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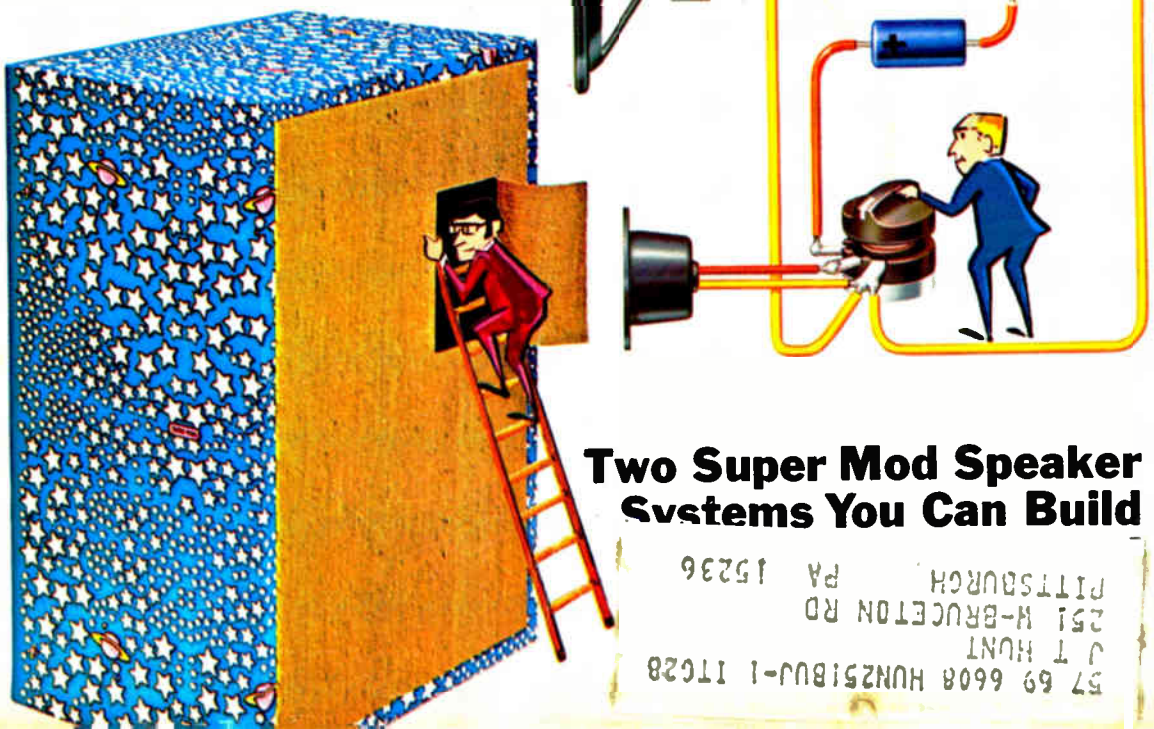

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I'd like to give this to my fellow men...

while I am still able to help!

I was young once, as you may be — today I am older. Not too old to enjoy the fruits of my work, but older in the sense of being wiser. And once I was poor, desperately poor. Today almost any man can stretch his income to make ends meet. Today, there are few who hunger for bread and shelter. But in my youth I knew the pinch of poverty; the emptiness of hunger; the cold stare of the creditor who would not take excuses for money. Today, all that is past. And behind my city house, my summer home, my Cadillacs, my winter-long vacations and my sense of independence—behind all the wealth of cash and deep inner satisfaction that I enjoy—there is one simple secret. It is this secret that I would like to impart to you. If you are satisfied with a humdrum life of service to another master, turn this page now—read no more. If you are interested in a fuller life, free from bosses, free from worries, free from fears, read further. This message may be meant for you.

By Victor B. Mason

I am printing my message in a magazine. It may come to the attention of thousands of eyes. But of all those thousands, only a few will have the vision to understand. Many may read; but of a thousand only you may have the intuition, the sensitivity, to understand that what I am writing may be intended for you—may be the tide that shapes your destiny, which, taken at the crest, carries you to levels of independence beyond the dreams of avarice.

Don't misunderstand me. There is no mysticism in this. I am not speaking of occult things, of innumerable laws of nature that will sweep you to success without effort on your part. That sort of talk is *rubbish!* And anyone who tries to tell you that you can *think* your way to riches without effort is a false friend. I am too much of a realist for that. And I hope you are.

I hope you are the kind of man—if you have read this far—who knows that anything worthwhile has to be *earned!* I hope you have learned that there is no reward without effort. If you have learned this, then you may be ready to take the next step in the development of your karma—you may be ready to learn and use the secret I have to impart.

I Have All The Money I Need

In my own life I have gone beyond the need of money. I have it. I have gone beyond the need of gain. I have two businesses that pay me an income well above any amount I have need for. And, in addition, I have the satisfaction—the deep satisfaction—of knowing that I have put more than three hundred other men in businesses of their own. Since I have no need for money, the greatest satisfaction I get from life is sharing my secret of personal independence with others—seeing them achieve the same heights of happiness that have come into my own life.

Please don't misunderstand this statement. I am not a philanthropist. I believe that charity is something that no proud man will accept. I have never seen a man who was worth his salt who would accept something for nothing. I have never met a highly successful man whom the world respected who did not sacrifice something to gain his position. And, unless you are willing to make at least half the effort, I'm not interested in giving you a "leg up" to the achievement of your goal. Frankly, I'm going to charge you something for the secret I give you. Not a lot—but enough to make me believe that you are a little above the fellows who merely "wish" for success and are not willing to sacrifice something to get it.

A Fascinating and Peculiar Business

I have a business that is peculiar—one of my businesses. The unusual thing about it is that it is needed in every little community throughout this country. But it is a business that will never be invaded by the "big fellows." It has to be handled on a local basis. No giant octopus can ever gobble up the whole thing. No big combine is ever going to destroy it. It is essentially a "one man" business that can be operated without outside help. It is a business that is good summer and winter. It is a business that is growing each year. And, it is a business that can be started on an investment so small that it is within the reach of anyone who has a television set. But it has nothing to do with television.

This business has another peculiarity. It can be started at home in spare time. No risk to present job. No risk to present income. And no need to let anyone else know you are "on your own." It can be run as a spare time business for extra money. Or, as it grows to the point where it is paying more than your present salary, it can be expanded into a full time business—overnight. It can give you a sense of personal independence that will free you forever from the fear of lay-off, loss of job, depressions, or economic reverses.

Are You Mechanically Inclined?

While the operation of this business is partly automatic, it won't run itself. If you are to use it as a stepping stone to independence, you must be able to work with your hands, use such tools as hammer and screw driver, and enjoy getting into a pair of blue jeans and rolling up your sleeves. But two hours a day of manual work will keep your "factory" running 24 hours turning out a product that has a steady and ready sale in every community. A half dollar spent for raw materials can bring you six dollars in cash—six times a day.

In this message I'm not going to try to tell you the entire story. There is not enough space on this page. And, I am not going to ask you to spend a penny now to learn the secret. I'll send you all the information, free. If you are interested in becoming independent, in becoming your own boss, in knowing the sweet fruits of success as I know them, send me your name. That's all. Just your name. I won't ask you for a penny. I'll send you all the information about one of the most fascinating businesses you can imagine. With these facts, you will make your own investigation. You will check up on conditions in your neighborhood. You will weigh and analyze the whole proposition. Then, and then only, if you decide to take the next step, I'll allow you to invest $15.00. And even then, if you decide that your fifteen dollars has been badly invested I'll return it to you. Don't hesitate to send your name. I have no salesmen. I will merely write you a long letter and send you complete facts about the business I have found to be so successful. After that, you make the decisions.

Does Happiness Hang on Your Decision?

Don't put this off. It may be a coincidence that you are reading these words right now. Or, it may be a matter that is more deeply connected with your destiny than either of us can say. There is only one thing certain: If you have read this far you are interested in the kind of independence I enjoy. And if that is true, then you must take the next step. No coupon on this advertisement. If you don't think enough of your future happiness and prosperity to write your name on a postcard and mail it to me, forget the whole thing. But if you think there is a destiny that shapes men's lives, send your name now. What I send you may convince you of the truth of this proverb. And what I send you will not cost a penny, now or at any other time.

VICTOR B. MASON
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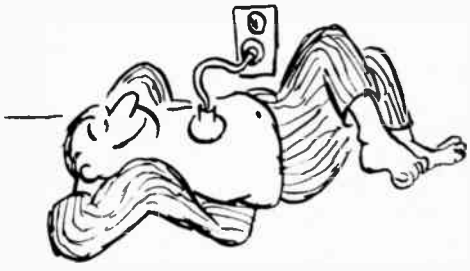
● **HAVE A HEART**



Sure, the electronic pacemaker for the heart is a marvel of engineering (THE CIRCUIT NOBODY UNDERSTANDS, Sept. '71 EI) but they should try to make a rechargeable one. Why undergo a $500 operation each time to replace a $2 battery.

Richard Fraschatti
Philadelphia, Pa.

The cardiologists are way ahead of us, Dick. Now they're talking about converting energy directly from the body. So long as the patient is warm, he'll power his pacemaker.

● **STRAIGHT FROM THE HORSE'S MOUTH**

Your CB REPEATER project (Sept. '71 EI) gave me a great idea. Why not hide a tiny transceiver at a race track, and have it repeat the odds to the outside world by radio. I could receive it on a CB set and get the upper hand over my local bookie, couldn't I?

Samuel R. Gibbon
Phoenix, Ariz.

Yes, you might. We heard of a similar scheme pulled by a fellow who now fixes radios in Kansas. Leavenworth, we believe and visiting hours are on Sunday.

● **THIS HAM'S HAD IT**

I could not expect anything less from Wayne Green when he took another pot shot at the American Radio Relay League (THE HAM SHACK, July '71 EI). Green advises individuals who want to obtain a Novice license to purchase an ARRL License Manual, then says "These are none too good, but they are about all that are available. . . ." I vehemently disagree with Green. I consider the ARRL License Manual a very excellent study guide and a fine reference text. I cut my eyeteeth with this manual and so have thousands of others. In my opinion, Green has long history of spicing his articles with half-truths and outright fiction.

Charles Derapelian, W51W
Port Neches, Texas

This one's a draw. Green is probably correct since ARRL manuals often look more like civil service exams than an enticement into an exciting hobby. You're right, too since ARRL manuals are thorough, authoritative, and still the best available today.

● **COUNTERREVOLUTION**

In your article THE COUNTERS ARE COMING (Sept. '71 EI) you say the instrument can be used to tune an electronic organ. How about a piano?

Larry Summers
Towson, Md.

No dice. The overtones produced by a piano are so intense that the counter will go haywire. In fact some are of greater amplitude than the fundamental.

● **ON THE LEVEL**

Thanks to your PERFORMER'S LEVEL CONTROL AND MONITOR (Sept. '71 EI). I can adjust the levels of my piano recording. It does seem a nuisance, though, to stop at a grand crescendo to make my adjustment. Isn't there any way to avoid this?

James Van Eyck
Croton Falls, N.Y.

You'd have to rig up a foot pedal or some other mechanical linkage to free both hands. The project is more a convenience than a method of making remote-control adjustments.

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CIRCLE NO. 1 ON PAGE 13

Uncle Tom's Corner

By Tom Kneitel, K2AES/KQD4552

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

★ *Recently I was in Atlantic City, N.J., and was tuning around on my VHF receiver. I heard a station sending out weather reports but I was unable to get any of the data written down. How can I find out what station this was?*

David Coskey
Haddonfield, N.J.

Apparently you eavesdropped on the National Weather Station which broadcasts continuous weather from Atlantic City. There is a rather large network of these stations on VHF. Most stations throughout the country operate on 162.55 mc, however the Atlantic City, Boston, and New London (Conn.) stations recently switched over to 162.40 mc.

★ *What is the motorboat-type sound I hear after sunset on about 1900 kc? It doesn't identify itself.*

Mark Williams
Trenton, Mo.

★ *For the past year I hear a weird motoboating station on my table-model receiver. It starts as a slow putt-putt around 1100 kc and increases in speed as I tune higher in frequency. What station is this?*

Edward McCullough, Jr.
Olympia, Wash.

Mark, you've stumbled onto a Loran navigational station—you would need an expensive Loran receiver to learn their ID and location. Ed, you've stumbled into a service problem with your receiver—better bring it to a service shop.

★ *There seems to be a rumor afloat which says that the FCC is about to do away with the need for passing a code exam for a ham ticket. If this is true, I support the idea. Do you?*

Carl Schirrmacher
Pleasanton, Calif.

Basically, it isn't true. This is standard rumor #5066-A which circulates through hamdon every two years or so. The FCC is required, by international agreement, to test hams for code knowledge if they are to operate on any bands below 144 mc.

