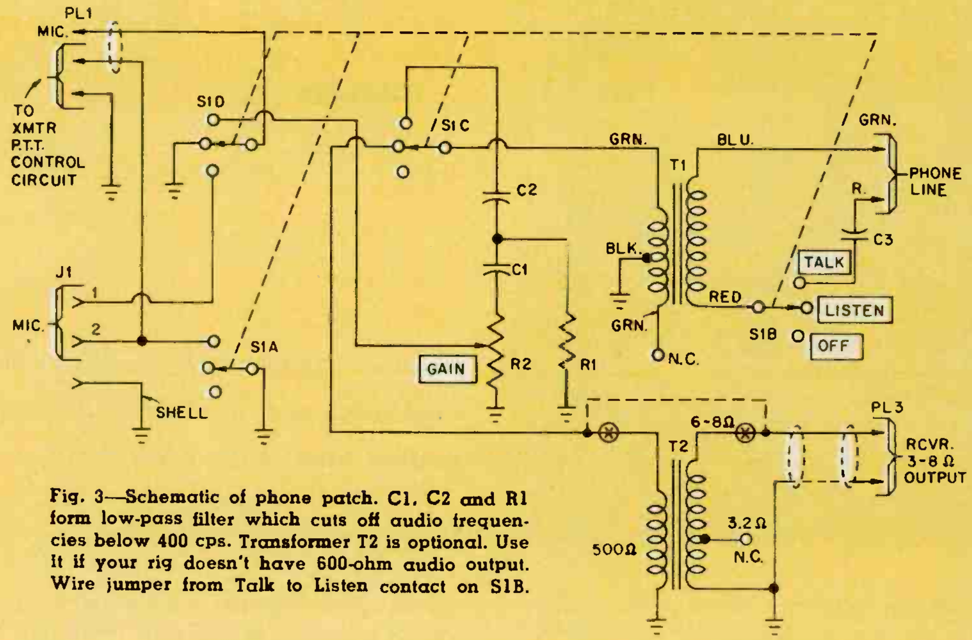


Fig. 3—Schematic of phone patch. C1, C2 and R1 form low-pass filter which cuts off audio frequencies below 400 cps. Transformer T2 is optional. Use it if your rig doesn't have 600-ohm audio output. Wire jumper from Talk to Listen contact on S1B.

Capacitors: all 200-volt, paper tubular unless otherwise noted
C1,C2—0.05 µf C3—0.22 µf
J1—Female chassis socket (Amphenol 80-PC2F or equiv. See text)
PL1—Microphone connector (see text)
PL2—Four-prong telephone plug (Lafayette 44R 60036 or equiv.)
PL3—Phono plug to match audio-output jack on receiver (see text)
R1—10,000-ohm, audio-taper pot (Mallory U-18 or equiv.)
R2—10,000 ohms, ½-watt
T1—Audio transformer; primary impedance: 7000-15000 ohms, secondary center-tapped. Overall turns ratio 1:2. (Stancor A52C or equiv.)
T2—Line-to-voice-coil transformer; primary: 500 ohms, secondary: 3.2/6-8 ohms (Stancor A8101 or equiv.)
1—2¼ x 2¼ x 5-in. aluminum cabinet (Bud CU-2104A or equiv.)
Misc.—two-wire shielded microphone cable, single-conductor shielded cable, two-conductor unshielded cable, three ⅜-in. grommets, mounting feet, two-lug terminal strip, No. 6 hardware, panel lettering, etc.

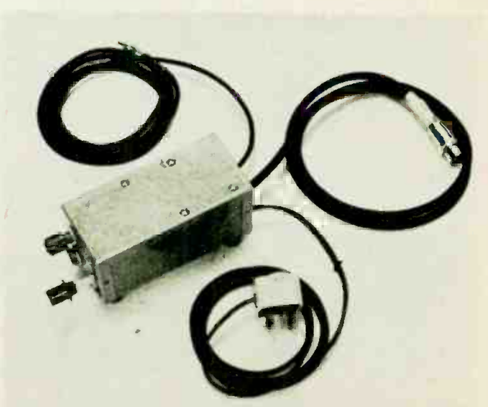


Fig. 4—Phone patch ready to go. Cable at top left (with phono plug) connects to ham rig's audio output. Bottom cable connects patch to phone lines; cable at right plugs into transmitter's mike input.

shielding. A 2¼ x 2¼ x 5-in. box accommodates all components if you follow the pictorial layout. If you need more space to work, try a 3 x 4 x 5-in. box.

Mount lever switch S1 first. Carefully drill its mounting holes 3/16-in. from the edge of the box. Position the holes equidistant from top or bottom of the box when it is closed. The terminals may be bent slightly to increase clearance if necessary.

The lever's slot is formed by drilling a 5/32-in. hole in the center of the slot area and elongating it with a small triangular file.

After the space occupied by the switch is determined, position and drill the holes for pot R2 and microphone connector J1. Our connector is an Amphenol type 80-PC2F female chassis connector. It matches the plug

[*Continued on page* 98]

Servicing Aids for the Hobbyist and Professional

If you're having trouble getting your workbench organized, here are some gadget ideas from a servicing pro.

By ART and DENNY MARGOLIS

LIKE the nifty cart shown above? Well, it's just one of hundreds of ideas that can make life easier for the professional and part-time serviceman or anyone who likes to tinker with electronic gear.

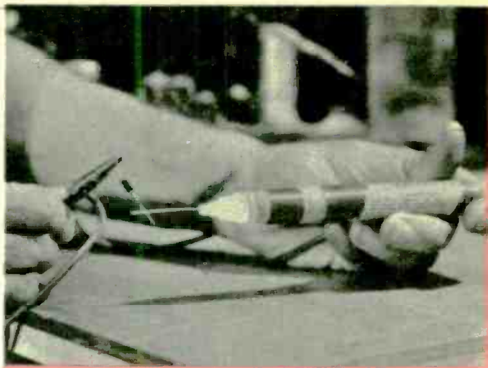
Anyone involved with servicing knows that time is money, so any servicing aid that saves time is well worth the initial investment—which usually is not much to begin with. People who like to browse for surplus parts or look in the bins at their local parts distributor undoubtedly have seen many of the gizmos illustrated in this article.

Don't let anyone kid you, having the right tool or servicing aid on your bench (or in your tube caddy, for that matter) at the right time can save you many hours of painful errors and sometimes backbreaking work. Ever try to unsolder a tiny transistor with a man-size soldering gun only to discover that you've burned out a number of components while applying the heat? A pencil iron would be your correct soldering tool for this job.

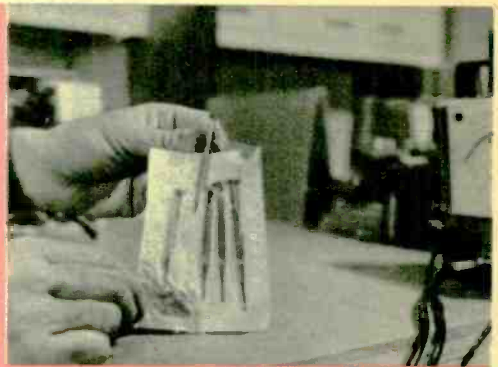
Maybe you already know that. At any rate, here are a few tricks of the trade based on some of the better products available.

Mundane and often ignored, a sponge rubber mat serves as an ideal surface upon which to rest scratchable TV cabinets or sharp objects.

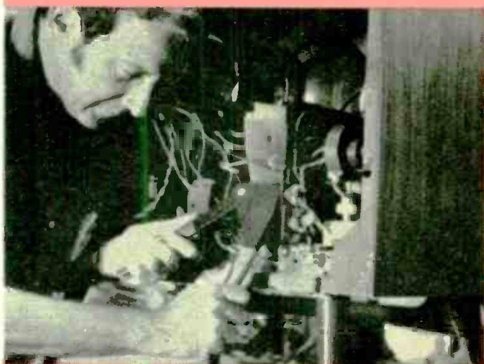
Tall bench lamp having vise-like mounting bracket maneuvers every which way and throws light right over your working area.



Neon lamp tester is perfect for quick-and-dirty continuity checks. Side benefit is positive indication of whether or not voltage is present.

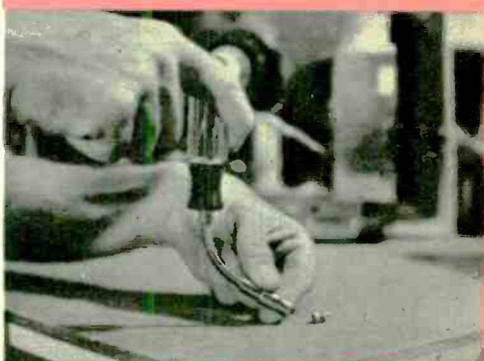


Collection of tiny jeweler's screwdrivers is just the thing for making adjustments in miniature gear and getting in and out of small slots.

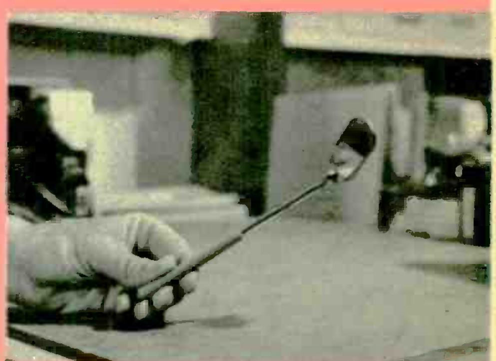


Hand-held rivet machine allows you to remount tube or transistor sockets and safety interlocks in professional manner for nice appearance.

Low-wattage pencil iron (shown here with stand and heat-sink attachment) is a must when working with PC boards and solid-state components.

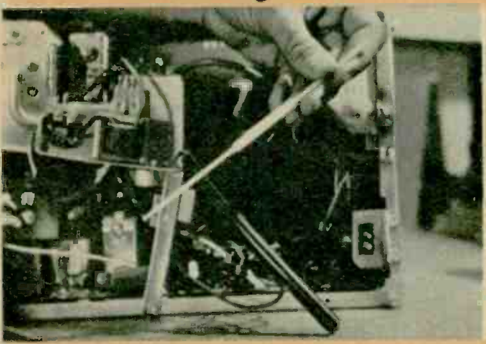


Nut driver having a flexible stem could be the trick you need to attach hardware in corners of chassis. Remember ¼-in. driver is common.

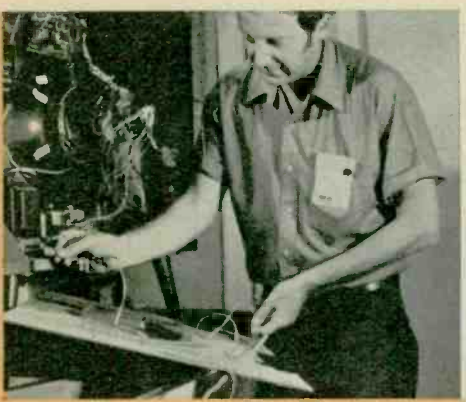


Adjustable dentist's-style hand mirror slips into a maze of wires or next to tiny PC board circuit paths to show what you can't see direct.

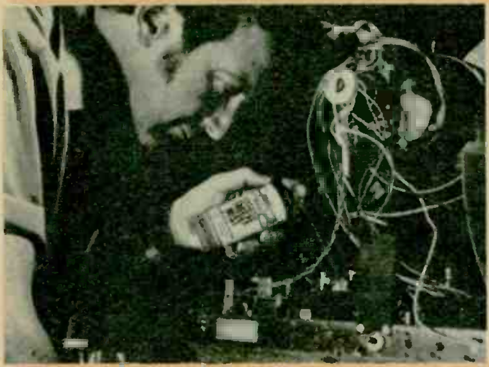
Servicing Aids



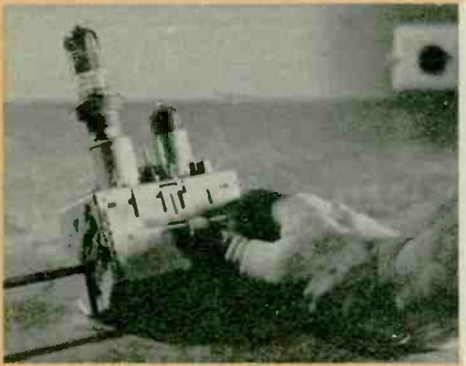
Plastic diddle sticks come in all sizes—to fit any type of core in transformers or coils—and are absolute must for tricky alignment jobs.



Cheater cords come in a number of styles: regular, polarized and back-to-back. They are used to defeat safety interlocks on back of set.



Chemicals for electronic gear can be helpful. Here, can of freeze-mist spray is used to cool down component in order to find intermittent.



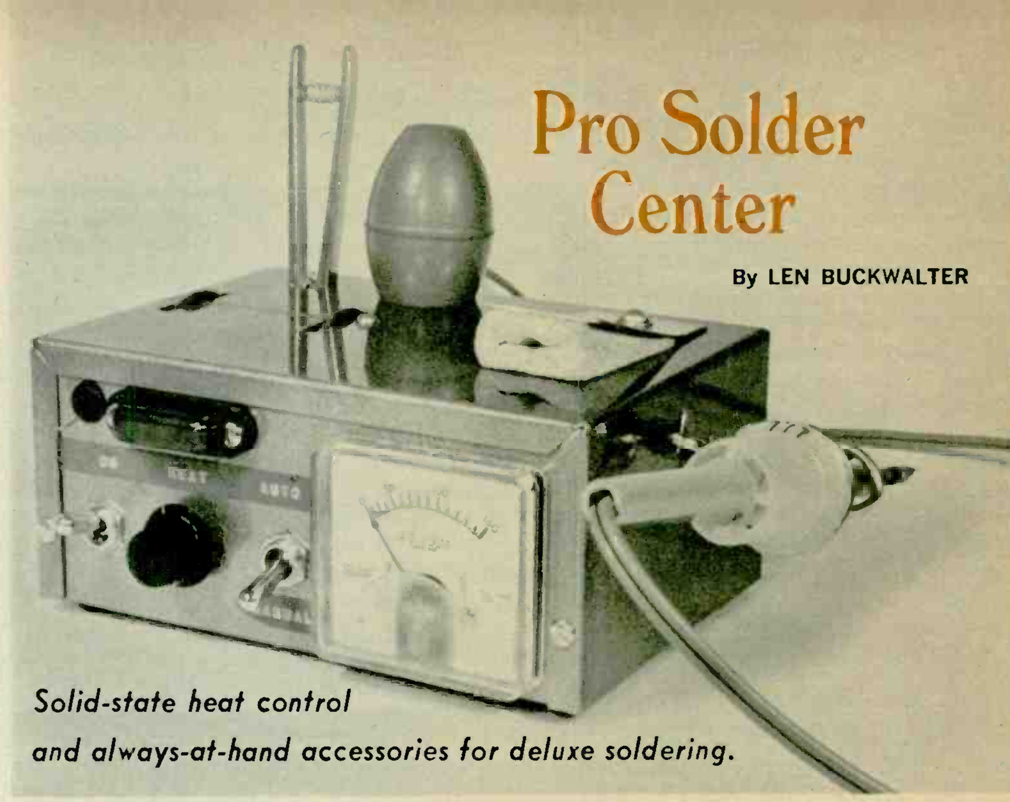
Tube socket adapter (shown here plugged into TV tuner) permits you to make voltage and resistance readings convenient from above.