★ *I recently purchased a used Hallicrafters S-108 receiver which works fine but can't seem to get up any steam on the 28-mc ham band. What's the problem?*

Tony Pina
Lincoln, R.I.

Many low-cost and other older receivers seem to share this dilemma. It's a simple lack of sensitivity which can easily be restored by the addition of an RF preselector between the antenna and the antenna terminals of the receiver. It will also soup up the set on other bands.

★ *I'm a sports fan and I wonder if others of my breed have ever been annoyed by the background noise of the crowd rapidly fluctuating up and down as the sportscaster speaks. Seems to blast through between his words and then muffle down as he speaks. What causes this?*

Mike Ferlan
Newark, Del.

It bugs me too, Mike. This is caused by the AVC circuitry in the audio pickup gear used by the broadcasters.

★ *You are always making snide remarks about the ARRL. I think you might have*

[*Continued on page 10*]

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CIRCLE NO. 15 ON PAGE 13

Uncle Tom's Corner

Continued from preceding page

some respect for an organization that was founded in 1914.

G. Harold Whyte
Topeka, Kansas

I'm not half as interested in when they got founded as I am in when they got losted.

★ *Can you tell me if I can get a QSL from a station I hear on shortwave which announces itself as CHU? They send out time reports something like WWV.*

Konstantine Rychalsky
Bridgeport, Conn.

I get more letters from folks wanting info on CHU than on any other topic. For the record, this is a time-signal station in Canada. They can be heard on 3330, 7335, and 14670 kc and their address is: Station CHU, 3 Observatory Crescent, Ottawa 4, Ontario, Canada. They welcome reports and send a nice QSL card.

★ *I'm taking a home-study course in TV servicing but here's one that isn't in the textbook. While working on a set which was out of the cabinet, I noticed that there are all sorts of things going on above the picture, the portion of the screen which is normally hidden behind the front of the set. There are all sorts of lines, bars of color, circles which flash from time to time, etc. What's this all about?*

Dave Margolin
Acton, Mass.

These are behind-the-scenes messages and program cue instructions which the networks send out to their affiliates. They advise when commercial breaks are about to take place, when a new program is about to be fed to the network, etc. They're about as interesting as most of the programs the networks pump out.

Civil Defense Dept. Some CD people recently confided in me that, insofar as large metropolitan areas are concerned, ham radio participation in CD is almost nil.

Uncle Tom's Corner

Ham radio has lost many potential members to Citizens Band, the military services, rock bands, and other *today* efforts. Besides that, seems that many of the large city ham-types have moved out of the jungles into the suburbs. Other networks, on VHF FM, have been pressed into service to fill the gaping hole left by the non-existent ham operators.

★ *Is there any practical use for a little military-surplus transceiver which bears the name AN/CRC-7? There's a surplus dealer in town that has crates of 'em at giveaway prices. Must be a catch.*

Carl Merz
Dallas, Texas

These are little VHF rigs which operate AM or modulated CW on 140.58 mc. With almost no effort this rig can be converted to the two-meter ham band (just change the rock and trim the coils). They're cheap because they came out in pre-solid-state days; that makes them too old fashioned to be attractive to today's surplus buyers.

★ *I really dig your column, it's the first thing I seek out when my copy of EI arrives. I sure wish I could devote most of my time to electronics like you do; well, maybe when I finish school.*

Sal Tarrantino
Skokie, Ill.

The great thing about being a writer is that you get to call the shots on your own schedule and pace. Hope it doesn't goof up my public image to let you in on a little secret—I spend as much time tinkering around with sports cars and casting for trout as I do trying to avoid electrocuting myself.

★ *I'm only beginning in Amateur Radio and I'd like you to explain what is the Voice of America.*

Stephen Baier
LaCrosse, Wisc.

Spiro Agnew.

[*Continued on page 12*]

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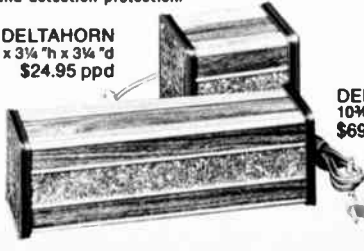

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CIRCLE NO. 18 ON PAGE 13

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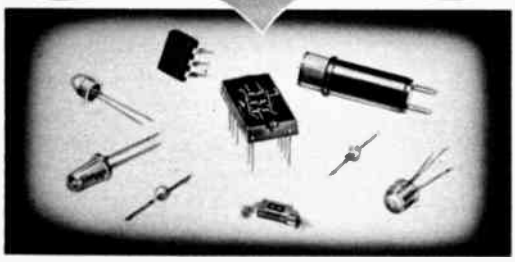

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CIRCLE NO. 14 ON PAGE 13

Uncle Tom's Corner

★ *I have an SCA (background music) adapter unit wired into my FM receiver. It worked fine at my last apartment, but I recently moved across town and I find that the music is now slightly distorted. Any quickie-cures?*

Vern Bodkin
Little Rock, Ark.

Off hand, I would say that the set isn't getting enough signal. Try a better antenna or a preselector.

★ *A buddy of mine tells me that when he was in the army he was assigned to do fancy electronics work for an outfit called the ASA. I think he's pulling my leg since nobody else ever heard of the ASA. Did you?*

Randy Weston
Myers Flat, Calif.

Yup, the ol' Army Security Agency is one of those ultra-gung ho outfits. Back in the 1960s I was asked to write some training films for this group. Trouble was that they were too paranoid to let me, a civilian, know what they were really up to. They told me next to nothing and I had to fake it through most of the scripting. It would be a minor miracle if anybody learned anything from those flicks. Their home base is at Fort Devens, Mass.

★ *Has anybody ever told you that you don't know what you are talking about?*

Albert Ridder
Golf Manor, Ohio

Only people that don't know what they're talking about.

★ *What do you think about those new dog training systems? You put a special electronic collar on the dog and the trainer has another electronic gadget. The trainer gives the dog a command and if he doesn't respond, he pushes a button and sends out a harmless shock.*

Ronald O. Summers
Keokuk, Iowa

It sounds like a great idea, but how do you get the dog to push the button?

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Next time you take apart a piece of equipment for repairs or modification, reach for a roll of masking tape. When the time comes to reassemble the equipment you'll be spared the job of hunting for and identifying parts. The trick is to place a strip of wide tape on your workbench. Then put screws and other parts on the tape to keep them from rolling away. Write the part's identification on tape.

You're being modern when you finish off your latest project with rub-on dry-transfer lettering. When letters are new, they about jump off the transfer sheet. But when old, the same careful technique will produce results that look like kindergarten scrawls. To correct this, heat an area with a soldering iron. But take care not to hold the iron too close or for too long because the letters may melt away.

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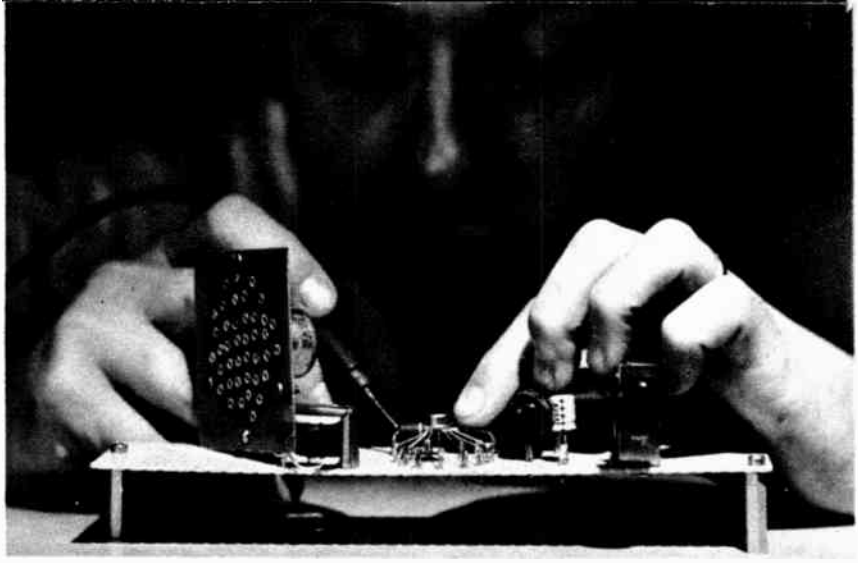

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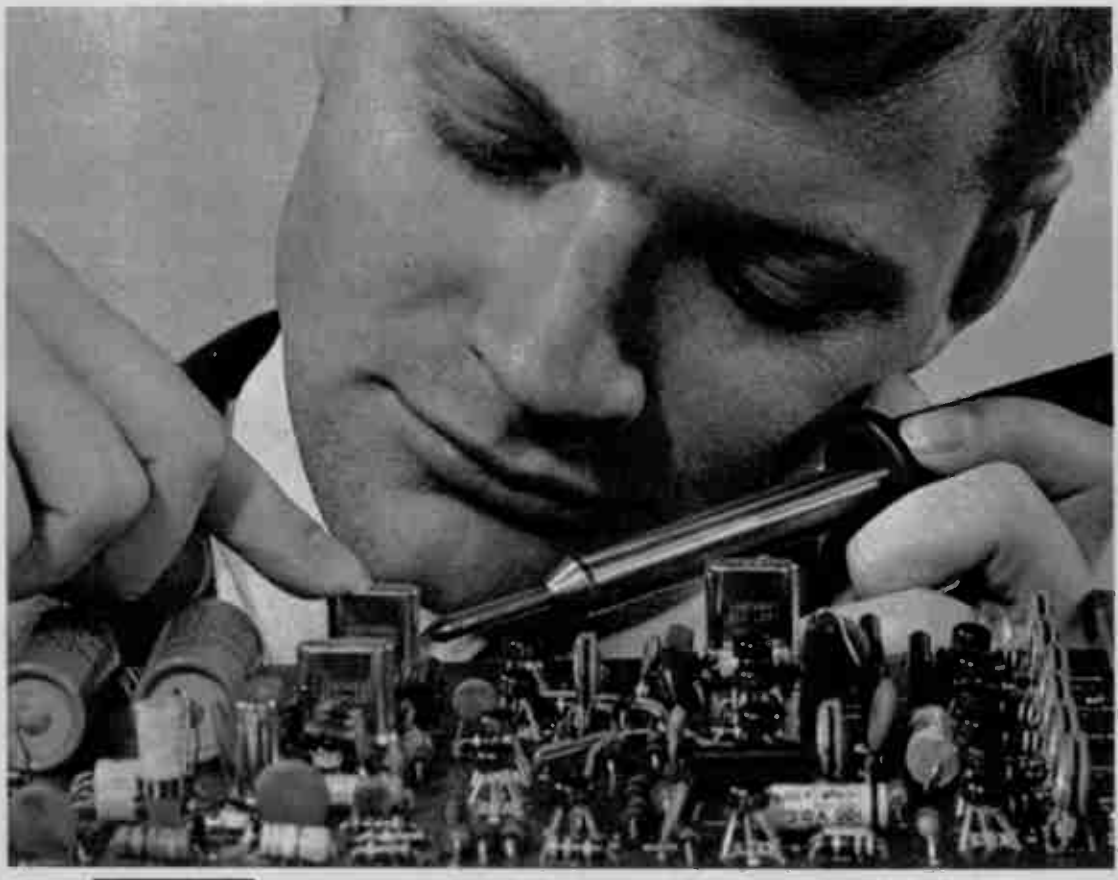

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WILL Tape You Anywhere. Akai America, Ltd. has made the video tape recorder scene with an 18-lb. portable system that uses ¼-in. tape. The VT-100 handles 5-in., 1,200-ft. reels and consists of a zoom-lens camera with built-in mike, detachable 3-in. video monitor, recorder/player and AC power supply/battery charger. Recorder has twin helical-scan rotating heads and the 11½-ips tape speed provides a recording time of 20 minutes. Resolution is 200 lines and video signal-to-noise ratio is said to be better than 40db. Optional accessories include 12-in. video monitor and RF adaptor to feed output to any TV set. $1,295. Akai America, Ltd., 2139 East Del Amo Blvd., Compton, Calif. 90220.

Electronic Marketplace

Four-Channel Adaptor. Heath's kit version (AD-2002) of the Electro-Voice EVX-4 Stereo-4 Decoder provides four-channel stereo from any tape, record or stereo FM broadcast that has been encoded with the Electro-Voice matrixing system. In addition, it enhances unencoded stereo program material. The AD-2002 requires an existing stereo system, another stereo amplifier and two more speakers. The kit sells for $29.95. Heath Co., Benton Harbor, Mich. 49022.

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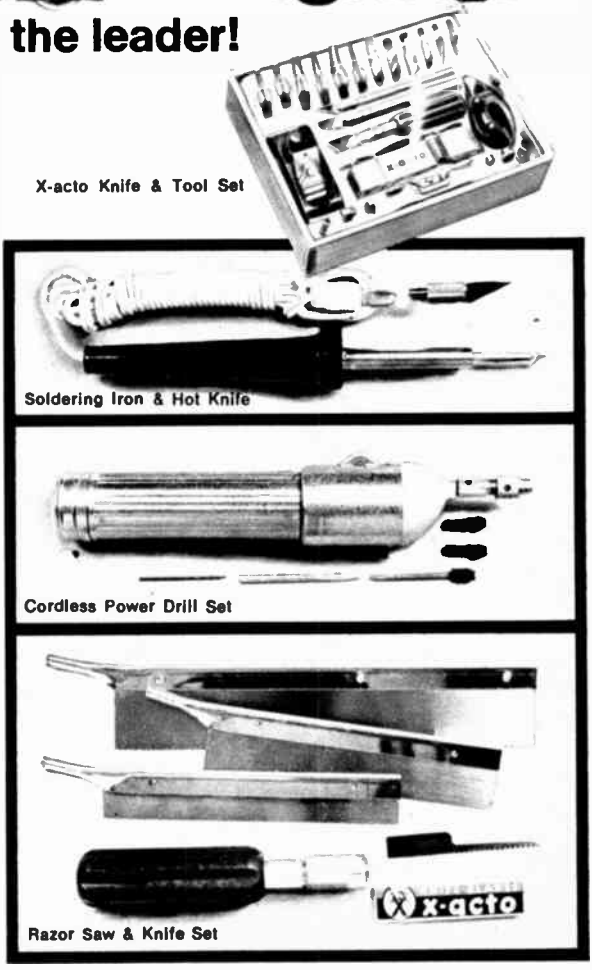

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CIRCLE NO. 22 ON PAGE 13

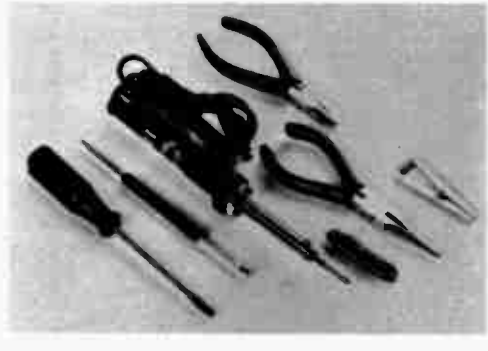
Electronic Marketplace

Two-Meter Mobile. Hams are moving up in the RF spectrum and hitting the road, too. To join the crowd, consider Simpson's Model-A VHF-FM two-meter mobile transceiver. Featuring four-channel operation, the rig is supplied with two pairs of crystals and a push-to-talk mike.

Transmitter specs: tuning range, 144-148 mc; frequency stability, 0.001 per cent; output power, 6 watts into 50 ohms; modulation, ± 5 kc for 100-per-cent modulation at 1 kc. Receiver specs: crystal-controlled dual-conversion superhet with ceramic IF filter; frequency stability, 0.001 per cent; sensitivity, 0.6 μv for 20db quieting; output, 2 watts. Power requirement is 12 VDC, negative ground. $249. Simpson Electronics, Inc., 2292 N.W. 14th St., Miami, Fla. 33125.

—

Have Tools, Will Build. Beginning kit builders and hobbyists frequently get hung up at the first step—getting a basic set of tools to do everything. Quick solution: GC Electronics' seven-piece hobbyist tool kit. It includes a pair of diagonal cutters notched to strip wire, long-nose pliers and a heat sink. The latter is in-



valuable for protecting semiconductors from heat damage when soldering. In addition there's a 30-watt soldering iron with conical tip, a package of 60/40 resin-core solder and a solder-aid tool. One end of the tool is forked for removing or wrapping wires. The other end has a stainless-steel brush. There's a screwdriver, too. Catalog No. of the $7.95 kit is H3-378.

Electronic Marketplace

Solid-State High Voltage. A frequent cause of high-voltage failure in color TV sets is the high-voltage rectifier tube. In many solid-state color TVs, the high-voltage rectifier is the only vacuum tube (in addition to the picture tube). EDI has introduced a solid-state high-voltage rectifier, No. R-3A3, that will replace, without electrical or mechanical changes, the vacuum-

tube high-voltage rectifier in most color sets. It replaces the following tubes: 1B3, 1G3, 1J3, 1K3, 3A3, 3AW3 and 3B2. The type R-3AT2 is the replacement for the 3AT2 tube. Advantages of using the R-3A3 are greater reliability, elimination of potential close-range X-ray radiation from an unshielded tube rectifier and elimination of heat from a tube's filament. List price of the R-3A3 is $9.95. For more information write Electronic Devices, Inc., 21 Gray Oaks Ave., Yonkers, N.Y. 10710.

—

Discrete Four Channel. The ideal route to quadriphonic sound is discrete and one way to get there is with cartridge tapes. The Fisher TX-420 two-channel/four-channel converter turns your stereo system into a four-channel system with the addition of two speakers. It plays either stereo or quadriphonic eight-track cartridges and has volume, bass, treble and balance con-

trols. Panel lights indicate the operating mode. When playing a four-channel tape, the converter's front-channel outputs go to your stereo amp's aux, tuner or tape inputs. The rear-channel signals go through the controls and amplifiers to the rear speakers. Power rating of each rear-channel amp is 15 watts, rms. $299.95. Fisher Radio Corp., 11-40 45th Rd., Long Island City, N.Y. 11101.

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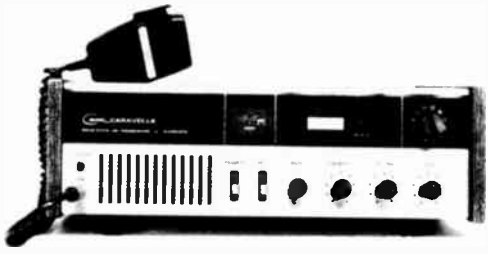
CIRCLE NO. 13 ON PAGE 13

Electronic Marketplace

Stylish CB. Dressed in walnut side panels, Courier's new Caravelle base-station/mobile CB transceiver features 23 transistors and protection against antenna mismatch and overload. The dual-conversion receiver's sensitivity is



0.3 μv for a 10db signal-to-noise ratio. Adjacent-channel rejection averages 60db. An on-the-air sign lights up when you transmit. A position of the channel selection switch is for PA operation. There's a combined RF/S meter. An adjustable TV1 trap is included as are crystals for all 23-channels. $179. Courier Communications, 100 Hoffman Pl., Hillside, N.J. 07205.

—

Mariner's RDF. No chance of getting lost at sea with Ray Jefferson's new RDF Direction Finder on board. The battery-operated (or 117 VAC) receiver has a rotatable antenna with two sighting vanes to take bearings. A meter aids in getting a precise fix. Five bands are:

AM and FM broadcast, 1.6-4 mc, long-wave marine and 108-174 mc. $89.95. Ray Jefferson, Main & Cotton St., Philadelphia, Pa. 19127.

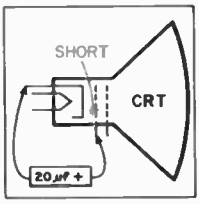
Service Tips

By Art Margolis

LEAKAGE between the heating element and the tip of a soldering iron can cause the tip of the iron to have voltage on it. This can mean trouble when soldering transistors or parts near them. Check your iron for leakage with a VOM by measuring the AC voltage between the tip and ground. Be sure to make the check with the AC plug inserted both ways. Any voltage means a defective, unsafe iron.

—

Should you suspect a short in a CRT between the control grid and cathode or screen grid, you can clear it without a CRT tester / rejuvenator. Simply take an electrolytic capacitor of 20 μf or more and charge it. Then attach one end to the control-grid pin and the other to the cathode or screen-grid pin as shown at the left. A resultant spark clears the short. (Caution: don't do this for heater-to-cathode shorts.)



—

Best approach to curing TVI is by careful analysis. Interference that appears as one or two jagged floating bars across the screen is usually caused by 60-cps interference and should be traced to 60-cps sources.

—

When equipping your work area with a fire extinguisher stay away from soda-acid of foam types. Electrical circuits when burning respond best to carbon dioxide, carbon tetrachloride of a powdered-substance extinguisher.

—

For maximum life from a battery you shouldn't take more than 10 per cent of its rated output on a steady basis. For instance if a battery is rated to discharge 1 A on a 10-hour-rate-basis try not to use it with more than a 100-ma current drain. Besides giving maximum life, it will recharge easier and the cell will hardly be hurt.

—

TV lead-in breakage around your rotator can be prevented permanently by installing two stand-off insulators—one above and one below the rotator. Just leave enough slack so the lead-in can twist during rotation in such a way that it never will become taut.

—

Working with a large schematic and constantly shifting your eyes from equipment to schematic? A lot of time can be lost every time you look back at the schematic and have to focus your eyes on the small area you're interested in. Stop, take a sheet of paper with a hole in it and place it over the circuit area you are looking at. Only that area will be exposed and can be spotted quickly.

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CB Corner

By Len Buckwalter, KQA5012

Better Band?

MOST exciting proposal to hit CB in years has been made by the Electronic Industries Association (EIA), a manufacturer group based in Washington. EIA wants to carve 80 new CB channels out of a little-used ham band up on 220 mc and call it Class E.

The new deal would give free rein to personal communications and would include a smattering of other useful CB services.

Like proposals before it, this one seems to echo the growing number of voices in favor of getting rid of many of the restrictions on CB and letting CBers gab, chit-chat, rag-chew or whatever else they want to do on airwaves that are public property.

EIA could swing it where others have failed. Those other voices were yelps in the wilderness but an EIA pronouncement booms with the authority of every major electronics manufacturer. EIA usually doesn't mutter in its whiskers but issues, forthright declarations. This one, which is, typical has quite a lot to say.

First, it points out failings in the Class-D band. Long-range skip on 27 mc encourages ham-type operation when CB is meant to be short-range. Secondly, says EIA, the band suffers poor range in many areas through man-made interference, low power and low antennas. EIA argues that overcrowding on CB's 23 channels renders the service hopeless in many places.

The cure, says the organization, is a new band from 220 to 222 mc. It would barely bother hams already up there because more than half the band would remain for amateur activity (from 222 to 225 mc). And it's widely acknowledged that this band has about as many active hams as you'd find on the moon.

Many products advertised in this issue offer you further information direct from the manufacturer. At the bottom of many ads will be a "Circle No." line. This means that the advertiser offers you further product information, free, right to your mailbox. Look through the advertising, and turn to page 13. Circle the advertisers' number, complete the coupon, and we will take care of the rest.

ELECTRONICS ILLUSTRATED

All this has a familiar ring since the Class-D band was taken from a dying 11-meter ham band.

Like surfers following the sun, CBers are slaves to sunspots. As solar action strips higher bands of DX, there's an exodus to lower frequencies where skip is good. This leaves 220 mc to a dwindling breed of ham technocrats who enjoy puttering among microwave plumbing. The faults of 220—short range and little activity—are just what make it a fine spot for a new Citizens Band.

The technical details in EIA's idea bear strong resemblance to those concerning the recent VHF marine band for pleasure boats. (That band was pressured into being for most of the reasons given here for CB.) Some highlights of what the EIA proposes:

Power Output. You'd be allowed to put 25 watts into the antenna, using FM (not AM). Public-safety agencies could sock out 100 watts for obvious reasons.

Antenna Height. The old 20-ft. limit would change to allow an antenna to top, by 20 ft., the nearest man-made or natural object within 500 yards or to be 60 ft. above the terrain, whichever is higher. The idea is to allow an antenna to clear nearby barriers that block signals. This becomes more important on 220 since higher frequencies are less able to penetrate obstacles. If a CBer lives within a mile of an airport, he'd observe the 20-ft. rule to keep the FAA happy.

Channels. There'd be nearly three-and-a-half times more frequencies, 80 channels instead of 23. Bandwidth presumably would be 25 kc. Besides the familiar separation of channels for units of the same and different call sign, other special categories occur: Channel 14 for weather, Channel 45 for calling, Channels 46 through 54 for business.

A block of channels from 58 to 80 would have a novel feature not found on 27 mc. Transceivers would have a reduction switch to knock power down from 25 watts to 1 watt. This idea, already used for VHF marine, cut man-made interference on short-distance traffic.

What are the chances for EIA's proposal? The petition is before the FCC now, but there's no date for action. It means the Class E could be a year away; its approval looks better than anything else to date.

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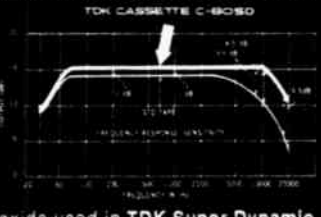

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The Strange Saga of Ivan The Terrible

By DON JENSEN

AS in the rest of Berlin's Charlottenburg district, the windows of No. 8-14 Masurenallee were shuttered and dark, for on August 21, 1941, the threat of night-raiding Wellington bombers was uncomfortably real.