Larger soldering gun familiar to old-timers still comes in handy to illuminate dark corners and provide high level of heat when it's needed.

Lazy susan style of tool holder brings correct tool into view at touch of a finger. Increased efficiency will mean less wasted time at bench.

Pro Solder Center

By LEN BUCKWALTER



Solid-state heat control and always-at-hand accessories for deluxe soldering.

STRANGE as it may seem, production-line soldering at most electronics manufacturing outfits is done with an old-fashion hand-held iron. While the soldering gun may be a marvel of convenience for the home craftsman and service tech, it's outclassed by the iron, especially during long sessions of kit building or homebrew construction. Today's iron is lightweight and easy to handle. When you're trying to solder heat-sensitive ICs and semiconductors into the circuit, an iron concentrates heat where you need it most.

Yet the soldering iron has a couple of disadvantages. Heat is hard to control and the tip soon deteriorates from oxidation. Worst of all, there's the risk of burning hands, elbows or anything else on the bench while the iron's hot.

Our Pro Solder Center does away with all these problems. It keeps tips from burning and pitting. When you pick up the iron from its cradle, it receives full wattage. Slip your iron back into its cradle and the Pro Solder Center automatically reduces heat to a preset low value. Tip life is greatly extended and you won't have the chore of cleaning and tinning the iron as often as you did before.

It's easy to dial the heat you need. With our Solder Center you can electronically throttle down the iron for delicate jobs like soldering components to a printed-circuit board. Heat control R3 regulates the iron from about half its rated wattage and continuously lowers it to zero watts. The heat control works on all irons rated up to 200 watts maximum. Note, however, that the Pro Solder Center will not control a gun or transformer-powered soldering iron.

A pilot lamp indicator is the one item that's most sorely missed from a soldering iron. Most hobbyists discover that it's too easy to forget to pull the plug when they're finished soldering. Our solder center eliminates the chances of a fire hazard if you accidentally leave the iron on overnight or longer. Chances are, though, you'll never want to pull the iron's plug out of the solder center—an on/off switch and indicator lamp are conveniently built into the circuit.

A handy cradle supports the iron to prevent accidents. Like scorched parts on the work table, or burned fingers and forearms.

Ever plug in your iron, and forget where you last left the solder? You can store a roll of solder inside the center's case, dispensing it as needed. After a job is finished, reel the solder back on the roll.

A sponge clamped to the case makes a first-class tip cleaner. Unlike flattened sponges, ours grabs the tip of the iron. It does a better job removing solder blobs and swabbing the tip clean.

By cutting holes in the top of the case you can provide convenient storage spaces for accessory items. Shown are provisions for holding a combination soldering aid/heat sink and a solder sipper. This is a gadget which lets you draw molten solder out of a clogged terminal or lug.

How It Works. A silicon-controlled rectifier limits current flow to the soldering iron. Q1 passes only half-cycles of AC line voltage to a soldering iron plugged into socket SO1. Since Q1 is really a controlled half-wave rectifier, line voltage seen at the iron's plug is about 84 VAC rms. This reduction lowers the iron's wattage to about one half its original rating.

The SCR's ability to pass current through it is determined by the control voltage injected into the gate of Q1. The setting of R3 determines how rapidly capacitor C1 is charged by line voltage.

When resistance is high, C1 charges slowly. The amplitude of the control voltage is dependent upon how long a period of time it takes to store a voltage which can trigger Q1's gate and fire the SCR into conduction.

When *Heat* control R3 is turned up, only a short burst of current reaches the load via Q1 during each half-cycle. But as R3 is adjusted to a lower value of resistance, capacitor C1 charges rapidly and triggers the

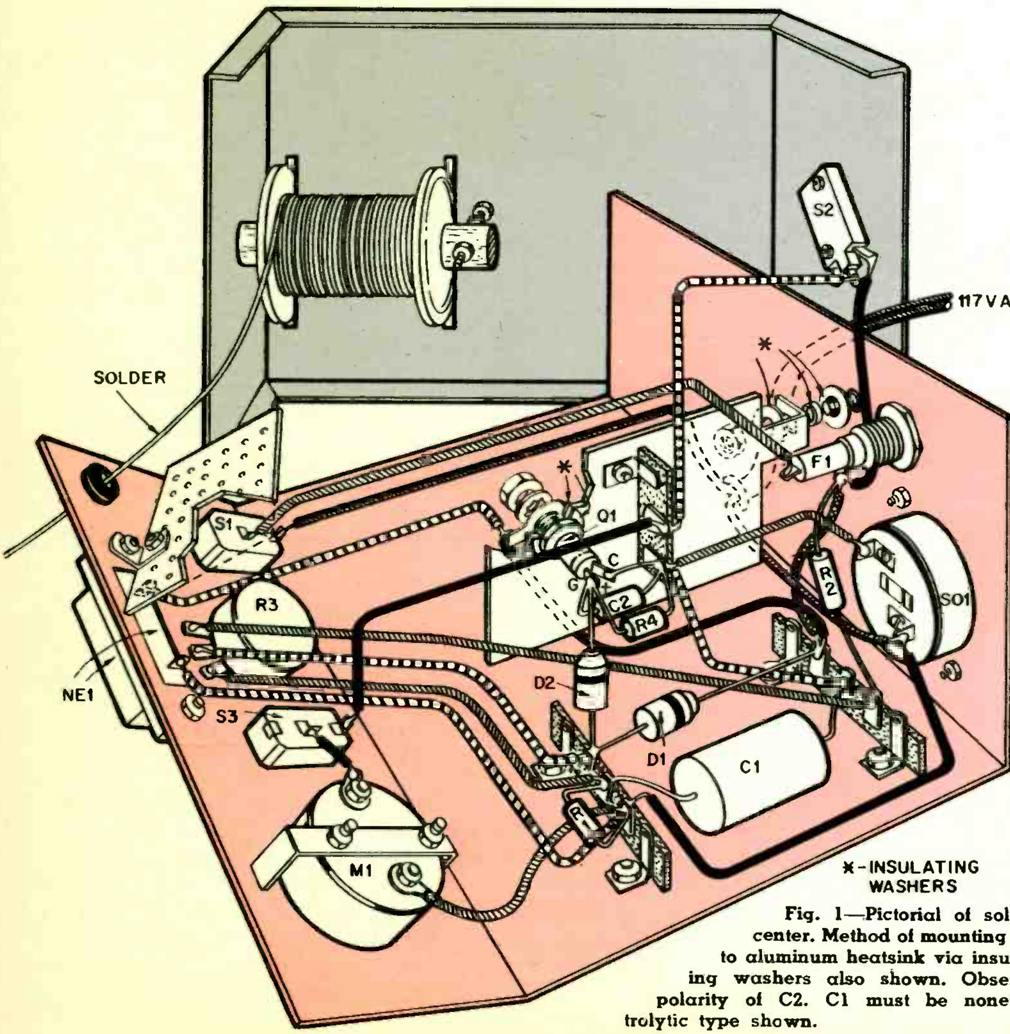


Fig. 1—Pictorial of solder center. Method of mounting Q1 to aluminum heatsink via insulating washers also shown. Observe polarity of C2. C1 must be nonelectrolytic type shown.

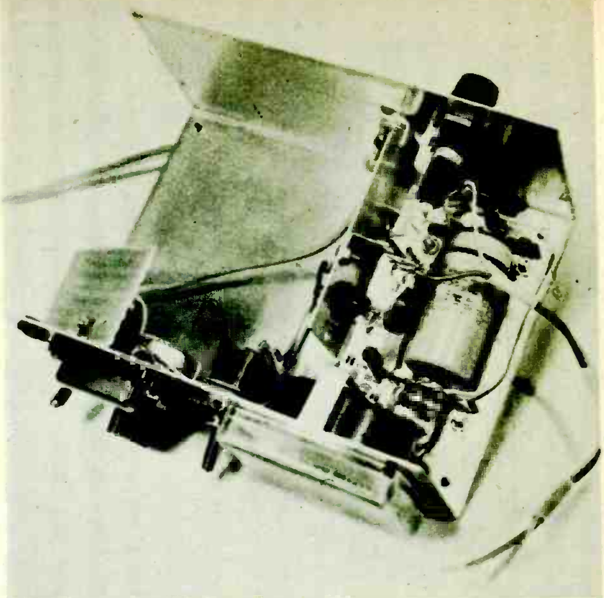


Fig. 2—Wires at right lead to normally closed (N.C.) and common (C) contacts on micro switch S2.

SCR into it *on* state during a greater portion of the AC half-cycle. More current reaches the iron, and it gets hotter.

Two silicon rectifiers (D1 and D2) clip the unused AC half cycle from the control voltage. Without them, the SCR would never be given a chance to switch into its *off* state.

The time constant formed by components R4 and C2 is long enough to keep SCR triggering action stable and reliable, even with a lot of noise on the AC line.

To apply full power to the soldering iron, lift it off the cradle. Switch S2 is closed, bypassing the AC around Q1 and its associated circuitry. Full line voltage now reaches the soldering iron.

Switch S3 is added for a second mode of operation. In the *Auto* position, the iron receives full power when it is lifted for soldering. Power to the iron is automatically reduced when it's placed back on the cradle.

[*Continued on page* 100]

PARTS LIST

C1—1 μf, 400 V capacitor
C2—5 μf, 50 VDC electrolytic capacitor
D1,D2—Silicon rectifier (min. rating 400 PIV @ 750 ma.)
F1—4A @ 250 VAC fuse (type MTH)
M1—0-150 VAC meter (Shurite No. 8406 or equiv.)
NE1—Neon indicator lamp assembly (Drake No. 110-025 or equiv.)
Q1—Silicon controlled rectifier (GE X-1)
Resistors: ½-watt, 10% unless otherwise indicated
R1—27,000 ohms
R2—330 ohms
R3—10,000-ohm, 2-watt linear taper pot. (Ohmite CU-1031 or equiv.)
R4—1,500 ohms
S1,S3—SPST switch
S2—SPDT snap-action micro switch (Burstein-Applebee No. 18C256)
SO1—Chassis-mounted AC female socket (Amphenol No. 61-MIP-61F)
1—7 x 5 x 3-in. aluminum minibox
1—Solder sipper (Burstein-Applebee No. 37A3006)
1—Combination solder aid/heat sink (Burstein-Applebee No. 37A3005)
1—Tip cleaning sponge (Ungar No. 455)
Misc.—Fuseholder (Buss HKP or equiv.), hardware, rectifier mounting hardware, perfboard, AC line cord, rubber grommet, solder, ⅝-in. dia. wood dowel, etc.

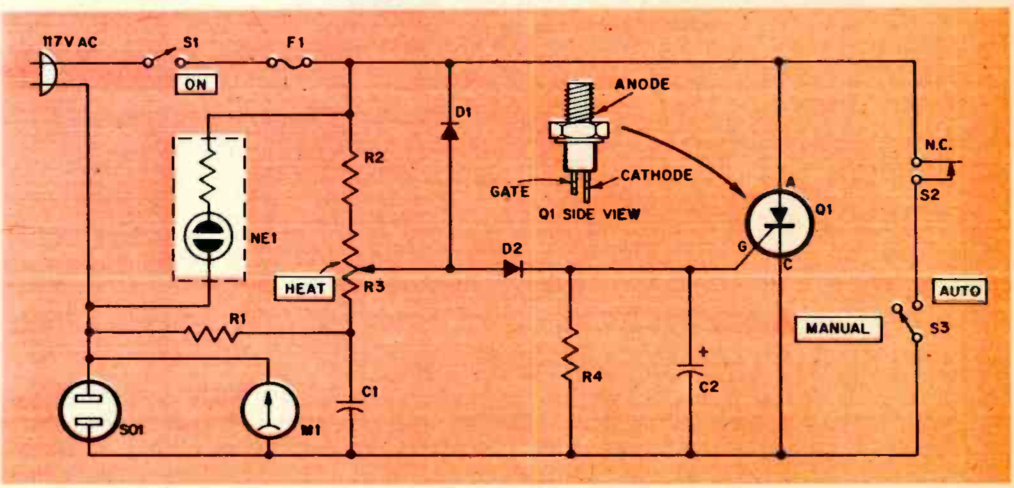
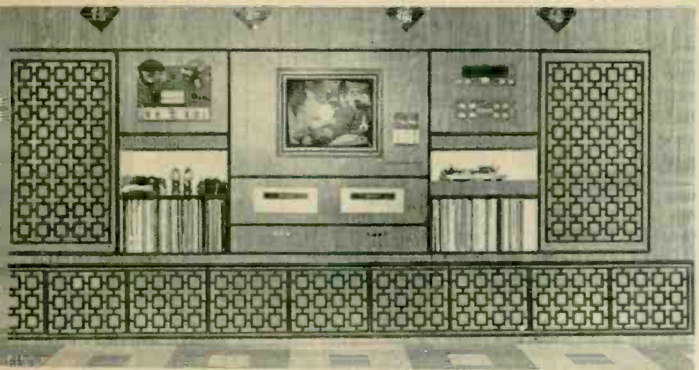


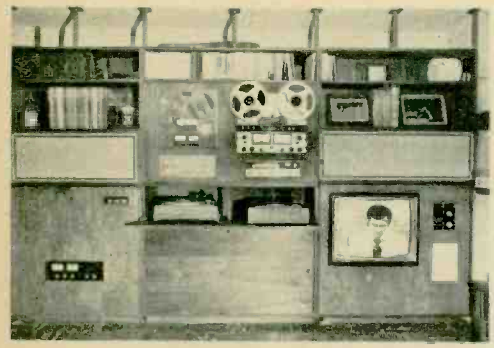
Fig. 3—Diodes D1, D2 cut off unused portion of control voltage waveform, making it easier to trigger Q1.

EI's Hi-Fi Contest



$200 First Prize goes to Y.P. Sheung, Montreal, Canada for his Oriental-motif installation.