But inside Rundfunkhaus, headquarters of the Nazi radio network, the propaganda mill was grinding away. In a studio no larger than a phone booth, an announcer began the home-service news, aired nightly by Deutschlandsender, the powerful long-wave station on 191 kc.

There was plenty to report. Since the start of Operation Barbarossa—the invasion of Russia—two months earlier, 9 million troops had been locked in a desperate struggle along the Eastern Front that stretched from the Arctic to the Black Sea.

"The Red Army is retreating east of the Dnieper," gloated the announcer. Suddenly, the listeners in the Third Reich were startled to hear another voice cut in . . .

"Lies! Fairy tales!"

The German continued, "New victories have been won by the Wehrmacht!"

"In the grave!" added the mystery voice.

Ivan The Terrible

Thoroughly puzzled, the engineers at Deutschlandsender (listening on monitors with off-the-air pickup, a common custom) informed the announcer about what was happening. Gamely, while he then began to monitor the signal, the announcer tried to bull his way through the broadcast. But each headline he read drew a caustic reply. Finally, the beaten newscaster gave up and an engineer slapped on some recorded um-pah-pah's played by a beerhall band.

Radio jamming was nothing new. Rome had tried it during the Italo-Ethiopian campaign. The Nazis had resorted to jamming during the Polish and Albanian invasion in 1939. Both Germans and the Russians had tried stepped tones and raucous buzzing to block each other's broadcasts.

But this was different. The mysterious broadcaster didn't try to jam the Nazi newscasts. He let the hapless Germans talk, then crushed them with scathing, often witty abuse. On August 24, he returned.

Announcer: "Here's the news."

Voice: "Here's the old liar again!"

Announcer: "German bombers went into action again last night."

Voice: "Have you got any left?"

And on August 29 . . .

"Fifteen Soviet planes were destroyed."

"But what about German losses?"

"And that ends the news."

"But the lying will continue tomorrow!"

Monitoring these exchanges in London, newsmen were intrigued by the unique counter-propaganda ploy. At first they dubbed the voice Der Snag, because of the way he snafued the Nazi network. But when British engineers pinpointed the transmitter's location in Russia, he was retagged Ivan the Terrible.

Ivan's lungpower, they learned, came from the 500-kw long-wave station RW-1 at Noginsk, 48 kilometers outside Moscow. It was built in the mid-thirties for Komintern, the international Communist movement. It was the most powerful station in the world, a distinction it held until the cold-war era of the million watter. Now, after more than three decades, it's still in use.

Russian technicians had found a way to shift the station's frequency from 172 kc and synchronize it perfectly with that of Deutschlandsender. Thus it was possible for the

UPI Photo

Joseph Goebbels, Minister of Propaganda in Nazi Germany, made frequent speeches to the German people during the war years.

At right is Solomon Lozovsky, originator of Ivan, as he appeared in 1941. Lozovsky was arrested in 1949 and quickly executed.

voice to cut in—sans heterodyne—when the Nazi announcers paused for breath.

Back in Berlin, Hitler's propaganda chief, Joseph Paul Goebbels was fuming. And when Goebbels burned, things got hot for Heinrich Glasmeier, manager of Reichs Rundfunk Gesellshaft—the German Broadcasting Company.

Glasmeier ran what was generally conceded to be the most effective broadcasting organization around. From his Berlin studios, postoffice landlines carried the programs to batteries of transmitters at Hamburg, Bremen, Cologne and, in the case of the key longwave station, the tiny village of Zeesen, just outside the capital. A humorless man, Glasmeier saw nothing funny in Ivan's remarks, particularly after being thoroughly chewed out by Goebbels, who told him to do something about it . . . or else!

He tried. The Deutschlandsender staff was told to speed up delivery. But Ivan was quicker. When announcers tried to slip in news items between records, Ivan was waiting. The frantic Nazis dropped news reports altogether and went to a non-stop music format. But, in the background, the sarcastic voice could still be heard. Even a wild cacophony of sound effects failed to stop him.

But the bedlam that engulfed 191 kc was too much for the German burghers in the audience. Many, no doubt, heeded Deutschlandsender's desperate pleas to try other channels. But others simply switched off their radios in disgust.

Flushed with success, Ivan wasn't content with wrecking newscasts. Soon, he popped up in the middle of feature programs, even sports broadcasts. Through the fall of 1941, he harrassed Deutschlandsender. One evening, after forcing the station off the air, Ivan turned mimic. Sounding exactly like Der Fuhrer, he roared away . . . "I am the greatest man Germany has had for centuries, perhaps for a thousand years. But I'm not only the greatest German, I also have the greatest mouth in world history!"

Prompted by Ivan's effectiveness in disrupting German broadcasts, the Soviets turned the tactic on the Finnish Radio, the Axis station at Sofia, Bulgaria, and finally, on Hitler's junior partners, the Italians.

On October 13, 1941, an Anglo-American intelligence team in Cairo heard a ghost voice calling itself La Voce del Populo on Radio Roma's medium-wave, home-service frequency. It berated Mussolini for selling out to Berlin.

Not long after, this Italian *Voce* jumped on Il Duce's pet announcer, Mario Appalius, calling him an Italian ass! Not one to take this insult in silence, Appalius shot back, "That's better than being a British citizen!"

Appalius, of course, had goofed. His tormentor wasn't British, but this error set off a chain reaction of mistaken identities that

[*Continued on page 98*]

UPI Photo

Ernst Fischer, a Czech, worked his way up as a journalist in Austria, finally becoming a high Communist official in Austria after the war. German-speaking Fischer was the real voice of Ivan the Terrible, and he also broadcast propaganda to German troops over the Voice of Free Austria in 1940s.

The EI Ticker

THE FCC is looking seriously at the idea of rule-changing that would bring new residents to the ham bands. Electronic Industries Association asked that such non-amateur groups as Red Cross, Scouts, United Fund and Eye Bank be permitted on ham frequencies. FCC is mulling, also has asked for opinions about restricting such signals to emergency use (or not). FCC also forsees applications by political parties, student groups, controversial organizations.

★ ★ ★

The Japanese apparently have in mind one more step in their domination of our electronics industry. First they made transistor radios cheaper than we could and sent them over. Then they started making components for us to assemble and, finally, American companies started getting whole radios, TVs, audio equipment and the rest made over there for sale over here. The latest: they are contemplating purchase of factories here to turn out products sold here. It could make for a long label: Made in USA by Rising Sun Electronics with American labor.

★ ★ ★

Electronic equipment is going down in price (surprise!) in Canada by some 10 per cent. Or at least that's what is supposed to happen. The government ended a 15 per cent excise tax on things electronic several weeks ago and predictions split the benefits at a third for the manufacturers, two-thirds for consumers.

★ ★ ★

Federal Trade Commission in this country is on the verge of demanding more consumer information from hi-fi manufacturers. The feds want amplifier specs to include continuous music power per channel in addition to peak power now required.

★ ★ ★

BSR Ltd. of England has gotten itself messed up with Uncle Sam to the extent of being indicted by a federal grand jury for, of all things, smuggling. The offense is more often connected with black-market cigarettes or untaxed whisky or perhaps diamonds from South Africa, but in this case BSR is accused of giving short count on record changers and other equipment when reporting to Customs, the whole thing totaling about $1 million worth of gear.

★ ★ ★

The Justice Department surprised a lot of people in the retail electronics trade by filing a civil antitrust suit to require the Tandy Corp. of Dallas to divest itself of newly-acquired Allied Radio of Chicago. Though Allied's profit picture in recent years has been spotted with red and black and its get-together with Tandy was considered by many observers as fortunate for both, Justice says it's too much of a good thing and lessens competition excessively.

★ ★ ★

American electronics manufacturers still in business after the bite of the Japanese import beetle finally got a piece of good news. The freeing of trade with China would mean they could sell TV and radio sets and a long list of other consumer products to the mainland Chinese. But since little is known of the electronics business in China, many American companies were left wondering exactly what might be sold and how.

★ ★ ★

Color TV sales next year will set new records, according to a study by Burnham & Co. Sales in 1970, a rather black year for living color, amounted to about 5,300,000 sets worth $1.7 billion. Burnham looks for 6.4. million/$2 billion in the current year and then between 7 and 8 million color sets to be sold next year, bringing in $2.3 billion. For 1975, furthermore, the brains at Burnham see 12 million sales and $3 billion.

★ ★ ★

Roadside radio callboxes in areas where there are no telephones are foreseen in an FCC ruling setting aside four pairs of 450-mc frequencies for use by such an emergency communications system. Though two-way radio, including CB, and other forms of emergency calling devices have been tried as devices to help motorists in need, to date none has been found to be the aspirin of the highway headache.

Good Reading

By Tim Cartwright

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

HOW to Become an Instant Noise Expert is the subtitle of a free 16-page booklet offered by Sperry Rand. It covers several important acoustic topics through charts, graphs and simple engineering explanations. The terms in this pamphlet (like sones, DBs and octave bands) should figure prominently in the rising cry against noise pollution. For a copy, write: Vickers Div., Sperry Rand Corp., P.O. Box 302, Troy, Mich. 48084.

RCA's latest **Transistor Thyristor & Diode Manual** (SC-15) is a whopper at 768 pages. Besides the vital specs on some 1,000 transistors and diodes, the manual contains a valuable section on semiconductor theory and ends with three dozen practical schematics and parts lists. The price is a piddling $2.50. You can buy one at parts distributors, or send the money to RCA Solid-State Division, Somerville, N.J. 08876.

Once you've collected the catalogs of electronic mail order houses, write for the one by Edmund. The new edition is jammed with more than 4,000 items for research labs, students and experimenters. The catalog has sections on optical components, special tools, measuring instruments and fascinating gadgets on psychedelic lighting. A free copy is available from Edmund Scientific, 701 Edscorp Bldg., Barrington, N.J. 08007.

If you envy those electronic eggheads who answer every question with a slide rule, don't despair. You can join slip-stick crowd and cube your own roots. With a second edition from McGraw-Hill, slide rule operation can be learned in about six or seven hours of self-instruction. It's a programmed text that assumes you know nothing, and allows you to proceed as far and as fast as you wish. Price is $4.50 for **Basic Slide Rule Operation** by W. S. Mittelstadt. McGraw-Hill, New York, N.Y.

Kepro specializes in just about everything for the hobbyist who makes his own printed-circuit boards. If you're an etch-a-sketch type, you'll want to send for the company's latest catalog. It shows more than 200 items—PC boards, nameplate kits, materials and tools—of interest to engineer and hobbyist alike. Net prices are given for all products and you can get a free copy by asking for Catalog No. CC-671 from Kepro Circuit Systems, 3630 Scarlet Oak Blvd., St. Louis, Mo. 63122.

We just received the first issue of **Sencore News**, a new company publication by a leading test-equipment maker. Maybe it's the wave of consumerism sweeping the country since this eight-page tabloid is one of the best pieces of product promotion in years. Instead of gushing over a new multimeter, company enginers justify every detail of the design in terms of real-life service problems. There is one hitch: to receive the publication you must have bought a company product and sent in the warranty card, or be a vocational electronics instructor. The address is Sencore, 3200 Sencore Dr., Sioux Falls, S.D. 57107.

If you're a clever technician or engineer working for an electronics company, you've probably come up with an idea or two with patent possibilities. Bardeen, Brattain and Shockley did just that in 1948 while at Bell Labs and invented the transistor. If you need guidance through the legalistic world of patents, try the new publication from Barnes and Noble (5th Ave. & 18th St., New York, N.Y.) called **Invention Protection for Practicing Engineers** by Tom Jones and Frank S. Vaden III. It covers everything. Price of this 190-page soft-cover book is $4.95.

Thermistors, those semiconductors that change resistance with heat, are a fascinating experimenter item. They're widely used in industry and medicine for measuring temperature. If you want to learn more about these electronic thermometers, write for the new catalog from Omega Engineering. Bulletin #8009 describes the company's products and prices, and has a complete glossary of terms. There's a step-by-step procedure for designing thermistor circuits. To obtain the bulletin write to: Omega, Box 4047, Stamford, Conn. 06907.

9 new Heathkit Products

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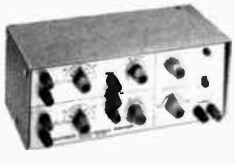

Ⓗ New Electronic Switch...39.95*

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Retail Heathkit Electronic Center prices slightly higher to cover shipping, local stock, consultation and demonstration facilities. Local service also available whether you purchase locally or factory mail order.