$100 Second Prize is awarded to D. Pulaski, Granville, Mass.



$50 Third Prize goes to P. Wassmann, Hyattsville, Md. for elaborate, but conventional rig.

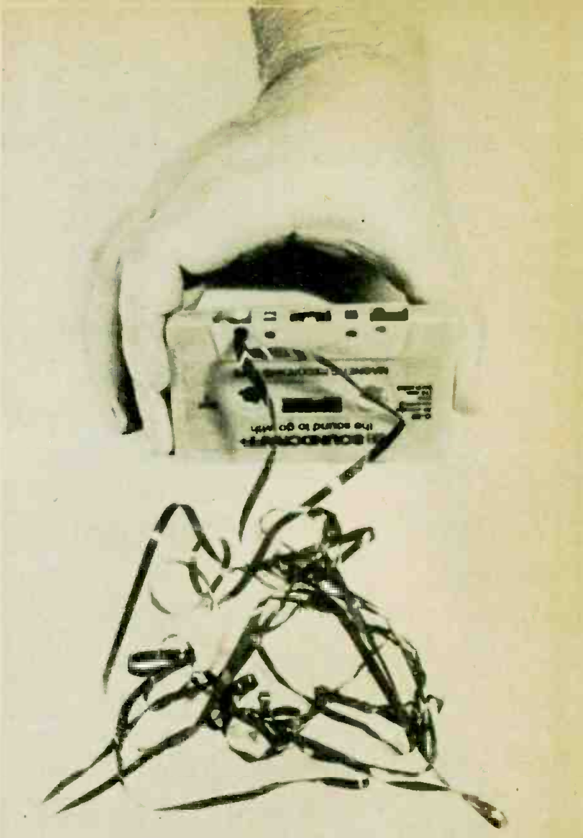
T. Newton of Bakersville, Cal. wins $25 Fourth Prize for housing rig in 1930's-style cabinet.

SINCE we announced our Hi-Fi Contest, reader's photos depicting their systems have crossed the editors' desk at a rather steady rate. Also, we've learned a thing or two about the typical audiophile-entrant—if we can call him that. Fact is, he is deeply engrossed in multi-channel audio, in particular two- and four-channel sound reproduction. Our entrant also has a talent for arranging the components making up his stereo rig in as many ways as hi-fi manufacturers have devising new looks for their amps, tuners and speakers in wood and metal enclosures.

As mentioned in the September issue, the amount of money spent on each installation is not considered to be the most important criterion in judging a setup's merit. Arranging the gear in an eye-pleasing manner became our best means of determining an entry's prizeworthiness.

This issue's prize winner's photos show arrangements given to pieces of gear within a good hi-fi setup. A couple are outstanding examples of integration of hi-fi gear within the listening area. Compare these and last issue's entries to your own proposed installation. Chances are, you'll get a good idea or two for your own prize-winning system.

By
ROBERT ANGUS



Quick Cures for Ailing Cassettes

All is not lost if you've got a cassette or two that looks like the one above.

YOU'RE playing a not-to-be-duplicated prize cassette recording of your son's birthday party, or a recording you made sub rosa at a rock festival. Suddenly there's a groan from the recorder, followed by silence. The tape has become hopelessly tangled around the capstan. To extricate it requires screwdriver, tweezers, possibly even a razor blade to cut away the tightly-packed tape.

If you think it's time to cry a little and throw away the cassette then you ought to think again. It's possible to doctor this cassette and others almost as badly damaged with a little know-how and a few spare parts. You can salvage something—sometimes everything—from most of the damaged cassettes you used to cast aside.

One of the most common problems, particularly with inexpensive cassettes, is a tendency for the tape to jam inside the cassette after many playings. There are two cures for this problem. Merely hold the cassette a couple of feet above and parallel to a table top and then drop it.

Hopefully, the cassette will land flat Repeat two or three times and try the cassette once again in your machine. This is the simplest cure for tape which wraps unevenly because the cassette lacks proper guides, or the tape itself has uneven slitting.

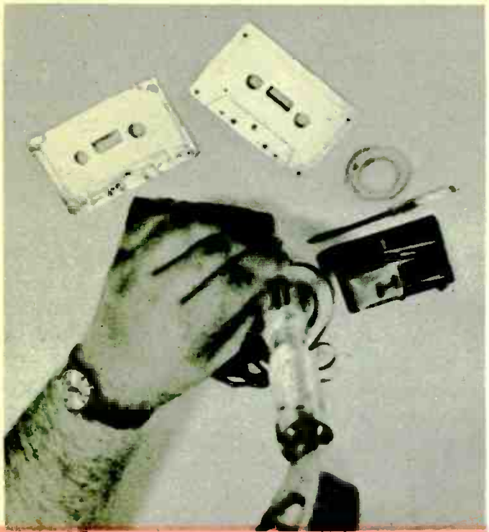
For a more complicated (but permanent) cure, break open the cassette and gently lift out the tape pack and hubs. The idea is to build a new cassette around them. Fortunately for the tape hobbyist, there's a do-it-yourself repair kit available from Robins Industries which contains all the necessary parts except tape. Included are hubs, shells, rollers and pins, plastic sleeves, a pressure pad assembly and screws.

Since friction-related problems are usually caused by substandard sleeve material, a lack

Some basic cassette repair tools. Use a wide-blade screwdriver to break open cassette only in emergency. Recorder comes in handy, too.

Quick Cures for Ailing Cassettes

Quality-built cassettes are screwed together. You'll need miniature flat- or Phillips-screw-driver used by jewelers to open cassette.



You run the risk of cracking the cassette shell by opening with screwdriver blade. Stiff-blade putty knife distributes force more evenly.

of rollers or steel pins and poorly molded shells, it's a good idea to rebuild your bum cassette using these new parts from the repair kit.

To begin the rebuild, take the bottom shell (the one with a plastic pin sticking up in each front corner) and lay one of the sleeves in it with the coated side up. Now insert the tape hubs containing your recording over the two holes so that the tape loops downward between them. Make sure that the tape isn't twisted and guide it around the rollers and past the molded parts of the cassette face. Next, insert the antistatic shield and pressure pad assembly.

Position the second sleeve inside the top shell with the coated side facing you. Gently lower both shell and sleeve over the rebuilt assembly. Before bringing both halves of the body together, make sure that the view through the cassette window is unobstructed and that the hubs are properly positioned. Also make sure that the tape can travel unhindered past the pressure pad. Now screw or cement the cassette together.

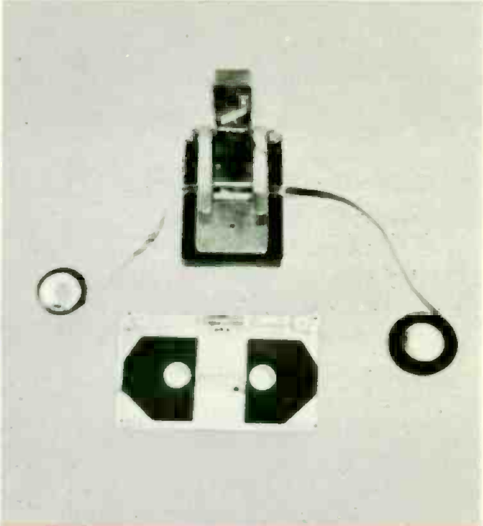
Obviously, it's much easier to do all this with a cassette that's screwed together than one that's welded shut. There are two types of screws used in cassette construction—a straight-slot type and a Philips screw. While a miniature screwdriver, or even a nail file, usually does the trick, a welded cassette must be broken open.

You'll need a hammer and stiff-back putty knife. In an emergency, a screwdriver, as shown, will do. Position the putty knife along the seam on the back of the cassette. Hit it with the hammer until the seam opens up. Work from one corner toward the other. You then can use the knife to wedge the end seams open.

It isn't necessary to buy repair kits, though. You might consider instead buying two C-30 cassettes—preferably ones that are screwed together. You can splice the two 30-minute tape packs together and convert one of the cassettes to an hour-long tape. The other cassette shell will come in handy for the tape pack you've removed from a previously-sealed cassette.

Tape splicing of the cassette is the other repair commonly encountered. Cassette splicing is not appreciably different from open-reel-tape splicing. A number of splicers are specifically designed for cassette tape.

These range from the simple splicing-block-and-razor-blade variety to the type of splicer which grips the tape and makes the cut at the press of a lever. Unless you have very steady hands and eyes, buy a cassette splicer rather than try to use your open reel splicer for cassette tapes.



Don't scrimp by trying to use ¼-in. splicing block with ⅛-in. wide cassette tape. Many good cassette tape splicers are available.

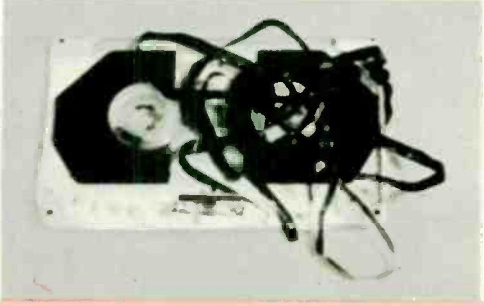
Perfect splice should be invisible from dull side of tape. Remove excess splicing tape protruding above or below magnetic recording.

Just as you apply splicing tape to the uncoated side of open reel tape, the same is true for cassette tape. If you put splicing tape on the wrong side, there will be a momentary silence each time the splice passes the playback head. Also, it's more likely to come off and gunk up your recorder.

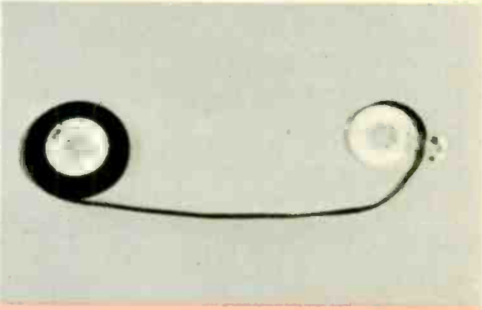
Cassette tapes are not only narrower and thinner than their open-reel counterpart but they tend to curl upward when you put them in the splicer. Remedy this by applying a tiny spot of saliva to the tape track before pressing the two tapes into the guide. Then put another drop to the lower tape where it overlaps the upper before you cut and trim the tapes together. Saliva and a little pressure usually are enough to hold the tape in place long enough for you to make your cut, remove the excess tape and apply the splicing tape.

And while we're on the subject of splicing tapes together, no serious recordist would dream of using splicing tape which bleeds—oozes goo around the edges after a little time. That rules out not only ordinary transparent

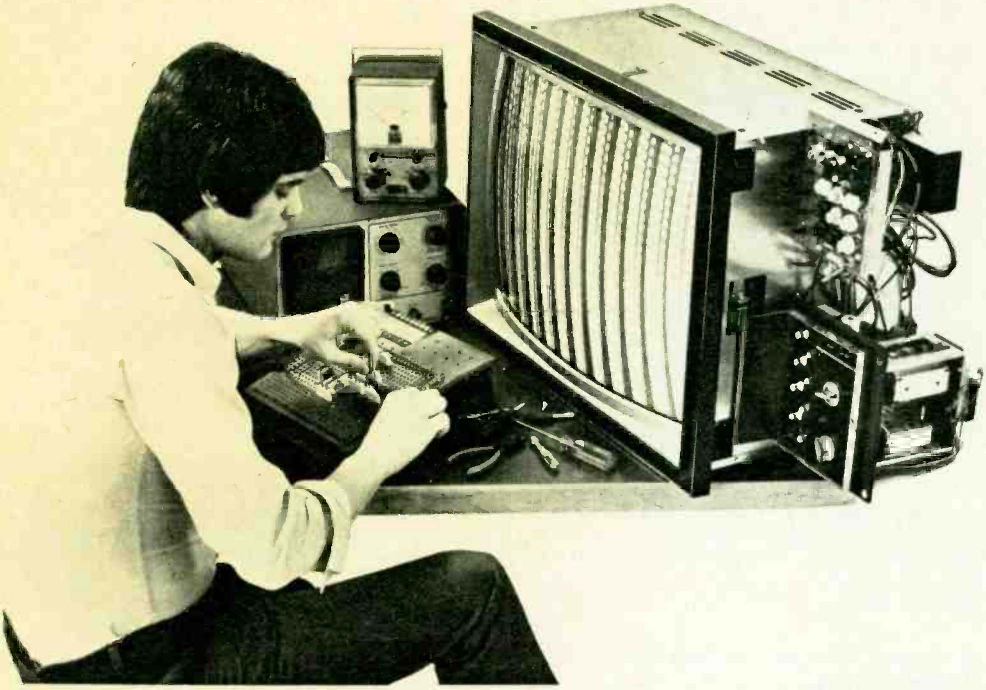
[*Continued on page* 97]



Tape has slid off outside of pack and become wrapped about hub. Replace damaged leader, too. Don't try to save badly crinkled tape.



Mini clamp holds leader to niche in tape hub. Place tape in niche before inserting clamp and rewinding leader and tape on hub assembly.



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You'll find it especially absorbing to build this superb color TV set. And you'll take pride in it because *you did it yourself!*

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The skills you acquire through this brand-new program can help you earn extra money—or start a business of your own in color TV servicing. We've helped many thousands of people start new careers or businesses of their own in electronics.

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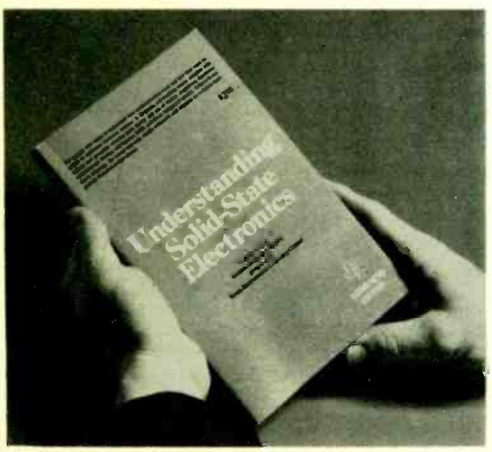
Good Reading

By Tim Cartwright

Books, Pamphlets, Booklets, Flyers, Bulletins and Application Notes.

TEXAS Instruments, Inc., one of the Big Daddies in the semiconductor industry, now has gone into the teaching business. A new division, called the Learning Center, has been formed to provide consumers and engineers alike with educational materials about solid-state technology. First offering to come down the pike is a handy paperback called **Understanding Solid-State Electronics** (242 pages, $2.95). For those who like theory simple, it's a good deal. Order from TI, Inc., Box 5012, MS/84, Dallas, Tex. 75222.