CIRCLE NO. 3 ON PAGE 13

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Ⓐ **The new Heathkit Stereo/Phonograph with AM Radio** gets it together in a portable package with a purple plum snakey skin that's as far out as today's sounds. Solid-state 18-watt amplifier, fold-down 4-speed automatic changer and swing-out high compliance speakers make it even better heard than seen. Speakers can be placed up to 5′ away for maximum stereo separation. A flip of the mode switch and you're into AM radio! 45 spindle adapter included.
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Ⓔ **New Heathkit Stereo-4 Decoder** – It's the soundest approach to 4-channel reproduction yet! Compatible with your present stereo system and FM receiver, it lets you hear all Stereo-4 material currently being broadcast by a number of stations across the country. Additionally, it imparts a 4-channel effect to your existing stereo library. Requires second amplifier and 2 speaker systems for installation with conventional stereo system.
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Kit GD-113, 5 lbs. 29.95*

Ⓖ **New low cost Heathkit Garage Door Opener** with all the heavy-duty features: strong chain-drive mechanism, ¼-hp motor, automatic light, automatic safety reversing. Pocket size transmitter and solid-state receiver come preassembled, ready to use. The GD-309A easily operates all conventional single or double overhead doors up to 8′ in height. Kit includes wall-mount switch, 1 transmitter, 1 receiver and door-opening mechanism.
Kit GD-309A, 43 lbs. 99.95*
Kit GD-309B, (w/2 transmitters) 43 lbs. 114.95*
Kit GDA-309-1, (mech. only) 41 lbs. 69.95*

Ⓗ **The New Heathkit Electronic Switch** provides simultaneous visual display of 2 input signals on a single trace oscilloscope. Has DC coupling and DC-5 MHz ±3 dB frequency response. Conventional binding posts permit fast hook-up, and the ID-101 can be left connected to scope at all times, if desired. The ID-101 is ideally suited for digital circuit work; amplifier input and output for gain and distribution checks; simultaneous monitoring of 2 stereo channels.
Kit ID-101, 6 lbs. 39.95*

Ⓘ **The New Heathkit Automatic Battery Charger** is a lifesaver for 12-volt batteries in boats, farm equipment or infrequently used cars. Just plug into a standard 105-130 VAC outlet, hook up the positive and negative cables and leave it! It's virtually impossible to hook up wrong. If wires are crossed it simply won't start up. The GP-21 brings the battery to full charge then shuts down, maintaining just enough current to compensate for normal leakage. There are no charge settings to adjust, and you can leave it hooked up indefinitely for a fresh start every time!
Kit GP-21, 13 lbs. 29.95*

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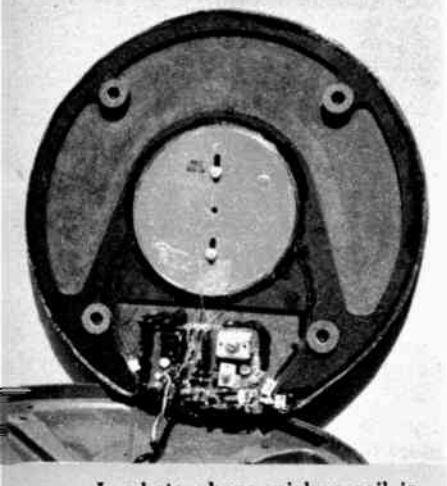
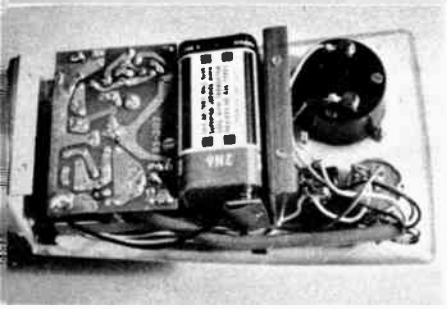
CIRCLE NO. 3 ON PAGE 13



In photo above, pickup coil is around round form in center of search head. Search coil is around outer rim. Oscillator board is at bottom. Photo below shows audio printed-circuit board and the control in the handle-mounted control box.



EI Kit Report

Semi-Pro Metal Locator

Heathkit GD-48

THOUGH they start off with dreams of finding buried chests filled with gold, treasure hunters frequently give up the sport quickly. The reason is the poor sensitivity of the locator, which generally is of the BFO type. Such locators are cheap and not able to detect deeply buried small objects.

A less common but much more sensitive locator incorporates an induction-balance circuit. Such a locator is the Healthkit GD-48, which has high sensitivity, is simple to operate and at $69.95 is about half the cost of commercially-made locators with comparable features.

In the GD-48's search head there are two coils—search and pickup. The search coil oscillates at a frequency of 100 kc and is modulated by a 650-cps signal. The coils are positioned so that the current induced in the pickup coil is out of phase with the current in the search coil. A trimmer capacitor mixes part of the oscillator signal with the induced pickup-coil signal. This results in minimum output from the pickup coil. When a metal object enters the magnetic field between the coils it upsets the balance between them causing a low 650-cps output from the pickup coil. The signal is amplified and fed to the speaker (or headphones) and a meter in the control box.

We encountered no problems in building the kit, however, extra care should be taken while soldering the fine wires of the search-head coils. Alignment consisted of adjusting two trimmer capacitors—one for maximum deflection and the other for minimum deflection of the panel meter. It is recommended that these adjustments be checked from time to time for best performance. Construction time was two evenings.

Operation is simple. First you adjust the telescoping handle so the search head is about 2 in. above the ground. Then you turn the sensitivity control to the point where a tone can be heard and then back off until the tone just stops. When you pass the search head over a piece of metal, a tone will be heard and the meter will deflect.

We tried the detector outside a new house. The first object uncovered was a chrome-plated shower head about 1 ft. in the ground. Next, a 1-ft.-long piece of electrical conduit about 4 in. deep was unearthed. Several 1-in.-dia. slugs from electrical outlet boxes, were found at depth of 1 to 4 in. Right next to the sidewalk, about 3-in. deep, we uncovered a Zippo lighter. In further tests we found the locator does do what it was designed to do—it meets Health's specifications on sensitivity by detecting a dime-size piece of metal at 6 in., a quarter at 7½ in. and a 5-in.sq. piece of aluminum at 20 in.

Hi-Fi for Today! ...Tomorrow! ...And Forever?

BY JOHN MILDER

THIS time we're trying to take a look at what's talk-aboutable in audio equipment for today and, even more, what might come along in the next year and then lastly, as our title implies, simply forever. In this field, forever is year after next . . . if somebody doesn't obsolete you next month.

At this writing, a lot seems to be coming along, some of it quite visible as gear already on the market. But, as you may have heard, things are not always what they seem. And some concepts that appear most promising never make it to market.

Record Gear. It's hard to find anything earthshaking in turntables and pickups but some of the things going on certainly are at least worthwhile. As I mentioned in my July column, the new Norelco 202 turntable is an outstanding example of good, clean design with such interesting goodies as a motor driven by a solid-state power oscillator instead of raw AC, making for fantastic speed control.

The most interesting newer entries to my mind are Garrard's new Zero 100 automatic turntable and Rabco's ST-4 turntable/servo tone arm combo.

Garrard has gone to a lot of trouble with the Zero 100 to combine a talk-producing departure. The departure is an articulated tone arm designed to achieve zero tracking error from outside to inside of a record surface. The articulated tone arm has been around but never with this level of precision and this final result. The Garrard is successful and produces an audible improvement in quality. That plus other refinements like a magnetic anti-skating system and vertical tracking-angle adjustment produce a player that appears to have gained the

CBS/Sony compatible quadriphonic disc system that permits four channels to be reproduced from a two-track source. What's called double-helical modulation encodes a quadriphonic program on a two-channel recording. A playback decoder restores four channels. System in photo at right includes Model SQ-444 decoder/amp.

AUDIO SPECIAL

Hi-Fi for Today! ...Tomorrow! ...And Forever?

New Teac cassette deck, the Model 350, features Dolby noise-reduction system and dual-bias (one for chromium-dioxide tape). $279.50.

top-of-the-heap position in automatics. The tab for this is about $189.50 (without cartridge, of course), which brings it near the top of the price heap, too.

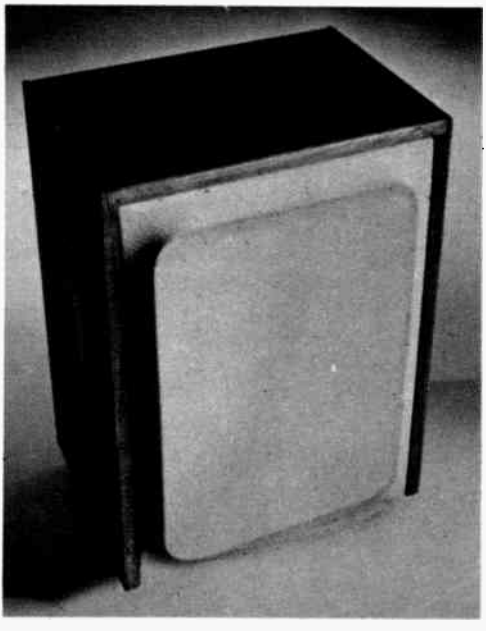
The Rabco ST-4 is a single-play turntable that combines an apparently well-made turntable with a new simplified mechanical version of Rabco's first servo-driven zero-tracking-error arm. Like the first arm, the new one is a radial-tracking design that follows the original path of the cutting stylus on the recording lathe. Even though it's less expensive than the Garrard, the single-play design means a narrower market for Rabco. But a goodly number of critical people will be impressed enough to buy.

In cartridges, there's no sign of a performance jump to follow the one of three or four years back which produced the Shure V-15 Type II and others. But new cartridges are coming, including the Norelco 400, which sounds much like the top Shure to my ears and also costs that way ($67). Also of real interest is Ortofon's new SL-15/MP 235 cartridge, which combines the Ortofon moving-coil pickup with a new solid-state preamp that replaces (at least in this model) the old transformer and helps contribute clean and wide-range sound. It's another premium-price entry at $150.

Cassettes. As noted elsewhere in this issue, cassettes finally seem to have gathered the strength for a full-scale attack on old No. 1, the record, as a program source. That means a plethora of new equipment and maybe a real change in how and to what you do most of your listening.

Since the Dolby System has proved the key to super-cassette machines, it is a feature of virtually every new deck coming to market these days. By the time this appears, the roll of Dolby-equipped decks should include models from Advent, Ampex, Concord, Fisher, Harman-Kardon, Hitachi, Teac, Vivitar and Wollensak-3M, with Sony rumored to have Dolbyized rigs in the wings.

The Advent, Teac and Wollensak are all in the near-$300 price class, which until now has been the price of a good open-reel deck. But I can testify in the case of Advent's 201, the only one of the three I've heard, that the results seem worth the price. There is a combined record-playback poten-



James B. Lansing L55-Lancer speaker has 14-in. low-frequency driver, 2-in. tweeter. $276.

Fisher Model 601 four-channel AM/FM receiver. FM usable sensitivity is 1.8 μv. capture ratio is 2db. Output power is 36 rms watts per channel. Price is $599.95.

tial, at least when Crolyn tape is used, that exceeds that of records. And prerecorded cassettes on Crolyn can sound demonstrably better than records in such critical respects as high-frequency response and lack of pre-echo.

What of four-channel cassette equipment? As we go to press Panasonic announced an eight-track four-channel deck. It incorporates a two-motor tape transport and Panasonic's Automatic Noise Reduction System. It's the Model RS-275 but price and date of availability were not stated.

And JVC also announced a four-channel cassette recorder that would be on the market in 1972 for about $300. A four-channel deck with JVC's own noise reduction system is in the works, too, for around $200.

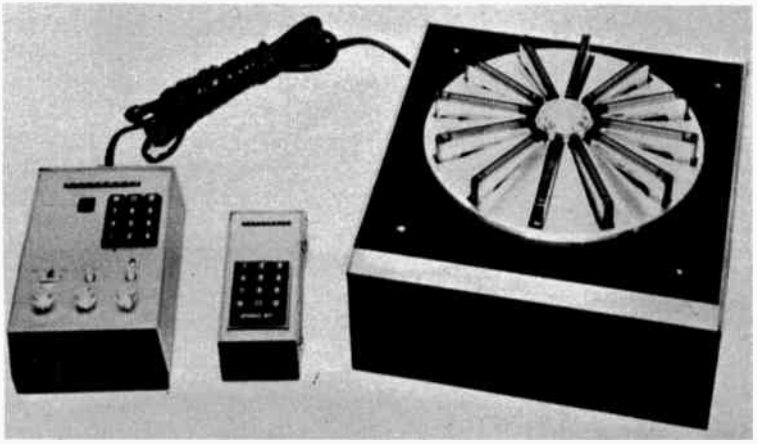
Dolby & FM. What could be the longest-lasting effect on audio next to the rise of the cassette is the arrival of the Dolby System (the same one used in cassettes, as just mentioned) in FM broadcasting.