If you care to match a Tasmanian female to an Andalusian jack, you'll probably find the right adapter in the **Switchcraft Audio Accessories Catalog.** The company's latest shows accessories by the hundreds—from plugs, switches and connectors to every conceivable cable assembly. One item for the home recordist are mini-mixers that blend several microphones into a single recorder input. New models just introduced include teeny consoles that combine up to six audio channels for studio-like sound mixing. Write for catalog A404a from: Sales Dept., Switchcraft, 5555 No. Elston Ave., Chicago, Ill. 60630.



Fundamentals of solid-state electronics are discussed in layman's language in new book from Texas Instruments. This handy primer costs $2.95.

When the groundhog appears and the crocus blooms, the **Radio Amateur's Handbook** can't be far behind. This year, the ARRL classic is bigger and better, yet holds its price at $4.50. Thirteen chapters have been rewritten, 50 new pages appear and there is much coverage where the handbook once feared to tread—digital devices, ICs and other solid-state items. Although the editors declare this a no-nonsense manual for anyone in electronic communications, they may be forgiven a bit of preening in the foreword. There they remind us that Time magazine listed the Handbook as one of the all-time best-sellers in non-fiction. True, true.

Anyone designing or testing electronic equipment in factory or lab should have a copy of the **Pomona General Catalog of Electronic Test Accessories.** The latest edition describes more than 500 items that make life happy around the test bench. Amid patch cords, connectors and test leads are two clever items. One is the Grabber, a plunger-like probe that flicks out a tiny hook to firmly seize a test point. It's more elegant than lurching around a circuit with a massive alligator clip. The second item—a Dip Clip—is an alligator of sorts. Two jaws rimmed with 16 teeth gently engulf all leads of an IC simultaneously. Since the IC remains in place, you can take measurements in an operating circuit. This is the solid-state equivalent of the older tube socket adapter. Catalog is available on request from: Pomona Electronics Co., 1500 East Ninth St., Pomona, Calif. 91766.

Basic Color Television Course by Stan Prentiss isn't for newcomers to TV service, but it's a good text to make the transition from monochrome to color. If you're in the service game and don't know chroma circuits, this is a good place to start. Mr. Prentiss provides a good mix of up-to-date theory and practice. There is considerable coverage of ICs and other solid-state subcircuits now creeping into everyone's TV lines. The author also covers cable TV and

[*Continued on page* 96]

Low-Cost Transistor Tester

By
WILLIAM F. SPLICHAL, JR.

BESIDES owning a multimeter and small set of tools, the hobbyist often only needs a simple transistor tester to round out his supply of workshop aids. Particularly for the beginner, a transistor tester is a most useful piece of test gear. With one, the novice can measure a transistor's specs and indirectly learn about the inner workings of this semiconductor. For the more advanced hobbyist who buys transistors by the bag, the simple transistor tester can speed his chore of deciphering the characteristics of each transistor in the lot.

Readily available components are used to build our Low-Cost Transistor Tester. It can measure DC gain and leakage current. All bipolar silicon and germanium devices can be checked without fear of ruining tester or transistor if one is incorrectly mated to the other.

A couple of light emitting diodes (LEDs) eliminate complex polarity switching arrangements. Furthermore, the LEDs contribute a degree of accuracy to our checker not usually found in such low-cost instruments.

How It Works. Current amplification is measured by supplying 10 microamps via switch S3 (h_{FE}) to the base lead of the semiconductor under test. Emitter-to-collector current flows through a 0-1 ma. DC meter wired in series with the transistor and battery supply. A 1 ma. full-scale reading on M1 means the transistor is amplifying its input signal 100 times.

Measurements of DC gain greater than 100 can be made by pressing both S3 and switch S2 (*X 10*). A portion of the current flowing towards the meter is shunted around it via resistor R3. Since the shunt resistance multiplies current handling capacity by 10 times, gain measurements up to 1000 can be read on M1.

The forward voltage drop across light emitting diode D3 acts as the base current reference source. Reason is, the voltage drop across this diode is fairly insensitive to small changes of current flowing through it. Diode D3 has one other job. The diode's glow, or lack of it, is a visual indication of battery condition.

Base current leakage in a silicon transistor is not the same as in a germanium one. A switch-selected current-limiting resistor normalizes this characteristic difference between transistor types. Switch S4 (*Germanium/Silicon*) inserts the appropriate resistor into the base circuit.

The other measurement our transistor checker can make determines the amount of emitter-to-collector current leakage present within the transistor. This test is performed by passing a current through the emitter and collector terminals while the base lead is disconnected from its current source. After switch S5 (ICEO) is pressed, a reading is taken on M1. The lower this leakage reading, the better the transistor.

Building the Transistor Tester. Begin construction by drilling holes for the cabinet-mounted components. In our prototype, the cover section of a 4 x 2⅛ x 1⅝-in. aluminum chassis box is used to mount these components. Size of the chassis box or place-

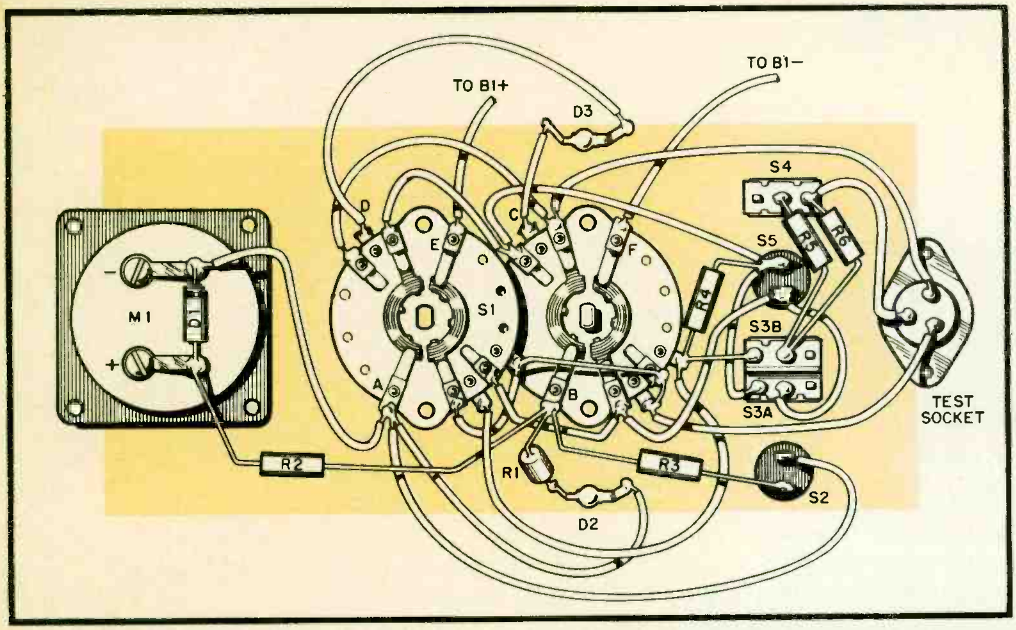


Fig. 1—Thickness of cathode leads of LED D2, D3 are exaggerated for clarity. One lead is .05 in. thicker than the other—just enough to eyeball.

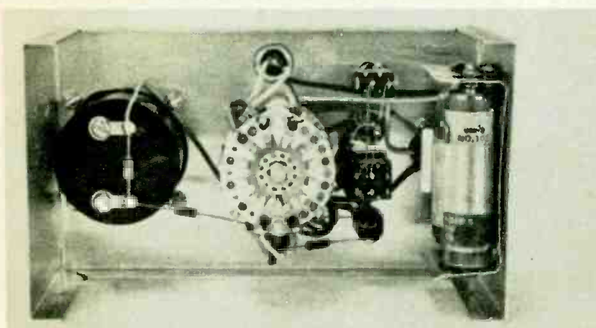


Fig. 2—Plastic lens caps, visible above and below rotary switch, are epoxied to the cabinet.

ment of the components is not critical. Scrounge parts from your junkbox if they have electrical characteristics equal to those in the Parts List.

Red plastic caps cover both LEDs and are cannibalized from a couple of old neon pilot lamp assemblies. The caps are epoxied to the chassis cover. Both light emitting diodes are positioned to face forward inside the caps with the cabinet cover in place. Flat pieces of red or clear plastic also could be glued below a couple of ¼-in. dia. holes in the chassis box if lens caps are not available. Light emitting diodes are available in panel-mounted indicator assemblies if their use is desired.

Exercise care when soldering wire leads to the LEDs. Heat sinks clipped between the diode body and lead while soldering prevent heat damage. Note that one lead of the diode is slightly thicker than the other. The somewhat wider wire is the LED cathode terminal.

Wiring switch S1 (*PNP/NPN*) is best undertaken before it is installed inside the cabinet. Note that S1 consists of six sections, three of which make up each switch deck. After S1 is prewired, mount it to the cover along with the other switches. The last component to be attached to the cover is M1.

After all components are mounted, apply dry transfer lettering to the cabinet. Some experimenters find it easier to work with the lettering before bolting home any of the components to the cabinet.

Operating the Transistor Tester. First set polarity switch S1 to its npn or pnp position. Also select the correct setting for base current switch S4 by flipping it to the silicon or germanium mode. Insert the transistor into the test socket and depress switch S5 (I_{CEO})

Fig. 3—LED D3, besides glowing when S3 or S5 is pressed, also supplies constant current to transistor base lead. D2 glows when test transistor is shorted.

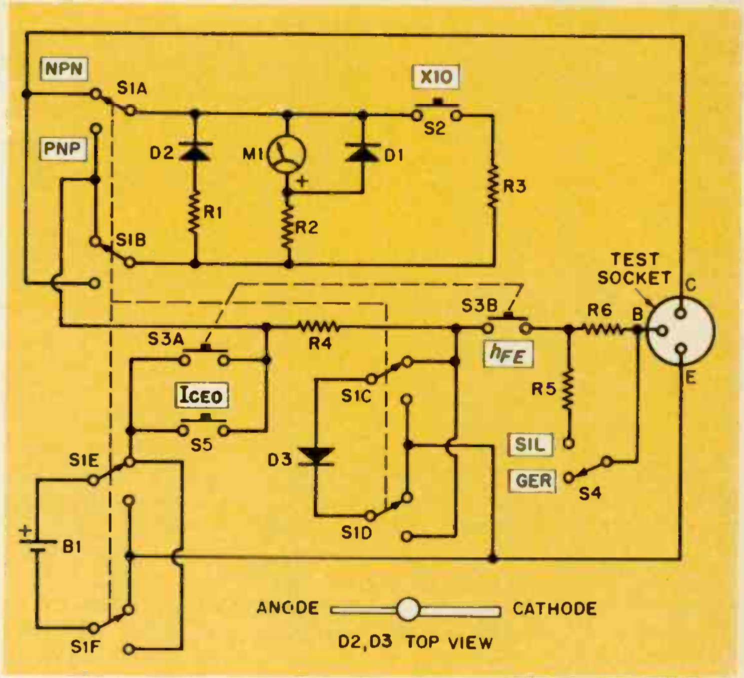


Fig. 4—Position of front-panel mounted components.

Low-Cost Transistor Tester

Read the leakage current directly on the meter. As a general rule of thumb, silicon transistors usually show almost no leakage while germanium ones may normally indicate up to 0.1 ma. during this test.

Next, press the DC gain, or h_{FE} switch S3. Multiply M1's reading by 100 to measure gain. If the meter needle pins the scale, also press S2. Now multiply scale readings by 1000.

If either switch S1 or S5 is thrown to an incorrect setting, the tester will not damage the transistor. You will only see an incorrect leakage or gain meter reading.

Shorted transistors are indicated whenever the short-circuit indicating diode, D2, glows. The meter needle also will go off-scale when either leakage or gain switches are depressed. Under ordinary test conditions, shorted transistors will force the short-indicating LED to glow. But transistors having a DC gain greater than 1000 may pull sufficient current through D2, forcing it to glow.

The battery pack is automatically checked each time any of the momentary switches are depressed. Failure of LED D3 to glow means that the batteries are run down and need to be replaced.

Some transistors made to operate at high frequencies often have a fourth, or shield, lead also coming out of the case. Trace this wire by setting your VOM to its RX1 setting and connect one lead to the transistor case. The other multimeter lead is briefly touched to each of the four transistor leads. The shield lead will show zero ohms. Bend this lead out of the way before inserting the transistor into the tester.

PARTS LIST

B1—Two 1½ V AA penlight cells in series
D1—Silicon diode (1N4004, 1N2071 or equiv.)
D2,D3—Light emitting diode (Monsanto MV50A) See note below.
M1—0-1 ma. DC meter (Lafayette 99R 50528 or equiv.)
Resistors: ¼ watt, 5% unless otherwise noted
R1,R4—100 ohms   R2—330 ohms
R3—47 ohms   R5—330,000 ohms
R6—150,000 ohms
S1—6-pole, 2-position nonshorting rotary switch (Centralab PA-1018 or equiv.)
S2,S5—Subminiature push-button SPST switch (Alcoswitch MSP-105F or equiv.)
S3—Subminiature push-button DPDT momentary switch (Alcoswitch MSP-205R or equiv.)
S4—Subminiature toggle SPDT switch (Alcoswitch MST-105D or equiv.)
1—Transistor socket (Elco 05-3301 or equiv.)
1—2 cell battery holder (Keystone 140 or equiv.)
Misc.—4 x 2⅛ x 1⅝-in. aluminum cabinet, lens caps (see text), pointed knob, dry-transfer lettering, solder, wire, etc.
Note: LEDs D2, D3 available from: Circuit Specialists, P.O. Box 3047, Scottsdale, Ariz. 85257

The Listener

By C. M. Stanbury II

Hooking the Tops in Pops

DISTANT radio listening has spawned many branch hobbies and one of the most interesting is the collection of weekly record surveys from top-40 and other rock stations in the United States and Canada. This sideline may, in fact, be responsible for a steady increase in medium-wave BCB DXing in general.

The procedure for collecting surveys is essentially the same as for obtaining QSLs. When a station of interest is heard, a typed or neatly-written request should be dispatched, containing time, date and frequency of reception, description of signal strength and interference, and sufficient program data to prove reception.

In that latter area the best procedure is to list two or three sponsors, the survey numbers of records heard or some combination. Be sure to include the exact time each piece was heard. Always send along return postage.

While both a QSL and record listing may be requested in the same report, you should not attempt to obtain more than one survey from each station contacted. In other words, once a station has been good enough to answer your request don't bother them again. Of course, some stations will not answer you at all. Despite these limitations, there are so many BCB stations from which surveys can be collected that you will soon build up a fascinating visual display from the ever-changing pop scene. Incidentally, a similar collection can be built up of program guides from TV and some FM stations.