When Dolby is used at the transmitter and subsequently at the receiver at home, its noise reduction is powerful by any standards. Stations previously unlistenable in the fringes come in free of noise—three times better than they normally would. That will mean a lot to many people because FM lost some much-needed signal strength when it went stereo ten years back and many people (myself included) just can't get as satisfactory reception as in mono days.

The factor-of-three improvement also means some stations might triple their areas of coverage and that lots of people can do well with simple antenna systems. The noise reduction is apparently significant even for stations on which full quieting is normally achieved.

It could be that a series of Dolbyized master tapes now being sold to FM stations by London Records might prove, when used with Dolby at home and transmitter, the best program material available by any means.

That, even to someone who hears about



Panasonic automatic cassette changer/player holds 12 cassettes and can be operated with wired or wireless controller. It has built-in amps and delivers 12 watts. No price yet because it's still a prototype.

AUDIO SPECIAL

Hi-Fi for Today! ...Tomorrow! ...And Forever?

Tracking error on $159 Rabco ST-4 turntable is eliminated as arm moves in a straight line.

Dolby as much as I do, is exciting stuff and it seems likely that some stations will be broadcasting Dolby by the time you read this. It also means that separate add-on Dolby components originally marketed just for tape recorders, now have a new capability. As for Dolby add-ons now available, there are two from Advent (at $125 and $250) and three from Teac (at $50 for cassette machines only, $130 and $290).

And because of the arrival of Dolby on FM, several manufacturers, including Hitachi and Kenwood, intend to make receivers incorporating the system, probably the last step needed to make Dolby a household word.

The Quads. The four-channel follies have resulted in two four-channel receivers, both from Fisher. The 601 checks in at $600 and a rated 32 watts of rms power per channel while the 701 supplies 40-rms watts per channel for $700. Other receivers are on the way and four-channel amplifiers promise to be commonplace before long with entries from Akai, Hitachi, Kenwood, Lafayette, Panasonic and Toshiba.

My money at this point is on some kind of matrixing, such as the Electro-Voice or CBS systems, winning out over discrete four-channel. The getting-four-channels-on-two-signals approach is the only one that makes economic sense these days and CBS and Sony have announced an agreement on marketing four-channel records and equipment based on CBS matrixing.

Koss Model K2+2 four-channel phones have switch for two- or four-channel modes. $85.

Four-channel and headphones would seem to have a bit of difficulty getting together because of the generally limited number of ears per listener. But Koss already is out with a Quadrafone Model K2+2 headphone for a mere $85, including carrying case. I haven't bent my two ears yet but I'm anxious to.

The Deuces. It's pretty hard to get excited in the area of good old two-channel stereo these days. Akai, the Japanese manufacturer responsible for Roberts tape equipment, has three interesting receivers, including one, the AA-8500, that looks like an aircraft console (done much better than usual) and sells for close to $1,000.

And Harman-Kardon has announced a new high-power receiver with separate power transformers for each channel. But generally the news is that, with some improvements and a bit of facelifting, a whole group of Japanese manufacturers—including Kenwood, Sansui, Sony and Pioneer—make a wide line of excellent receivers in the $250-$350 range, machines whose performance was unthinkable for the price a few years ago and which do everything any sane man wants to do with audio. Together with Akai, Panasonic and the American manufacturers already mentioned, they should offer enough of a choice for anyone.

Of course, some people aren't entirely rational about amplifier power, figuring that enough is never really enough. New entries in the highest-power category include Marantz's 250, which delivers 125 watts (rms) per channel into 8 ohms for $500, and a new rig from SAE that supplies about the same power at very low noise for $700.

Marantz Model 250 power amplifier delivers 125 rms watts per channel. It features two VU meters and circuitry to protect the output transistors, speakers and power supply. $495.

None too old, of course, is Crown's DC 300, which delivers a whopping 300 watts rms per channel into 4 ohms.

There's a mini trend at the moment toward a new generation of compacts that supply everything but the speakers in one centerpiece that you match with your choice of speaker systems. The one that impresses me most at the moment is Altec's 911, which combines a high-power (44 rms watts per channel) receiver with a Garrard SL-95B automatic and a Shure cartridge for $500. New models from Benjamin and others are supposed to be here soon. I think the trend, however small, will prove sensible.

Speakers. There is a certain lack of razzmatazz in upcoming speakers, with hardly any strange shapes or operating theories left for the marketing types to milk. But good things are going on. Two speakers that impress me are inexpensive. One is the Smaller Advent Loudspeaker, which sells for $70 and has the same frequency range and general characteristics (except for efficiency) as the company's $125 model.

The other is Microstatic's unique add-on tweeter ($57), an angled, four-speaker array in a tiny cabinet that perches on any bookshelf or larger system and apparently matches well with any medium- or low-efficiency system.

But there's no lack of more expensive systems. One of the least expensive in that category is Bose's 501 ($125), designed to preserve many of the virtues of the original 901 at about half the cost. More expensive —and more surprising from a company making thoroughly conventional speakers for 30 years—is Tannoy's new Orbitus 1, which puts the company's famous dual-concentric 12-in. speaker in a top-to-side firing omnidirectional enclosure for a tab of $250. And Harman-Kardon's latest omni offering, the Citation Thirteen, puts five drivers in an upward-firing arrangement for $300.

Worth special mention is Dynaco's A-50, which doubles the speaker complement of the well-liked A-25 and sells for $180. The original Dyna has been an excellent value and the company deserves more notice for its efforts.

Open Reels. All the foofaraw about cassettes has left the impression that there's little life in open-reel machines. That may be so in terms of sales figures but good and interesting decks continue to appear. Akai has jumped in with six ambitious decks with glass-ferrite heads and cross-field recording and with two four-channel decks with the same features. The prices go from $150 to around $600.

Ampex has two new decks, the AK-50 at $250 and AX-300 at $500, that are ambitious and seeming departures from previous Ampex efforts, which haven't given the company anything like the position in consumer tape sales that it has had in the pro field.

If high-number sales from here on are going to be, as many people are beginning to believe, in the high-price category, Teac will be there with an impressive array of three excellent and heavy-duty decks that should stand up to any home use. The machines, the 6010 SL, 7010 SL and 7030 SL, all provide solenoid-operated tape-motion controls and low-noise solid-state electronics. The 7030 provides four-channel playback along with standard recording. The prices are $700 to $900.

Not new in the strict sense but certain to be important over the next year is Tandberg's amazing 3000X, which at $300 provides performance seemingly identical to the company's more expensive ($500) 6000X.

Control Center For Audio Generators

Turn your service-grade generator into a professional instrument!

By HERB FRIEDMAN, W2ZLF

BET you six manhole covers you're doing audio service the hard way. That is, you're using a signal generator that doesn't have a metered output and a calibrated, stepped output attenuator. Expensive professional instruments have these features—generators that don't waste time . . . and that means money.

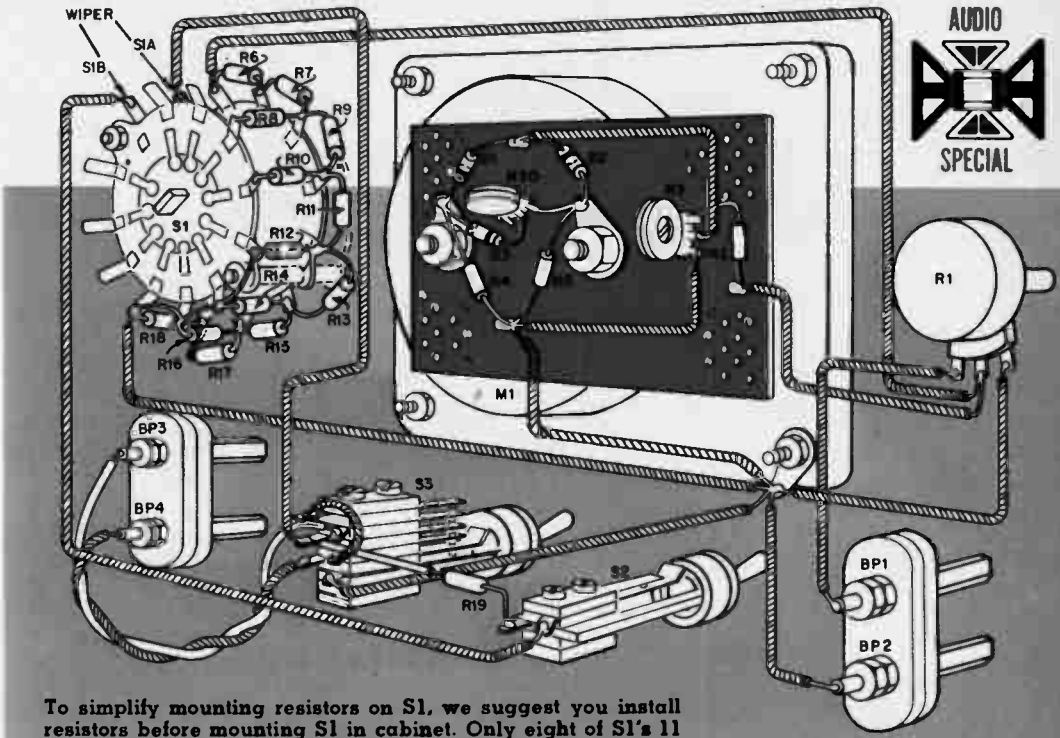
Like when you check the frequency response of an audio amplifier. To be sure the level of the signal to the amplifier is flat over the audio spectrum you must go back and forth with a meter from the amplifier's output to the generator's output. (Unless of course, you have an extra VTVM.)

Pros don't get bogged down in this game of musical test probes. Instead they use a generator with a metered and calibrated output or run the generator's output through an *audio microvolter*—a device that gives a generator both output metering and a calibrated output level.

Our easy-to-build and low-cost Control Center (microvolter) can be used with just about any service-grade generator whose output is up to 10 V. The circuit consists of output-level meter M1, adjustable *input-level* control R1 and 10db-per-step attenuator S1. The output at binding posts BP3, BP4, is terminated by a resistor of about 600 ohms (R19). When the Center is terminated by the internal 560-ohm load resistor any impedance from 6,000 ohms up can be connected to BP3, BP4. The Center's input impedance is about 5,000 ohms; therefore, it can be used with signal generators having an input impedance of up to 5,000 ohms.

When fed by a generator with a 10-V output the Center will provide any output voltage in 10-db steps from 10V down to 0.003V Load resistor R19 is only used in the 1 to 0.003-V ranges and not on the 3- and 10V ranges which are high impedance. Switch section S1B is wired in such a manner that load resistor R19 is automatically cut out on the 3- and 10-V ranges.

Construction. Meter M1 is a standard 200-μa DC microammeter. We provide a full-scale template for a 4½-in. meter, such as the Allied unit specified in the Parts List. In the event the scale is too large or small for your particular meter, pointer correction can be made with R20, which we will get to later. Simply cement the scale or a tracing of it over the meter scale. If you use one of the new plastic meters such as the Allied, remove the face of the meter from the case by cutting through the four or six cement spots and prying the face cover away from the case. Carefully remove the old scale, paste the new scale over it and replace the old scale taking care not to bend

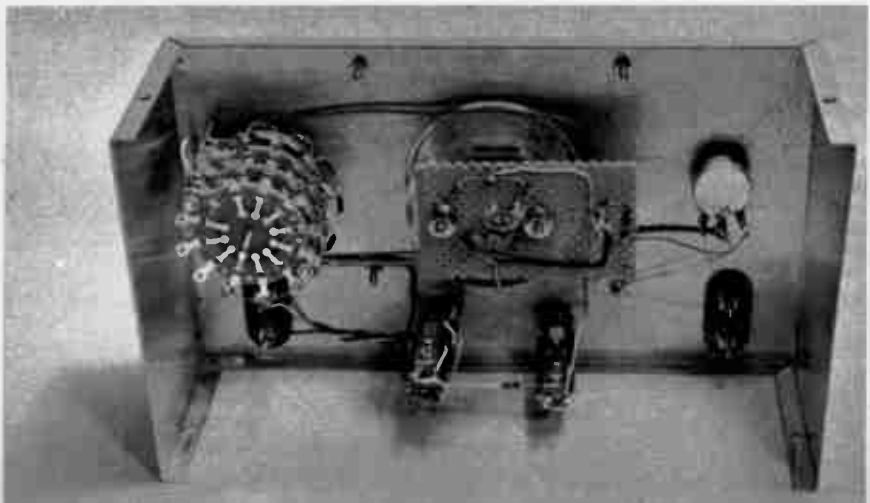


To simplify mounting resistors on S1, we suggest you install resistors before mounting S1 in cabinet. Only eight of S1's 11 positions are used. Slide switches may be used for S2, S3.