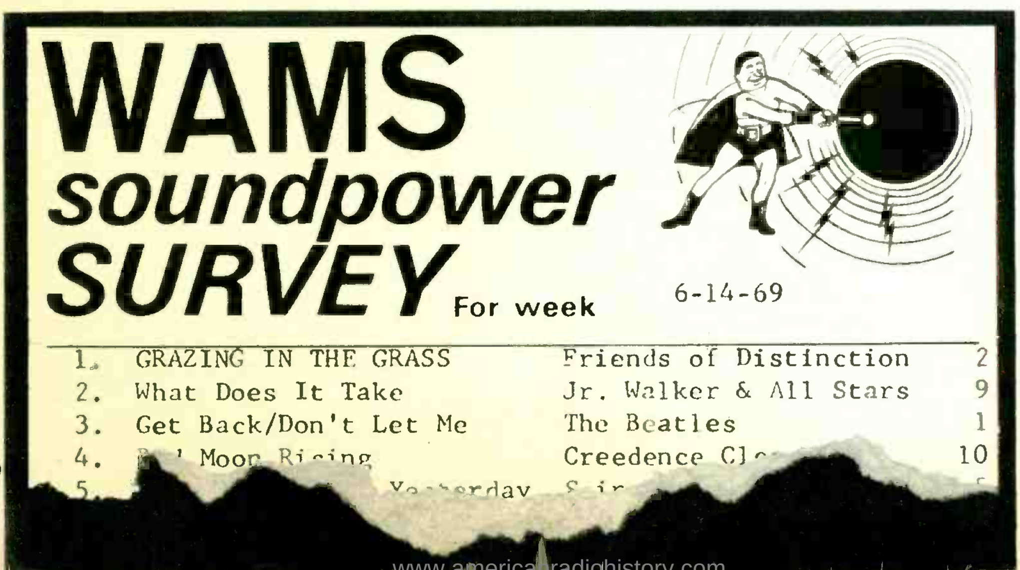
Santo Domingo Is Back. Ever since the days of General Trujillo, the tiny Dominican Republic has been of major interest to American SWLs. That interest was increased considerably by direct U.S. involvement in 1965. During that period one of the Pentagon's Flying Radio City portables (the same kind employed by the Voice of America in Vietnam) was used to set up a military broadcast station (HIFA) near Santo Domingo.

Now, after a couple years of silence, the Dominican Republic's own international broadcast outlet, Radio-Television Dominicana (HISD), has returned to 31 meters, where it can be heard with even the simplest of receivers on 9505 kc, at the lower edge of the band. Best time for a logging is during daylight hours when interference from more distant stations is at a minimum.

Meanwhile, according to reports from radio clubs, HIFA, the 1970s version of La

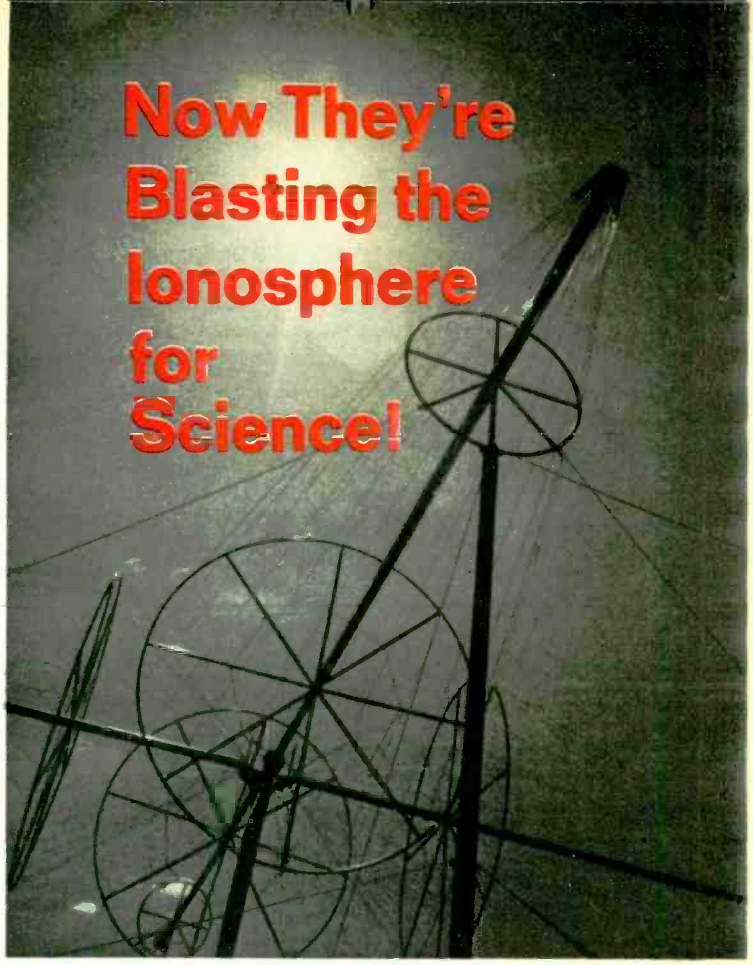
[Continued on page 100]

VINTAGE '69 record survey from WAMS, Wilmington, Dela., is typical of prizes now sought by SWLs.



1.	GRAZING IN THE GRASS	Friends of Distinction	2
2.	What Does It Take	Jr. Walker & All Stars	9
3.	Get Back/Don't Let Me	The Beatles	1
4.	[illegible] Moon Ri[illegible]ing	Creedence Cl[illegible]	10
5.	[illegible] Yesterday	[illegible]	[illegible]

Now They're Blasting the Ionosphere for Science!



Ever hear the story about the guys who zapped the ionosphere with 1.25 megawatts just to get an echo? Okay... It's being done to study electromagnetic pollution—a subject you're going to hear a lot about in the future.

By STANLEY LEINWOLL

ITS Photos

ANYONE who listens to the shortwave bands depends on the ionosphere for the propagation of frequencies from 3 to 30 mc. Broadcasters and listeners alike benefit from research that is carried out by scientific agencies on the ionosphere.

To learn more about the effect of high-power radio signals on the electrified layers in our atmosphere, scientists at the Institute for Telecommunication Sciences (ITS) located in Boulder, Colo., have been blasting this electrical path in the sky with 2-megawatt pulses that literally are poking holes in it.

Pollution Problem. Why belt a friend? Well, if you tune the bands, you've probably noticed that in spite of increased signal strength (put out by the transmitters of such biggies as Radio Nederland, Deutsche Welle and the BBC), shortwave bands—like 49 meters, among others—still are suffering from increased interference and overcrowding. At the present time, some 250 high-power transmitters (of 250 kw or more) either are operating, under construction or planned for the near future. Most of these transmitters will be concentrated in Europe.

Not only do some of these transmitters put out 250 kw, but broadcasters are hooking these rigs up to high-gain curtain antennas that have an effective gain of from 20 to 30db (i.e., gains of from 100 to 1000). This means the equivalent of 50 million watts of RF energy could be radiated into the atmosphere, some of it wiping out transmissions of neighboring broadcast stations and some of it undoubtedly heading directly into the ionosphere.

As the trend toward super-high-power broadcasting continues, the cumulative effect of all this radiation becomes a serious matter for those people concerned about our electromagnetic environment. Just as people today are concerned about water and air pollution, so scientists also are worried about the pollution of the electromagnetic spectrum. Government agencies in Washington have begun a study which will survey current use of the spectrum here in the U.S. Present-day

Overall view of ITS transmitter at Platteville. Ten 200-kw amplifiers hooked up in parallel can deliver 2 megawatts—if that much juice should be needed.

Now They're Blasting the Ionosphere for Science!

communications practices of commercial, military and government stations will be examined and recommendations will be made with an eye to preserving what's left of a valuable but limited resource.

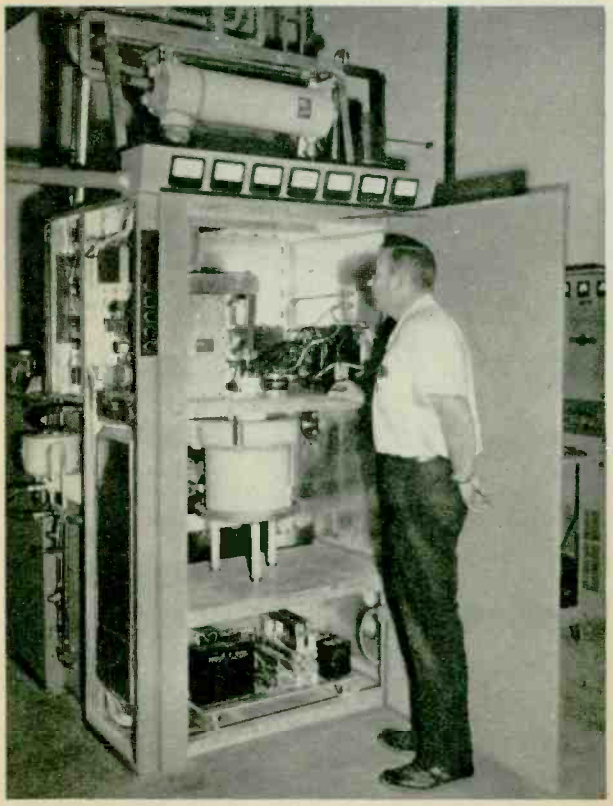
Obviously, experiments such as those being carried out at the Institute for Telecommunication Sciences are a positive contribution towards stopping electromagnetic pollution. There will undoubtedly be many more like them. Let's take a more detailed look at what the ITS is doing out in Colorado. There may be a lesson to be learned.

The Experiment: ITS engineers, under the direction of J. C. Carroll, have constructed a high-power transmitter that develops a 2-megawatt output from ten 200-kilowatt amplifiers connected in parallel. Each final stage in the transmitter (see photograph) uses a vapor-cooled tetrode. The transmitter, which is located at Platteville, Colorado, operates over a frequency range of 5 to 25 mc.

To develop a precise vertical beam of radio energy, an antenna of special design is used. It's a 10-element ring array, operating from 5 to 10 mc, whose elements are crossed broadband, conical dipoles. The overall gain of the ring array is nearly 17 db (a gain of 50), so the overall ITS transmitter/antenna system can develop peak radiated powers in the neighborhood of 100 million watts.

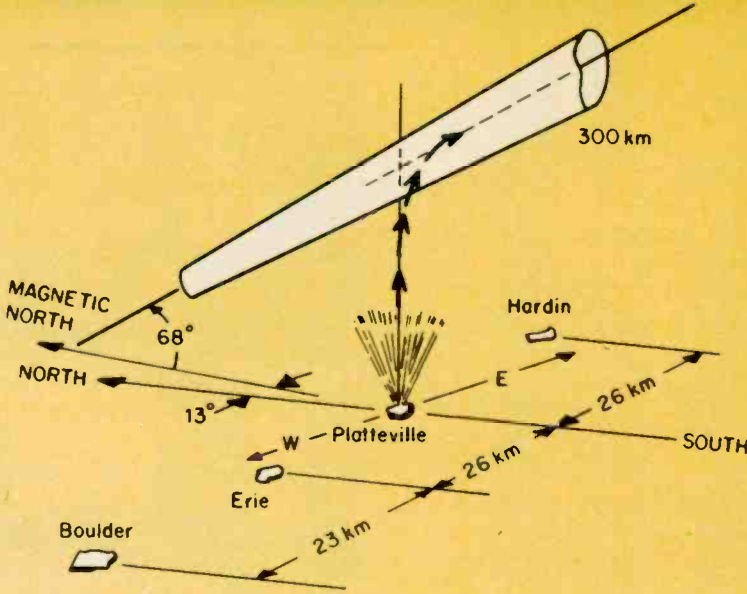
The effects of the Platteville transmitter on the ionosphere are measured by means of an *ionosonde*, a transmitting device that emits a succession of short pulses of radio energy over a wide range of frequencies, starting at 1.5 mc and quickly sweeping up to the vicinity of 10 mc. A receiver synchronized with this transmitter picks up these pulses and its output is fed to an oscilloscope display. These traces show which range of frequencies the ionosphere is reflecting at any given moment. Photographs of these traces are called *ionograms*.

The physical layout of the ITS equipment in Colorado can be seen in the diagram—the respective locations of the Platteville transmitter, the ionosonde transmitter at Hardin, and the receivers which are located at Boulder and Erie. The ionosonde sites were chosen specifically so that the reflection point in the ionosphere for a signal traveling from Hardin to Erie or Boulder would be directly over the Platteville transmitter.

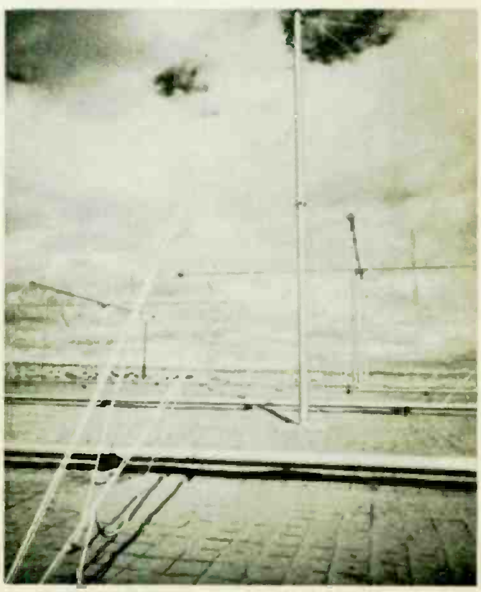


ITS scientist examines colossal final stage of one 200-kw amplifer unit that's part of transmitter. Vapor-cooled tetrode sits there looking fat and sassy.

Overview shows method used to monitor effects of Platteville transmitter on ionosphere. Ionosonde transmitter located at Hardin beams RF pulses at affected area in ionosphere which are received at Eire. Changes in ionograms give results.



A Big Bang? What happened to the ionosphere when the big ITS transmitter went into operation? Quite a bit. The ionosphere consists of layers of electrically charged particles (ions plus free electrons) which range in altitude from about 100 to 600 kilometers (60 to 360 mi.) above the earth's surface. Most important regions in the ionosphere are the E layer, which is fairly stable at an altitude of 100 kilometers, and the F layer which can vary in altitude from somewhere in the neighborhood of 200 to 600 kilometers.



High-gain antenna used by ITS has 10 crossed conical dipole elements arranged in a ring. Overall gain of this skyhook is about 17db (gain of 50).

Under normal conditions, the E and F layers will reflect radio waves in the shortwave region of the spectrum. Because of its altitude, the F layer is more important for shortwave communications—it makes reliable long-distance reception possible. The E layer plays a role in short-skip propagation.

As we mentioned, the ionosphere can reflect a wide range of frequencies, starting at about 3 mc and ending typically at 30 mc. As the ionosonde frequency increases, a gradual upward curve begins to appear in the ionogram until finally no further trace appears.

The frequency at which no trace can be seen is called the *critical* frequency. It represents the highest frequency which the ionosphere will propagate at a given moment. This information is vital to high-frequency communications because it reveals the highest useful frequency that's available over any given circuit. (The ionogram also shows traces from second-hop reflections in the ionosphere. These are signals that have bounced off the ionosphere twice; they make it appear that radio signals are coming from a greater height than is actually the case.)

The ITS experiments show that within minutes after the Platteville transmitter is turned on the critical frequency is lowered. The ionosphere will not propagate certain frequencies which moments before it could.

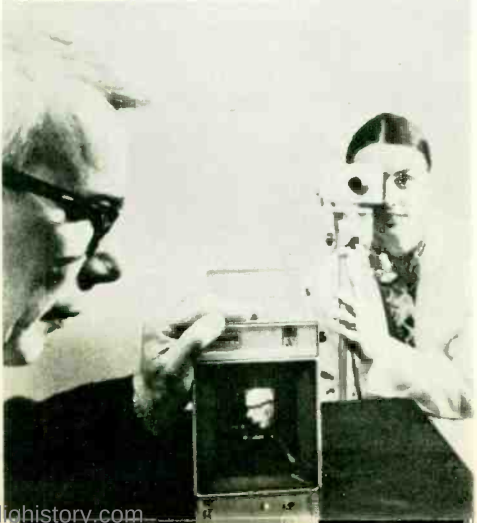
On the evening of April 30, 1970, for instance, the Platteville transmitter was putting out about 1.25 megawatts at a frequency of

[*Continued on page* 98]

BIG-SCREEN COLOR. If anything can turn the videocassette player into a consumer product for home use, it may well be Sony's new video projection system. Providing 30 x 40 in. of viewing area, the projection system offers the same color reception as Sony's Trinitron color picture tubes (by using new hybrid phosphors), but on a larger scale. While price (approximately $2,000 for system and $250 for screen) is a bit out of sight, volume production may soon bring it within reach of the consumer. Sony first will take aim at the industrial/institutional market, just as it is doing now with its videocassette player.

Electronics in the News

Video from a Chip. TV cameras of the future were recently demonstrated by Bell Labs (left) and RCA (shown below). New solid-state technology called charge coupling is responsible for both of them. Charge-coupled devices (CCDs) are flat chips of silicon containing arrays of metal electrodes which pass signals along in bucket-brigade fashion proportional to amount of light falling on each element. Scanning is done away with.



A Letter to Our Readers:

For almost 15 years EI and its readers have been carrying on a conversation about one subject of abiding interest—electronics as a hobby. As we have said, electronics is exciting fun when pursued from a hobby viewpoint. Through the years both electronics and publishing have undergone change until it now has become most practical for EI to merge with its companion publication, Mechanix Illustrated.

This is the last appearance of EI as a separate and independent publication. Beginning with the November issue of MI, material that might have appeared in these pages may be read in our companion publication instead. Those who subscribe to EI will receive the balance of their subscriptions in copies of MI.

We hope newsstand readers also will give consideration to Mechanix Illustrated including Electronics Illustrated, the name of the new combined publication. Though all of EI will not be reincarnated in the combined publication, I do believe the combination will mean high-quality construction and feature articles in the electronics area for the new, combined magazine.

If you have questions, please feel free to write to me. I have served as Editor of EI these past 12 years and of both MI and EI since 1963. I shall continue as Editor of the MI/EI combination. Though I shall miss the club-like atmosphere and special insider's language enjoyed by EI's readers and its editorial staff, I believe you'll find our combined publication especially rewarding in its own way.

Cordially,

Robert G. Beason

Robert G. Beason
Editor

What's Happening to Ham Radio?

By LEN BUCKWALTER, K1ODH

BIGGEST thing to hit ham radio in 15 years! Those words from one old-time ham describe the remarkable success of FM repeaters—hill-top robots that snatch up pipsqueak signals and fling them over the horizon.

But as FM hogs the spotlight, other developments are shocking new life into ham radio. Some examples: Hams are now transmitting *color* pictures on slow-scan TV. They're beating their worst natural enemy—a dying sunspot cycle—more effectively than ever. And hams today stand at the brink of their greatest adventure. It's the launch of the first communications satellite for Everyham, not just a few aerospace engineers.

Here's what's being heard through hamdom:

FM Follies. The stampede to get on 2-meter FM and enjoy repeater operation continues. Hams pioneered mobile radio more than 30 years ago but never has QSOing from a car been such sheer delight. With the boost of a repeater and quiet VHF frequencies, noise and QRM are nearly gone. Plenty of gem-like, inexpensive equipment spills out of factories and surplus gear is plentiful. The latest transceivers transmit on one frequency and receives on another. Can all this continue?

Rumbles of discontent are being heard in repeater-land as some hams squat on channels already occupied by other stations. The threat of rising interference means that some form of frequency assignment is inevitable. Whether hams themselves will do it or await directives from official sources is a big question. One highly-placed FCC official has been quoted saying that hams should do the job of frequency-coordination themselves. That's exactly what may happen, since hams can marshal tremendous skill in working out their own problems with little government interference.

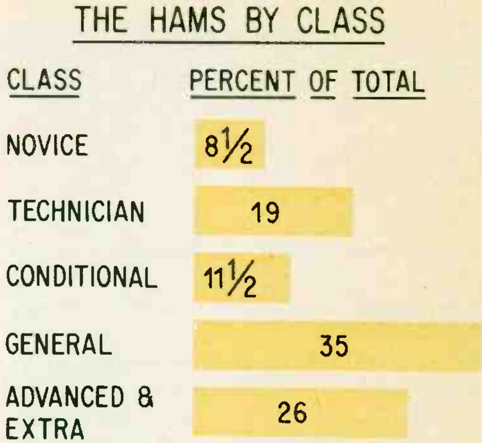
The Clown Banders. The amazing growth of 2-meter FM has aroused even greater friction between ham and CBer. Thanks to the joy of repeater operation, hams are looking to 220 mc for more of the same. This band now stands threatened under a proposal to chop away a meaty slab (2 mc) for CB. So ham publications continue to characterize the average CBer as something like beer-bellied Brutus in the Popeye cartoon. But the hams' indiscretions also appear in the same journals. An Illinois ham recently wrote this about a DX contest: "Never heard such obscene language used on the amateur bands before in my life—not to mention the dirty-name calling exchanged between U.S. and foreign amateurs."

Justice Goofs. How ever a ham decides to break the law—by out-of-band operation to catch DX, a chirpy CW signal or some other transgression—he can expect a curious rise in FCC prissiness. Two recent examples reveal why. One ham received a violation notice from an FCC monitor because he allowed his wife to say hello to a foreign ham he was working. What's wrong with that? Seems there's a restriction against working third-party traffic with that country.

The other instance of bureaucratic balderdash happened in Detroit, where FCC men called in station logs to spot-check whether hams there were doing their bookkeeping. Sure, it's the law but c'mon, fellars, there's much bigger game roaming radioland. One new development from the FCC, though, *is* reasonable. The theory part of ham exams is shifting toward more solid-state circuits.

CQ Polaroid. If hams are guilty of silly misdemeanors, they're acquitting themselves grandly in the new-projects department. A pioneering spirit, perhaps their most valuable

This rig, Regency HR-212, transmits on one frequency, receives on another via split selector.

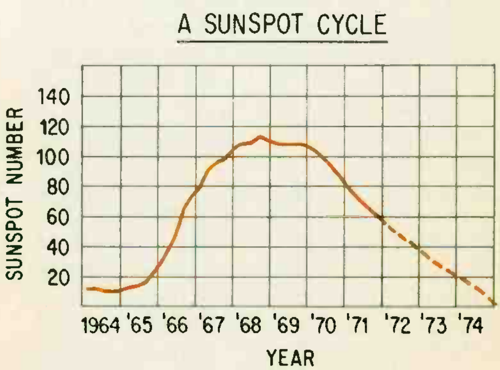


After holding initial license for two years, Novice ham may move up to a higher grade. Many Novices eventually reach General classification.

Slow-scan TV is fast becoming hamdom's hottest topic. Image above is being sent 4,000 miles.

asset, is not only alive and well but downright exciting. One of the latest developments is SSTV, or slow-scan television. The idea isn't new, but it's quickly winning converts on every continent. It's not the familiar live-action TV, which hasn't gripped the ham community because high transmitting frequency (420 mc) makes it strictly a local affair. (The signal must be high because it's much too wide for the lower bands.)

SSTV, on the other hand, is now being transmitted on 20 meters to more than 50 countries around the world and it needs no more width than a regular voice channel. SSTV's limit is that it can work only on still photos. It's been compared to viewing a slide show since one complete frame is transmitted



Number of sunspots in a given year largely determines propagation of transmitted signal.

every 8 seconds. The latest development sends color images by separating a scene into primary hues (red, blue and green) and sending one at a time. The image is recreated on a familiar Polaroid color camera.

SSTV equipment is still quite costly in commercial form—about $1,000 for a complete setup, plus your existing sideband station—so it's still a status symbol of the affluent. But, like single sideband, which also began as a costly item it should eventually be cheaper.

Talking about sideband, this mode of transmission has almost completely taken over the lower phone (voice) bands. One ham remarked recently that he tuned in 20 meters and was amazed to hear two old-fashion AM stations amid the sidebanders.

Houston, This Is Apollo. Millions heard those words from the moon, but a couple of hams did it the hard way. In a dazzling display of technical pluck and knowhow, they intercepted signals directly from the lunar spacecraft and heard live voices from the moon. It was nearly a replay of Marconi 70 years ago, when the experts said it couldn't be done. The hams faced tremendous odds of low transmitter power (the spacecraft emitted only 13 watts), high frequencies about 2300 mc) and great distance (a quarter-million miles). But on August 4, 1971 K2RIW pointed a homemade dish with the ridiculously small diameter of 12 ft. at the moon—and recorded astronaut voices

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Hi-Fi Today

By Robert Angus

2+2=6?

THERE are times when 2 + 2 do not equal 4 but are more likely to come out 6 or 8. One of them is when a new technique, called *power bridging,* is applied to four-channel amplifiers and the amplifier sections of four-channel receivers.

Power bridging (or strapping), involves the wiring of two amplifier sections (usually front left and rear left, or front right with rear right) in series for two-channel use. Suppose, for example, your four-channel receiver has four 20-watt amplifier sections. By coupling any two for two-channel use, you should have 40 watts at your disposal in each channel. In fact, because of the efficiency of the circuit, you're more likely to get 50 watts.

Power bridging is available on new four-channel receivers from Harman-Kardon, Fisher, Sony and Toshiba, among others, at prices starting at around $300. A front-panel control switches easily from two- to four-channel operation.

The advantages of such an arrangement are obvious to audiophiles interested in equipping themselves for four-channel operation, but have a large library of two-channel program material. It's possible to use one of these receivers as a relatively high-power two-channel receiver and then, at the flick of a switch, convert the entire system to four-channel operation.

Interestingly enough, while power bridging provides benefits with virtually any speaker system, it works best with 8-ohm loads. In the case of a 20/20/20/20-watt receiver, for example, at 4 ohms power bridging delivers two 50-watt channels. But at 8 ohms the same circuit delivers 32/32/32/32 watts, or two channels of 90 watts each.

POWER bridging means 4 amps drive either 2 or 4 channels and is feature of Fisher's 504 receiver.

For nearly 20 years the trend in high-fidelity prices was down. As manufacturers effected economies in manufacture and perfected things like printed circuits, IC chips and the like, audiophiles reaped the benefit in terms of lower prices. For example, in 1961, a modest 40-watt stereo receiver would have cost you $369.50. Ten years later, you could have gotten a better rig from the same manufacturer with more power and higher tuner sensitivity plus a host of new controls and connections for $199.95.

Now, it seems, the trend in audio prices is upward again, particularly for items made in Japan like stereo receivers and tape recorders, but also for other imports such as German-made microphones and British automatic turntables. The reason: the international monetary crisis (which doesn't appear to be over yet) and rising labor costs in Japan and elsewhere. In fact, the cost of making high-fidelity equipment in Japan has gotten so high that some American and Japanese manufacturers are producing components and tape equipment in places like Taiwan, Korea, Hong Kong and Mexico.

When President Nixon devalued the dollar it meant that importers had to pay more for the record changers, speakers and other products they bring into the U.S. At the same time, Japan revalued the yen upward—making a difference of up to 20 per cent between what they had been paying last year at this time and what they're paying now. Result: the receiver which used to sell for $199.95 now costs $229.95 and doesn't contain as many features.

Because some experts see further currency revaluations as a distinct possibility, it's altogether possible that still higher component prices may be in the offing. What can the hi-fi shopper do to minimize hi-fi inflation? Well, here are a couple of suggestions:

● If you're planning a component or tape purchase sometime in the next 12 months,

[*Continued on page* 99]

The Ham Shack

By Wayne Green
W2NSD/1

Fast Pace for Slow Scan

ONE of the biggest surprises of the Dayton Hamvention was the emphasis on slow-scan television. The forum drew the largest crowds of all . . . probably more than 500 in attendance . . . and most of them on SSTV already.

The slow-scanners had a tremendous exhibit of homemade monitors and cameras. Robot Research was there with a demonstration booth and a new outfit, J&R, was showing a low-cost monitor.

There are 50 countries on slow scan as of this writing, with more coming on all the time.

I've been active on slow scan during the last few weeks. I've worked all continents and I'm up to 24 countries so far. I don't know how to tell you about the excitement of actually seeing the chap you are contacting—seeing him smile, wave to you, hold up a QSL, signal reports, etc. Some slow-scanners have worked up interesting programs of slides and show them via tape recordings, slides of themselves, the shack, the wife, the kids, the town, a map locating the town. Some show Snoopy cartoons, some show Playmates. Many are imaginative.

My contact with EA8CI in the Canary Islands was particularly interesting since he spoke no English and the entire contact was made with video-pictures and signs. I predict a big future for slow-scan television.

The most efficient use of the FM channels available on 146 mc can be made when all repeaters have the same spacing between input and output frequencies. While 600 kc has been the accepted standard for some time, almost half the repeaters in the country were not using this standard as of one year ago.