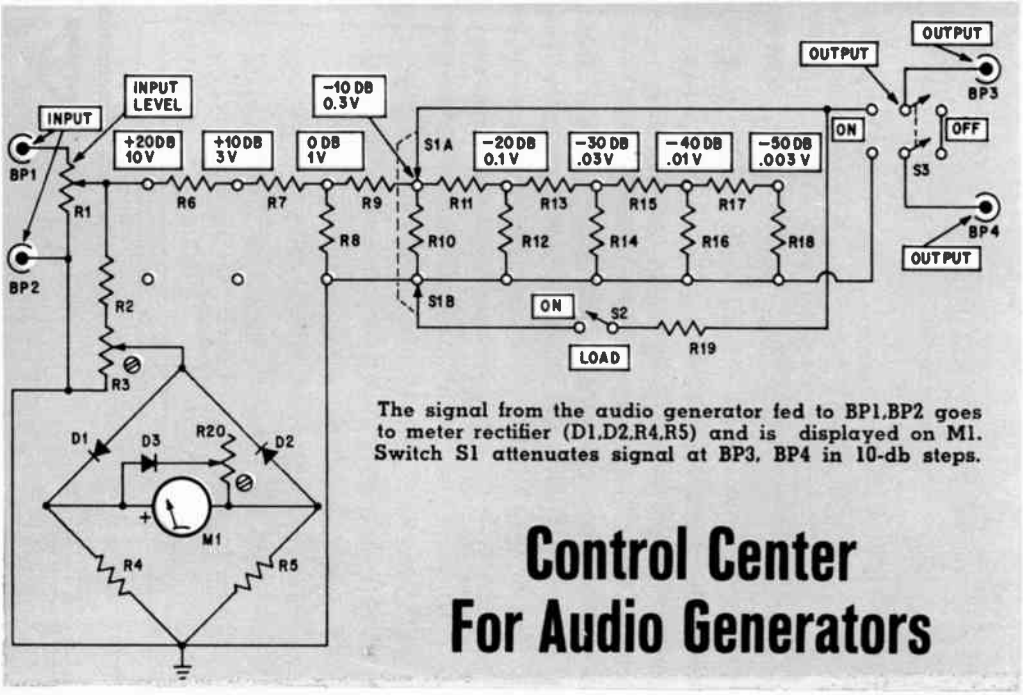
the pointer. Put the face back on the case and cement it in place with a few drops of silicone-rubber adhesive such as GE's RTV.

The Center is built in the main section of a 10 x 6 x 3½-in. Minibox. Pay particular attention to the common-ground connection. Note that *output* switch S3 is wired so that the generator's ground is disconnected from the equipment being tested (connected at BP3, BP4). This separation of grounds when S3 shorts BP3 and BP4 makes for accurate signal-to-noise measurements without error caused by hum induced through the generator's ground.

The switch specified for S1 has 11 positions. Eight on one deck are used for the voltage divider (R6 through R18 and six on the other deck are used for the R19 load interlock. Count off eight positions from the full clockwise position (10-V output). Install the switch stop so the switch turns through only eight positions. If the rotor stops on the wiper contact simply move the stop one hole counterclockwise.



Reason for the large cabinet is that we chose to use a 4½-in. meter (note its four mounting screws in center). Perforated circuit board is held on back of the meter on the meter's four large terminal screws.



Control Center For Audio Generators

While the wiring layout is not critical, try to duplicate ours to avoid problems. We suggest you use the lever switches specified for S2 and S3 though a toggle switch can be substituted for S2. Solder all resistors on S1 before installing it in the cabinet. Five-percent resistors are adequate for most applications.

Complete all cabinet wiring before installing the 2 x 3½ in. perforated board on the back of the meter. The board is Keystone Type-G pattern; the hole spacing exactly matches the lugs on trimmer potentiometers R3 and R20. To avoid damage to the diodes don't cut the leads shorter than ½ in. and use a heat sink when soldering.

Do not use bargain diodes; use brand new 1N60s for D1, D2 and D3. After the board is mounted on M1's terminals, adjust R20 for 2,500 ohms across its two used terminals. You get this resistance when the terminals point straight down and the indent on the adjustment knob is at the 1 o'clock position. Then set R3 to off—full counterclockwise.

Calibration. Connect BP1 and BP2 to the output of your audio generator. Close S2 so load resistor R19 is connected. Connect a VTVM across the generator's output terminals, and using a 1,000-cps signal, adjust the generator output for 10 V (rms). If the generator cannot deliver 10 V, use 3 V and in the following instructions substitute the 3-V range of S1 for 10 V. And use the 3-V scale on M1. S1's voltage attenuation steps on the schematic are based on a 10-V input.

Set S1 to the 10-V position and turn *input level* control R1 wide open—full clockwise. Advance meter-calibrate trimmer

PARTS LIST

BP1-BP4—Dual five-way binding posts
D1,D2 D3—1N60 diode
M1—0-200 μa DC microammeter (Allied Electronics Corp. 701-0319. Industrial Catalog)
Resistors: ¼ or ½ watt, 5% unless otherwise indicated
R1—5,000 ohm linear-taper potentiometer
R2—4,700 ohms
R3—10,000 ohm linear-taper trimmer potentiometer (CTS X-201/R103B, Allied Industrial Catalog No. 745-3606)
R4,R5—10,000 ohms
R6—2,400 ohms
R7—390 ohms
R8,R10,R12,R14,R16—1,100 ohms
R9, R11, R13,R15,R17—1,600 ohms
R19—560 ohms
R20—5,000 ohm linear-taper trimmer potentiometer (CTS X-201/R502B, Allied Industrial Catalog No. 745-3605)
S1—Three-gang, three-pole, 11-position nonshorting rotary switch (Mallory 1331L, Allied Industrial Catalog No. 851-0741)
S2—SPST toggle or slide switch
S3—DPDT locking type two-position lever switch (Switchcraft Type 3006) Allied Industrial Catalog No. 933-6511)
Misc.—10 x 6 x 3½-in. Minibox, perforated board

potentiometer R3 until M1 indicates exactly 10 V (full scale). Then adjust the generator's output level for, progressively, 6 V, 3 V and 1 V. Use the VTVM for these measurements. The Center's meter, M1, should track with the VTVM. If it doesn't, track the high end of M1 with R20. Continuously vary the generator's output from 1 to 10 V adjusting R20 in very small increments until you get perfect tracking at 1 and 10 V. Intermediate values will fall in line with reasonable accuracy. Note that R20's deviation from 2,500 ohms will be very slight.

If you give R20 a big twist you will have to start the calibration procedure from the beginning. When calibrating, keep in mind that R20 predominantly affects the high end of the meter.

When R20 is adjusted, move your VTVM to the Center's output terminals, BP3, BP4. It should indicate 10 V. Then switch S1 to the lower output ranges and make certain the VTVM's indications correspond to the reduced output level. If it doesn't there is a wiring error on S1.

Using the Center. Connect the audio generator to BP1, BP2, set R1 full clockwise and adjust the generator's output level until M1 indicates 10 V full scale. The Center's output level will now be determined by the setting of S1 and R1. For example, if S1 is set to the 0.1-V range and R1 is adjusted so M1 indicates 0.5 V the output level is .05 V. (0.1 x 0.5=0.05).

If the input impedance of the amplifier is exactly 600 ohms, open S2—the amplifier provides the correct load. If the amplifier's input impedance is between 600 and 6,000 ohms, open S2 and connect across BP3 and BP4 a resistor of such value that when combined with the input impedance of the amplifier, the Center sees a 600-ohm load.

For example, suppose the input impedance of the amplifier is 4,000 ohms. To determine the value of the resistor use this formula:

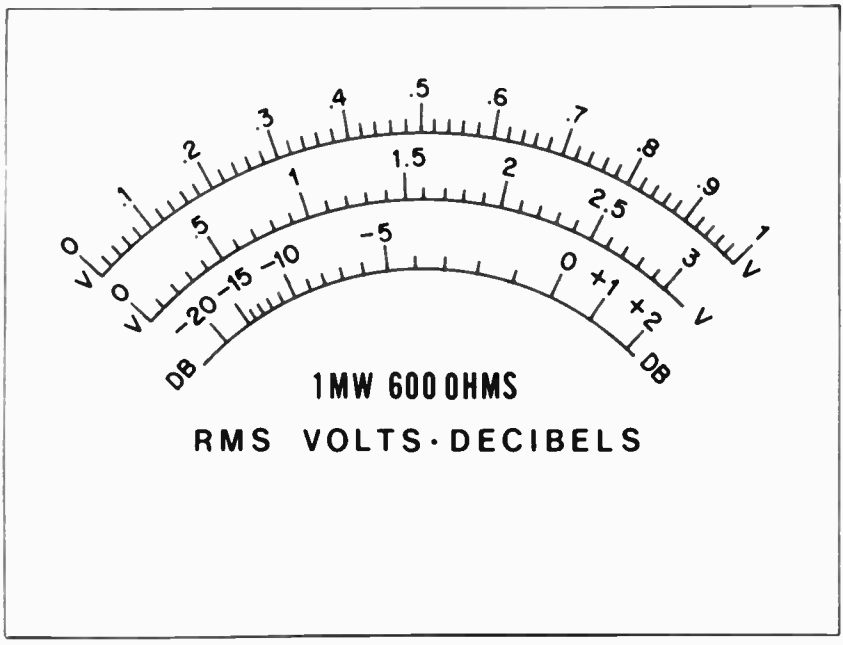
$$R1 = \frac{Rt \times R2}{R2 - Rt}$$

R1 = the desired resistance value, Rt = 600 ohms and R2 is 4,000 ohms. For these values R1 comes out to 706 ohms; however, use a 680-ohm resistor—the closest standard ten per cent value.

If the input impedance of the amplifier is greater than 6,000 ohms, close S2.

The Center's output is calibrated only when a 600-ohm load is provided. If the load is greater than 600 ohms, the Center's output level will be greater than the calibrated value. If the load is less than 600 ohms, the output is less than the calibrated value.

Scale fits meter specified in Parts List. For smaller meter, have scale reduced with a photostat.



Making 2 Channels Into 4

UNTIL the money tree begins to shake again and prices start falling, discrete four-channel (quadriphonic) equipment will be beyond the budget of many audiophiles.

But for the time being, there is an inexpensive way to enjoy quadriphonic sound using your present stereo system, two more speakers, a decoder adaptor and specially encoded records. These adaptors are passive (do not require power) devices that are connected to the speaker terminals of a stereo amplifier and to which your front speakers and two additional rear speakers are connected.

The adaptor will dematrix or decode (recover) the four separate signals that have been *encoded* on a stereo program source (record or stereo-FM broadcast). If the program source is not encoded (simply stereo), the adaptor will recover the ambience (reflected sound, liveness, the sound of a concert hall) that exists in most stereo program material but which is not reproduced by a stereo system. The sound will be enhanced by the adaptor.

At this time there are four passive adaptors on the market, three of them kits. The Dynaco QD-1 *Quadaptor* is $19.95 ($29.95 assembled), the Eico QA-4 *Quatrasonic* is $17.95 ($29.95 assembled) and the Eicocraft *Sound/4* is $9.95 (kit form only).

There is so little in the adaptors that their construction is a breeze. Both the Dynaco and the Eico consist of a multiple-position switch, a three-gang pot, two wirewound resistors and three screw-type terminal strips. It took 45 minutes to build each. The Eicocraft consists of two slide switches, two wirewound resistors and three terminal strips. We built it in 30 minutes.

The three kits have the same basic circuits, but there are minor differences among them. Both the Dynaco and Eico have a

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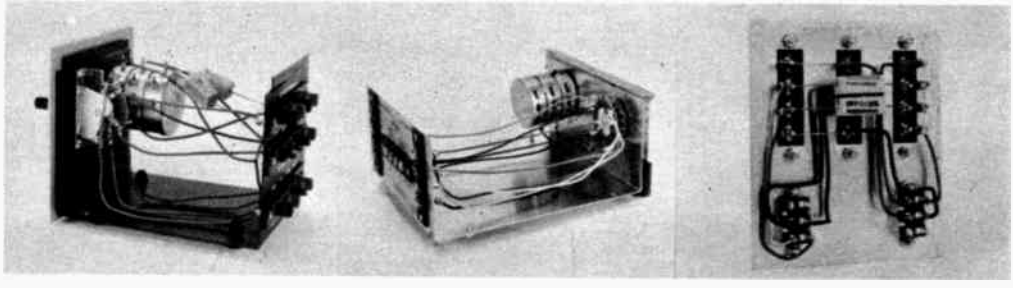

As you can see in the photos above, these are easy-to-build kits. The Dynaco is at the left, the Eico is in the center and the Eicocraft is at right. We built the kits in just over two hours.