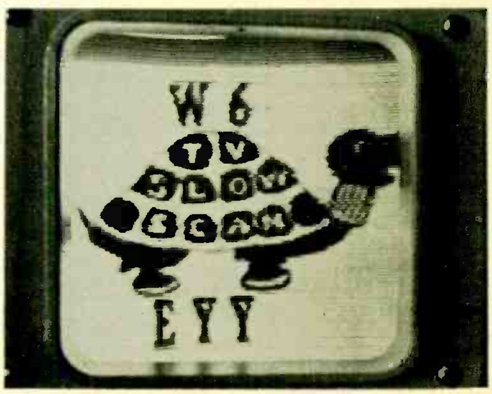
Standardized repeater spacing not only means there can be more repeaters in a given area without serious interference, but it also makes the buying of crystals for transceivers simpler. From my nearby mountain I could hear repeaters coming out on 146.76, which had inputs on 16 (shorthand for 146.16), and that being WA1KGM, on 22 (WA1KGK), on 25 (K1MNS) and during skip on 34 and 52. Several New England repeaters used the 25 input, such as WA1KGQ 25-79. Other interesting and conflicting pairs were 13-73, 37-73, 37-97, 19-94, 46-94, 01-64, 04-91, 31-91, 31-88, 28-88, 19-73, 11-61, 13-85, 22-32. It was awful.

Early this year repeater operators started getting together to work out problems and trade channels. This was carried out in a series of meetings in Pennsylvania, Massachusetts and Connecticut.

This may be hard to believe, but every repeater in the Eastern U.S. is now on 600-kc frequency splits. Dozens of repeaters had to change channels, some with as many as 400 users, so it was difficult. The fact that it was accomplished at all is an important statement for the ability of hams to cooperate.

Amateurs *can* run themselves. How much better to get together in a few meetings and get this done than to petition the FCC and then hassle for five years as the thing goes through the slow administrative process, finally ending up with something none of us needs or wants and creating oceans of ill will. The situation that brought on the request for legislation would probably be gone long before any action could come from Washington, anyway. We can solve our prob-

[*Continued on page* 99]



Coming on strong with hams is slow-scan TV. This is a turtle display from transmitter of W6EYY.

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Electronic Bongo

Continued from page 49

portion of the circuit consists of four diodes arranged as a bridge modulator, a two-transistor switch and load (pot R13).

Incoming squarewaves charge up electrolytic capacitor C6 via diodes D3-D6. Transistors Q5 and Q6 draw their operating voltage from C6.

So long as the touch plate is left alone, zero voltage appears across pot R13 *(Volume)* and looks like a straight line, or DC waveform.

Whenever the touch plate is struck, spurious AC signals appear at the base of transistor Q6. These signals are amplified by Q6. Further amplification is provided by transistor Q5, which is biased to be overdriven by the touch-plate generated AC signal. As Q5 saturates, capacitor C6 discharges.

At this instant, two things happen in the modulator. The voltage waveform appearing across R13 changes shape from straight line to square wave. Capacitor C6 also begins to recharge from the square waves rectified via the diodes.

Of course, as C6 begins to charge, square waves flow through components R10, C5 and pot R13. What you hear is the square waveform first building up quickly to a maximum voltage level and then logarithmically decaying back to zero. This is how the sound of the percussion instrument is simulated.

Building the Bongo. A piece of 2½ x 5-in. perfboard was used to mount all components except pots R13 and R14. Eyelets were inserted into the board and serve as convenient soldering points.

The touch plate is fabricated from a piece of sheet copper having the same diameter as the top of the bongo drum. Cut the plate into the shape shown in Fig. 1. The two parallel sides are about 3-in. apart.

After you cut the touch plate to size, cement it to the bongo top. Remember to leave a strip on one side of the copper plate. This strip eventually slips under one of the tacks holding down the bongo top fabric. It serves as the contactor terminating one end of a length of shielded cable. The cable's other end is soldered to Q6.

Both pots were epoxied to the drum. We suggest that you prewire the pots before gluing them down.

Last step is to drill a hole in the bongo for the output cable. It can be cut to any length up to 3 ft.

To operate the Electronic Bongo, plug it into the auxiliary input socket on your hi-fi and advance S1 to its *on* position. You should not hear anything in the speaker. Advance the volume control and start tapping the bongo's touch plate. Depending upon the setting of pot R14, the tones produced should simulate a percussion instrument.

DX Guide to Armed Forces Radio

Continued from page 46

the globe's mid section.

Much tougher is AFNT, American Forces Network Taiwan. It's headquartered in downtown Taipei, the capital of Taiwan. Shortwave frequencies are 3,990 and 7,215 kc. Powers are low—1000 watts each—and both operate within the ham bands where QRM is severe.

Of the hundreds of local medium-wave AFRTS outlets, only a handful are heard in the U.S. Among these are MW stations of the American Forces Caribbean and Southern Command Networks.

The Navy operates one at its Guantanamo Bay base. Gitmo broadcasts on 1340 kc seven days a week, 24 hours-a-day. It can be heard best in the southeastern corner of the United States, and only rarely elsewhere. The best time to try is early Monday morning, when most other stations are off the air. It identifies simply as AFCN. Programming is usually local dee-jay shows and the CBS Young Sound network feed.

In the Canal Zone, there are a pair of stations belonging to the Southern Command Network. These are 790 kc at Ft. Clayton and 1420 kc at Ft. Davis, which operate day and night with parallel programming. They have been heard by some listeners during the midnight to dawn period, when propagation conditions caused by the Aurora Borealis (Northern Lights) tend to block out other, more northerly signals which normally cover the channels.

If you're a dyed-in-the-wool medium-wave DXer, there's plenty of challenge in trying to log these regional and local stations. If you take your DXing more casually, there's still a lot of good listening to be had from the powerful shortwave stations of the American Forces Radio and Television Service.

Good Reading

Continued from page 76

includes a chapter on foreign TV standards. Published by TAB Books, the 420-page softcover sells for $6.95.

Any experimenter worthy of the name wouldn't be caught without his test leads—or transistor substitution guide. The ability to switch transistor numbers in a circuit turns a junkbox into a gold mine, or completes a circuit at 3 a.m. when you don't have an odd 2N3613 lying around. An excellent aid in the gentle art of transistor juggling is the latest guide from International Rectifier. The Company's **Semiconductor Cross Reference and Transistor Data Book** lists thousands of transistors and related components, then shows how to replace them with relatively few IR numbers. We put it to the test by recalling the oldest transistor in memory—the benevolent CK722—which appeared over a decade ago at about $20 a piece, then dropped to about 20 cents as manufacturers improved their skills. Today the CK722 is as rare as a whale-bone corset, but survives nonetheless as the IR TR-05. It's handy to know if you build fossilized projects from old magazines. There's no cover price on this manual, which should be available at a local IR dealer.

The **IEEE Standard Dictionary of Electrical and Electronics Terms** could be the worst publishing mistake committed by our greatest engineering society. Although billed as the work of authorities in 31 different fields, page after page is filled with outright error, glaring omission and, worst of all, a crippling lack of clarity. Let's examine some examples. If you wish to look up important terms like *synchronous detection* or *X-band*, forget it, they're simply missing. Read the definition of *shadowmask*, a major item in any color TV, and you'll find it incorrectly described as an electrically conductive electrode. Many other definitions are awkward because they were apparently written by people from far afield.

For example, a dimming resistor should be called a rheostat, and a deflecting yoke is always called a deflection yoke. The illustrations show poor logic. An important image in electronics, the sine wave, is not pictured at all, while the bacteria-killing ability of ultraviolet light wastes a quarter-page chart. Sloppy hi-fi definitions may insult the serious audiophile. The term *wow*, for example, is defined as a "slow periodic change in pitch or low frequency flutter due to nonuniform rate of reproduction of the original sound." The terms flutter and nonuniform are simply wrong when applied to wow. Certain definitions meander into drivel: "Marker-beacon receiver—a receiver used in aircraft to receive marker-beacon signals that identify the position of the aircraft when over the marker-beacon station." The cruelest blow: electricity is never defined. This $19.95 book does contain valuable information, but sorely needs a major overhaul before it can meet its claim as an official standard.

How To Repair Your Own Cassettes

Continued from page 71

tape but also the cheaper splicing tapes.

In addition to the poorly made cassette, there are a number of faults which slip past even the most conscientious manufacturer. One of the most common problems is pressure pad trouble. Pads that come unglued, develop broken springs or an assembly that's simply out of place all mean you'll have to open the cassette to correct the trouble. After breaking open or unscrewing the shell, use a small screwdriver or nail file to lift the pressure pad out of the lower shell.

If all the pad needs is repositioning, you can do so with a little patience. If the pad has come off the spring, or the spring itself is broken, simply insert new ones.

What happens to tape wound around the capstan or pulled off the tape pack and tangled in the hub inside the cassette? It can be saved, in most cases. Unless there are tiny tears along the edge of the tape, or it looks stretched out of shape, flatten the tape out and rewind after splicing.

But unless you're trying to save a particularly valued recording, you might be well advised to cut off any damaged portions. Reason is, minute tears could develop into tape breaks at a later date. And folded or mangled tape never sounds quite right afterwards. It's simply impossible to regain proper head-to-tape contact once the tape has been folded and crinkled. If you cut off such damaged portions you'll have a cassette that's perhaps a minute or two shorter than the advertised length, but perfectly satisfactory for a new recording of music or anything else.

Simple Phone Patch For Hams

Continued from page 61

on our microphone. You may need a different type of connector. Lettering for front-panel components is easiest to apply if hardware is removed temporarily before you apply the letters.

Wiring is point to point. Be sure to slip a solder lug under the mounting foot of transformer T1. This lug serves as a ground point. We also soldered the mounting foot of a two-lug terminal strip to T2. This strip accommodates one lead from capacitor C3 and one of the conductors that connects the patch to the phone line.

Both capacitors C1 and C2 and resistor R1 are supported by the leads. Connections are made between S1, pot R2 and J1 with scrap lengths of wire left over when the transformer leads are trimmed.

Using the Phone Patch. After your wiring is done, make appropriate connections to your receiver. Bring out the proper leads from the telephone terminal block and connect them to the phone patch. The colors of the phone wires are usually red and green but the lead that normally is green is sometimes black. You have the correct pair of wires when you can hear signals from your rig in the telephone receiver. The phone patch switch should be in the *listen* position.

To test the patch in the transmit mode, connect the phone patch to your transmitter or transceiver microphone connector. Plug the microphone into the socket on the front of the phone patch. Then call a friend on the telephone and make a contact with another ham.

Flip S1 to the *talk* position, adjusting the gain control for normal transmitter modulation while he talks. You may find that you modulate the transmitter more than your friend when you talk into the telephone. This is normal. Either turn down the patch's gain control when you talk or hold the telephone mouthpiece away from your mouth. You also can flip S1 off and work with your regular microphone.

One minor problem you may encounter is RF feedback. This happens when your transmitting antenna's coax runs parallel and too close to the incoming phone line. If RF feedback appears, insert a 2½-millihenry choke between S1D and the center lug of the gain control. Bypass both sides of the RF choke to the chassis with two 270 $\mu\mu$f mica capacitors.

Shack-related problems are more likely to occur than technical problems. For instance, never dial a phone number with the patch in the talk mode. The transmitted clicks cause unnecessary interference.

Keep the gain control turned down. Most complaints due to interference from phone patches are caused by transmitter overmodulation. Remember, too, that a phone patch does not entitle you to a clear channel on the air.

Blasting the Ionosphere

Continued from page 83

7.7 mc. Moments after the transmitter's energy was beamed straight up into the ionosphere, the electrically charged layers started to heat up and ionogram traces in the vicinity of 7.7 mc disappeared entirely. Two things occurred. The critical frequency was lowered and at even lower frequencies signal strength was reduced by almost 10 db (by a factor of 10). Also, reflections from the E region disappeared at frequencies above 2 mc.

Another phenomenon, known as *spread-F*, occurred at all frequencies. During daylight hours, the F region in the ionosphere actually is divided into two separate layers, F1 and F2. However, under normal conditions, reflections during night hours take place from a single height within the F region. If they should occur at different altitudes (due to spread-F) this results in weaker signals, increased fading and echoes in radio transmissions. This splitting of the F region at night becomes more pronounced at higher frequencies—beginning at a point where there are F-region echoes—and all signals then become diffuse.

This particular ITS experiment shows that the ionosphere lost much of its effectiveness as a propagation medium due to the 1.25 megawatts of energy which the ITS transmitter produced. Also, this high-power radiation affected a 60-mile cross section within the ionosphere. Experiments carried on during daylight hours confirm these results.

For the moment, scientists at ITS are unable to explain many of the strange phenomena that have occurred. Researchers all over the world are watching the events at Platteville and an electromagnetic clean-up campaign may yet be the result.

The Ham Shack

Continued from page 89

lems and we can do it quickly and efficiently.

One of the benefits of standardized spacing is that it is no longer necessary to switch from one crystal to another when you are traveling. The rig with a 22-76 channel and a 25-79 channel required fast switching when you passed through a 22-79 area or a 25-76 area. Now all repeaters are on channels with the same splits: 01-61, 04-60, 07-67, etc. You can use your 13-73 pair in Maine, New York, Washington and a dozen other places. Ditto most other pairs.

The increase in repeaters has made more amateurs think in terms of getting 12-channel rigs. And even a 24-channel set is starting to sell. For myself, I set up two 12-channel transceivers in my car for a while, then managed to get a 22-channel station and find that it meets my needs up here in New Hampshire. Twenty of the channels are being used. As soon as two more repeaters go in I'll have to look for a bigger set . . . or go for a frequency synthesizer.

Hi-Fi Today—2 + 2 = 6?

Continued from page 88

make it now before prices rise after Jan. 1. ● Don't buy more power in an amplifier or sensitivity in a tuner than you really need. ● Since the greatest price increases are on imported items, you just might find domestic components a better buy. The brand name on a piece of high-fidelity equipment alone doesn't tell you its country of origin. If you're really interested, ask the dealer or examine the chassis. If it's not made in the U.S., it's supposed to carry the information about where it comes from.

Unlikely as it may seem, Japanese manufacturers like Sony and Panasonic actually are looking for American products—presumably including hi-fi components—to export to Japan. And they and others are building factories in Canada, Mexico and San Diego to build home-entertainment products right on our doorstep. Finally, would you believe that an American manufacturer (Admiral) actually is making home electronics for a Japanese company (Toshiba) for sale in the United States under the latter's brand? The times, they change!

The Listener

Continued from page 80

Voz de la Fuerzas Armadas, which has been off the air a while, may return around 1600 (last heard by us on 1597) and 4825 kc. HISD is a good verifier but HIFA issues QSLs erratically. For addresses, all you need is the station, city and country.

Elusive Challenge. From September through March a substantial darkness path around sunset EST runs from Eastern North America across the polar region to East Asia. This produces signals from Radio Peking around 2200 EST on frequencies as low as 90 meters.

In fact, many DXers believe that a medium-wave logging from the Far East is possible during this period, although none has ever been confirmed. Unfortunately, QRM at that time of day on the MW broadcast band makes the trying difficult. On the other hand, certain non-standard broadcast frequencies between 2 and 3 mc (everything from 300 through 3000 kc is medium wave) look promising, especially R. Pyongyang (North Korea) on 2850, along with Red Chinese outlets on 2800 (listed as Fukien) and 2200 kc (listed as Foochow).

The proper procedure is to watch for R. Peking on 3450 or 3220 kc. When it appears on either frequency, check for those rarer channels below 3 mc.

Briefly. One of the few domestic phone services still using shortwave frequencies is operated by the British Columbia Telephone Co. During the hours of darkness watch for transmitters at coastal locations on 4820 and 4865 kc. Needless to say, there will be plenty of QRM from 60-meter SWBC stations, particularly HRVC at Tegucigalpa, Honduras, on 4820. . . . Speaking of phone services, the U.S. Virgin Islands are one of the more difficult DX countries to log. Try for Bell's marine telephone terminal at St. Thomas (WAH) on 2506 kc. There will be QRM from similar stations at Boston, Delcambre, La., San Francisco and Eureka, Calif.

Propagation Forecast. Of the 20 sunspot cycles recorded since regular observations began in the 18th Century, this one, which began in 1964, is the most unusual. Most sunspot cycles last a little under 11 years. Sunspot numbers increase from minimum and reach a maximum during the first four years of the cycle. Then activity begins a decline, which continues another seven years, after which the cycle begins again.

This cycle, from November 1964 onward, has been unusual in that it has had two plateaus during which sunspot activity remained at a constant level.

For approximately three years beginning in 1968, sunspots remained around 100. During that time conditions were stable and the range of frequencies the ionosphere would reflect remained constant and predictable.

Then a decline in sunspot activity began and projections were that put the minimum cycle in 1975. Now sunspots appear to have hit another plateau. During much of this year they have remained in the mid-60s and this unexpected development has benefitted the listener and amateur alike because the higher the sunspot numbers, the greater the available spectrum space.

Conditions are expected to continue stable this winter with 15, 17 and 21 mc optimum for daytime DX and 6, 7, 9 and 11 mc good at night.

Pro Solder Center

Continued from page 67

By flipping S3 to the *Manual* position, however, automatic action is defeated. It enables you to use the iron at low power while it's off the cradle. Dial desired heat with R3 from zero watts to half-wattage with S3 in the manual mode.

Meter M1 monitors load voltage, while NE1 indicates when the power switch is turned on.

Building The Solder Center. Semiconductor Q1 is mounted to a 1½ x 3-in. piece of sheet aluminum. The 1⅛ x ⅝-in. mounting tab shown at the end of the SCR mounting bracket is bent as shown in the pictorial. Since the case of Q1 operates at full line voltage, it must be insulated completely from the heat sink. Insulation is provided by using the mounting kit supplied with Q1, and by following the installation instructions provided with the semiconductor.

Drill a clean hole in the aluminum bracket before mounting Q1. Remove all metal burrs to prevent puncturing the mica washers. Since line voltage is hazardous, another set of insulation washers is added for double protection. Instead of bolting the aluminum heat sink directly to the metal cabinet, use another set of insulating washers as shown in Fig. 1.

All items needed for both insulated mounting points will be found in any electronics mail order catalog. After the heat sink and fuseholder are mounted, check both items to be sure that their bare metal surfaces don't short circuit against other components, or touch the cabinet top cover.

Use ordinary hookup wire (No. 20 or 22) for the circuit except for leads carrying the load current. Wires in this part of the circuit should be at least No. 18. Two flexible leads (cut from an unused length of linecord) about seven inches long run from the main circuit to switch S2 in the top cover.

The cradle, which holds the soldering iron, is a piece of hardware commonly sold for mounting tools on pegboard. Buy the type having two 1-in. dia. loops, a 1½-in. separation between loops, and mounting prongs intended for pegboard holes spaced 1-in. apart. With a pair of pliers, squeeze one loop of the cradle so the iron won't slip through.

Since your soldering iron may differ from the model shown, dimensions for cradle size and location are not given. Hold your iron next to the cabinet and determine the best position for the cradle.

One cabinet hole is circular, while the other forms a slot to permit the cradle to swing and operate the switch. Some experimentation will determine the best position for S2. After S2 is fastened to the cabinet, place some insulating tape under its terminals to prevent possible short circuits against the metal cover.

Final Assembly. The diameter of the holes you cut in the top cover depends upon accessory items you choose. In any case, don't make holes so large that an accessory can drop inside the cabinet.

Add a small piece of perfboard next to the pilot lamp, as shown in Fig. 2. It prevents possible back-up of solder into the circuit while you're respooling the solder back onto its roll. The board is mounted by a small L-shaped bracket held under one of the pilot lamp mounting screws.

Cut holes for the solder roll so that the dimensions accommodate a standard roll of solder. When the roll is exhausted, a new one can be installed by unfastening the 6-32 machine screw that holds the wood dowel in place.

Finally, the sponge holder is fastened to the top of the cabinet. It's a piece of aluminum measuring 3 x 1½-in. with one hole drilled for a retaining screw. Before tightening the screw, place a folded piece of sponge under the bracket. Tightening the screw forms the desired V-shape. The sponge is dampened with water before it's used.

Operation. First time the circuit is turned on, make a quick check with a 100 watt incandescent lamp plugged into SO1. Flip S3 to *Manual* and turn the heat control knob throughout its range. The lamp should glow from dark to partially bright.

Flip S3 to *Auto* and remove the soldering iron from the cradle. With S3 closed, the lamp should go to full brightness.

Some experimentation reveals the best setting of the heat control for your specific soldering iron. Adjust R3 to some meter voltage until you see the iron just start to melt solder. Then, when the iron is lifted from its cradle, it should only take a few seconds to reach full operating temperature.

In our model, we used a 50-watt iron. When the meter is set to read 70 VAC, solder touched to the tip of the iron just begins to melt. Lifting the iron from the cradle produces full voltage and maximum heat in about three seconds. Whenever you remove your iron from the cradle, jiggle it once or twice to assure positive operation of S3.

Voltage indicated on M1 can give a rough indication of watts delivered to the iron. First, heat your iron completely, and then unplug it from SO1. Measure the resistance across the iron's plug with an ohmmeter. Our 50-watt iron measured 300 ohms.

Once resistance of the heating element is known, you can figure the approximate wattage at any voltage setting from the formula:

$$E \times E \div R = \text{Watts}$$

After multiplying indicated voltage by itself, divide the answer by the iron's resistance. For example, our iron can barely melt solder at 70 VAC.

Thus: $70 \times 70 = 4900 \div 300$, or about 16 watts. Since our iron idles at less than one-third the rated 50 watts, tip life is greatly extended. Dialing the heat control to 85 VAC, would provide about 27 watts—just the thing for delicate low-heat soldering jobs.

What's Happening to Ham Radio?

Continued from page 87

for nearly four hours. NASA was so delighted at the first independent station in the world to monitor its signals that the agency invited the hams for a personal tour of the space center. Now that this is history, hams are getting ready to take a crack at monitoring the coming Jupiter flyby and the 1975 Mars lander.

Oscar for Everybody. This is all prelude to what's awaiting a ham generation about to take the great leap into space. After five earlier Oscars (ham satellites inserted into orbit by NASA), the latest one scheduled for fall 1972 is the smartest moonlet yet. It will accept 2-meter signals and retransmit them to earth on 10 meters.

Talk about repeaters, this one will lay an entire continent at a ham's door. Oscar 6 will broadcast a signal over a 5,000-mi.-wide circle, minus the headaches of skip and other vagaries of the ionosphere. The package will ride 900 mi. high and float around the earth in sun-synchronous orbit to illuminate much of the earth on each revolution. Besides its great capacity and sophistication, Oscar 6 brings closer to reality than ever the dream of making a satellite accessible to average hams around the world.

Where can it lead to? This question was tackled recently by the top FCC man for ham affairs in Washington, D.C. Addressing a club, A. Prose Walker said the objective would be a ham satellite with these features: It would be accessible to hams without complicated tracking antennas on the ground. The orbit would be near geostationary, meaning it would appear to drift slowly around the globe and be available to hams everywhere for periods of several weeks or months at a time. Walker said the satellite's power would be in the 20-watt range and be able to handle about ten conversations by voice simultaneously (or 200 by code). Greatest use of such a repeater, he said, would not be rag-chewing or DX but to train young people in the techniques of satellite communications. By 1975, special purpose ham satellites might prove economically practical; a repeater for phone-patching, one for traffic-handling, another for DX and so on.

Sick Sol. The satellites should give DX-hounds a welcome shot in the arm because they're getting precious little help from the sun. The eleven-year sunspot cycle, which creates good propagation conditions on higher bands, is nearly bottoming out. Back in 1970 (see chart), the average number of sunspots was 89 for the month of November. The number dips to 63 for November 1971 and is predicted at only 39 for November

1972. Despite this sagging performance, DXers are faring better than they did over the last dip in the sunspot cycle. The reason is mainly potent signals. The average ham today is more apt to have single-sideband gear and a multi-element yagi or quad. They add as much as 10db to push signals through lousy band conditions.

Hardware. The chances are the 1972 ham's signals are generated by a factory-built transceiver, one of the most popular rigs today. Homebrewing isn't dead but the added complexity of sideband makes constructing your own trickier than during the crystal-set days. There are far more guts in today's sideband gear than in the super-regen inhaler and one-lung transmitter of old. Linears and other accessories continue to be popular homebrew items, and there are signs that project-building may be enjoying an upsurge.

The Ham Plateau. It is no secret that ham radio has reached a static growth rate and some accuse it of becoming an old-man's game. This charge is answered by the claim that nearly half of the 20,000 new hams each year are teenagers or younger. FCC-man Walker may have pegged the reason for the level-off when he said recently to a group of long-time hams, "Today's youngster generally is not thrilled by the same things that sent you and me into orbit 40 or 50 years ago." But the likes of slow-scan TV, ham satellites, FM repeaters and other exciting developments could inject many a new communicator into the ham groove.

CB in a Motor Home

Continued from page 50

tuning dial to channel 23 and again key the rig. If the SWR reading is lower on channel 1 than on 23, the antenna is too long. But if the SWR is lower on channel 23, the overall antenna is a bit short. This is a cut-and-dry method, but it worked for me.

After I reached my best SWR figure, I tuned the SSB-500 for maximum output power. Last tuneup step is to rock the tuning dial between channels 1 and 23, making sure that indicated SWR and output power doesn't radically change from one end of the band to the other. You may have to readjust the length of the whip, or repeak the transceiver RF output adjustment in order to reach an optimum setting for your particular motor home installation.

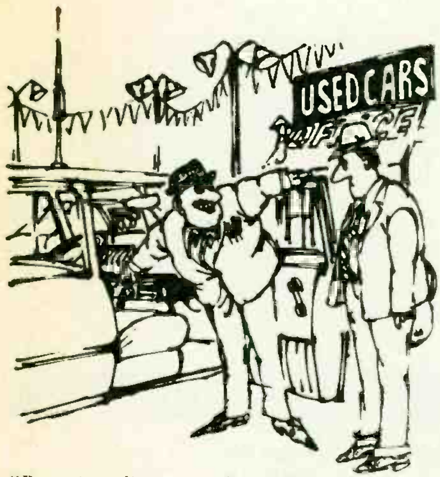
"What channel is the grapevine on?"

Over and Out

rodrigues

"I'm telling you guys for the last time. BREAK ON CHANNEL 9!"

"Lissen, don't youse guys sell no more channel 22 crystals. You unnerstand that?"



"Boy, just listen to those skips!"

"Using CB as a hobby—ME?"

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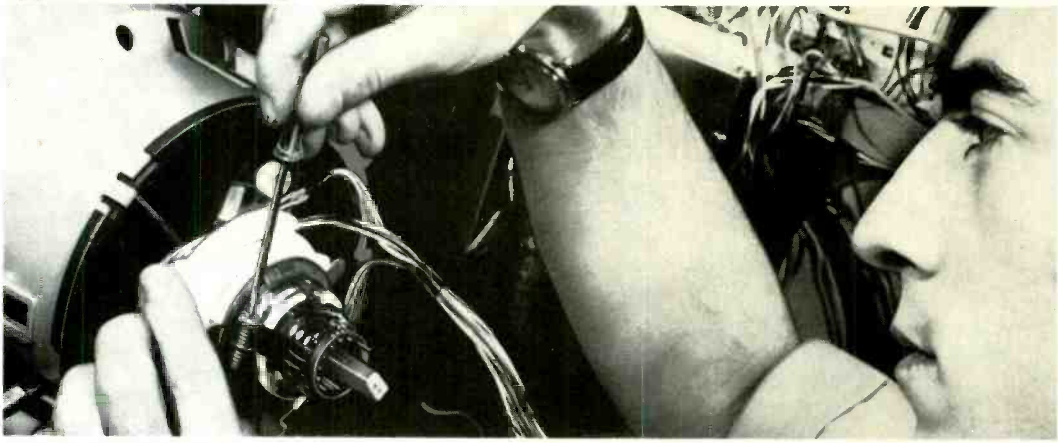

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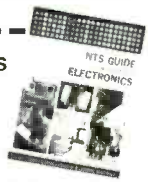

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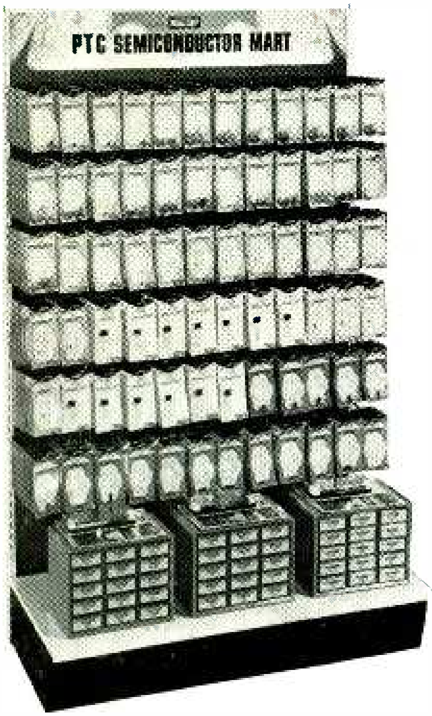

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