Super-Mod Speakers for All Budgets

Modest in size and cost, but really big league in terms of performance.

By HARRY KOLBE

IF YOU haven't heard the word yet, four-channel audio is the wave of the future. And no matter what route you take to achieve it (discrete or synthesized), you'll need two more speakers. That's if you have one stereo system already. If not, you'll need four speakers.

Now the program sources for a four-channel system are going to cost you a few dollars. You'll need a new reel-to-reel tape deck or a cartridge tape player. Then you may need another stereo amp. However, you may be able to get away with your present stereo amp and merely an adaptor.

The back of the system (the speakers) is where you'll be able to save some money. How? By building our Super-Mod speakers. Depending on your budget and standards, you can spend as little as $20 for the low-cost system's low-frequency driver, tweeter, L-pad and two electrolytic capacitors. The more expensive system uses just a $32.50 full-range speaker.

Of course wood is extra and its cost will depend on the lumber you may have at hand or the going price of about 25 sq. ft. of ¾-in. plywood or particleboard for each speaker. Also extra are the grille cloth, wood for cleats and fiberglass wool.

The Design

Regardless of the quality of a speaker, the sound is only as good as the enclosure it's installed in. But the combination of a high-quality speaker and enclosure is still no guarantee of top-notch sound. Optimum system performance results only when the speaker and the enclosure are carefully matched.

Our two speaker systems are examples of how the parameters of a given type of enclosure are adjusted to match the characteristics of two different speakers. But before considering the specifics of the systems, let's discuss how the enclosure works.

Technically both these enclosures are a bass reflex with horn. The combination of the horn and bass-reflex enclosure has often been employed in large theater systems but has seldom seen service in small systems found in the home.

It is the nature of a cone-type loudspeaker by itself to cause serious interference with its own input. This is due to the fact that both front and back of the cone produce sound output. The two outputs are out of phase and if they are allowed to meet they cancel each other. The primary function of the enclosure is to prevent the speaker from cancelling itself.

The bass-reflex enclosure actually is a phase inverter which is able to reverse the phase of the sound radiated from the back of the cone and then add it in-phase to the radiation from the front. Since the phase of the rear radiation has been reversed, reinforcement rather than cancellation results when phase-inverted rear radiation is added

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to front radiation.

Compared to sealed-box enclosures, such as the infinite-baffle and acoustic-suspension, which simply trap the rear radiation, the bass reflex is far more efficient because it puts to work most, if not all, the sound energy radiated by the driver.

The bass-reflex system does not increase efficiency over the entire audio spectrum. Its main contribution is in the vicinity of the low-frequency resonance of the driver. Efficiency drops off rapidly as the driver approaches low-frequency resonance, to the point where there is little useful output below resonance. The increase provided by the bass-reflex enclosure effectively extends useful low-frequency output down to and below driver resonance. In addition to extending low-frequency response, this type of enclosure places a load on the driver which helps control non-linearities with resultant lower distortion and smoother response.

At first glance, our two enclosures look like a bass-reflex design with an overly large port. But this large port is actually the throat of a horn projector which is an acoustical transformer. Its effect is to present to the smaller area at the throat of the horn a high but consistent acoustic impedance. At the same time its transforms the high-pressure, low-particle-velocity wave at the throat into a high-particle-velocity wave with a low-impedance, that matches that of the air in the room as it reaches the mouth of the horn.

The addition of the horn to the port of a bass reflex system results in a greater increase in low-frequency efficiency and smoother low-frequency radiation than is possible from a simple port aperture.

You might think that the horn employed in the two systems presented here are too short to develop any significant horn action. This would certainly be true if the systems were operated in free space, but they were designed to be placed in the corner of a room. In this position, the floor and walls of the room behave as an extension of the horn effectively increasing its size.

The drivers used in these systems are 8-in. wide-range speakers. The more expensive systems uses an Electro-Voice SP8B. The budget system uses an Olson X-Air S-786. By properly matching these high-quality speakers to our high-efficiency enclosure, we obtained low-frequency performance and large sound output that is usually associated with much larger systems.

As we mentioned earlier, the full potential of the speaker and enclosure can be realized only when the enclosure has been designed to match the characteristics of the driver. In the design of horns and bass-reflex systems the most important consideration is the low-frequency resonance of the driver. In the case of the bass reflex, the port size is such that the enclosed volume of air resonates at the same frequency as the driver. The horn produces output down to its cutoff frequency. Below cutoff the horn output drops very rapidly.

The cutoff frequency of a horn is determined by its flare constant (the rate at which the horn expands). For optimum system per-

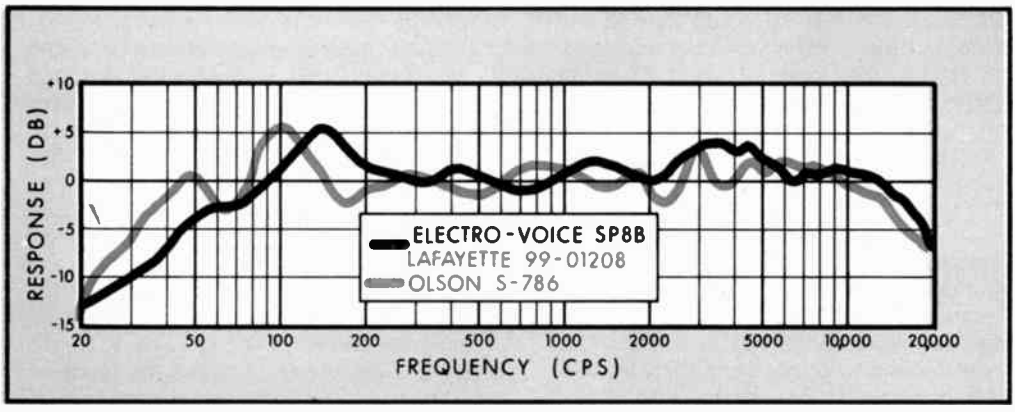


Fig. 1—Response of Olson and Lafayette speaker system is in color. Electro-Voice is in black.

formance the horn should be designed to cutoff at or just below, the resonant frequency of the driver. In the case of the Electro-Voice SP8B, the low-frequency resonance is around about 45 cps. The Olson S-786 resonates at about 35 cps.

The flare rate and port size are calculated for a 42-cps cutoff for Electro-Voice SP8B enclosure. The enclosure for the Olson S-786 cuts off at 30 cps. It was necessary to augment the high-end performance of the Olson S-786 with a Lafayette 99-01208 tweeter.

Building the Cabinet

Construction of either cabinet is not a difficult job. If you plan to cover the enclosures with decorative plastic material such as Contact, butt joints are permissible. On the other hand if a conventional cabinet finish is desired the joints must be mitered or rabbeted.

A covered cabinet can be made with fir plywood. A conventional cabinet should be made with a cabinet-type wood such as birch, oak or maple. Lumber-core is recom-

[*Continued on page 56*]

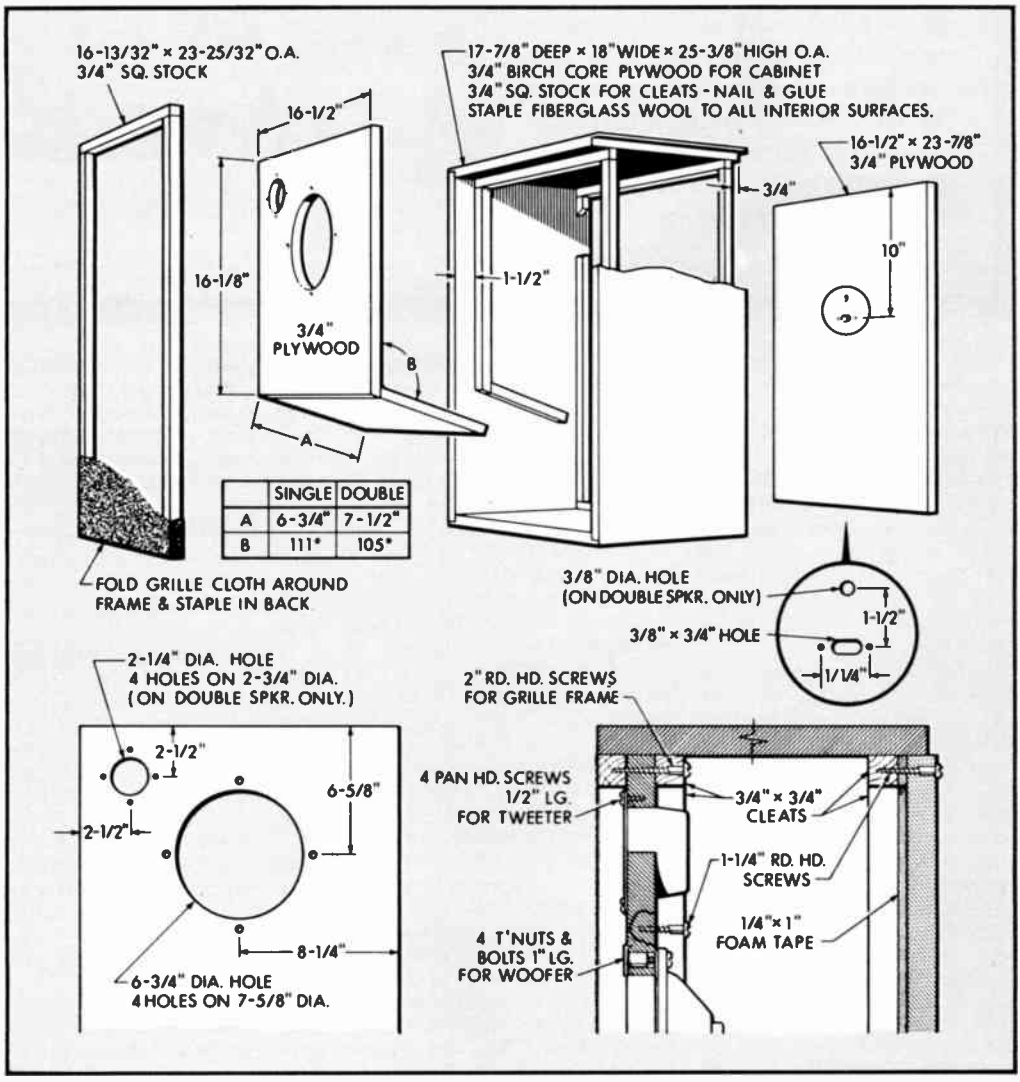


Fig. 2—Note that size and angle of board at bottom of front panel depends on speaker system.

"CIE training helped pay for my new house," says Eugene Frost of Columbus, Ohio

Gene Frost was "stuck" in low-pay repair work. Then two co-workers suggested he take a CIE home-study course in electronics. Today he's living in a new house, owns two cars and a color TV set, and holds an important technical job at North American Rockwell. If you'd like to get ahead the way he did, read his inspiring story here.

IF YOU LIKE ELECTRONICS—and are trapped in a dull, low-paying job—the story of Eugene Frost's success can open your eyes to a good way to get ahead.

Back in 1957, Gene Frost was stalled in a low-pay repair job. Before that, he'd driven a cab, repaired washers, rebuilt electric motors, and been a furnace salesman. He'd turned to TV service work in hopes of a better future — but soon found he was stymied there, too.

"I'd had lots of TV training," Frost recalls today, "including numerous factory schools and a semester of advanced TV at a college in Dayton. But even so, I was stuck at $1.50 an hour."

Gene Frost's wife recalls those days all too well. "We were living in a rented double," she says, "at $25 a month. And there were no modern conveniences."

"We were driving a six-year-old car," adds Mr. Frost, "but we had no choice. No matter what I did, there seemed to be no way to get ahead."

Learns of CIE

Then one day at the shop, Frost got to talking with two fellow workers who were taking CIE courses... preparing for better jobs by studying electronics at home in their spare time. "They were so well satisfied," Mr. Frost relates, "that I decided to try the course myself."

He was not disappointed. "The lessons," he declares, "were wonderful—well presented and easy to understand. And I liked the relationship with my instructor. He made notes on the work I sent in, giving me a clear explanation of the areas where I had problems. It was even better than taking a course in person because I had plenty of time to read over his comments."

Studies at Night

"While taking the course from CIE," Mr. Frost continues, "I kept right on with my regular job and studied at night. After graduating, I went on with my TV repair work while looking for an opening where I could put my new training to use."

His opportunity wasn't long in coming. With his CIE training, he qualified for his 2nd Class FCC License, and soon afterward passed the entrance examination at North American Rockwell. "You can imagine how I felt," says Mr. Frost. "My new job paid $228 a month more!"

Currently, Mr. Frost reports, he's an inspector of major electronic systems, checking the work of as many as 18 men. "I don't lift anything heavier than a pencil," he says. "It's pleasant work and work that I feel is important."

Changes Standard of Living

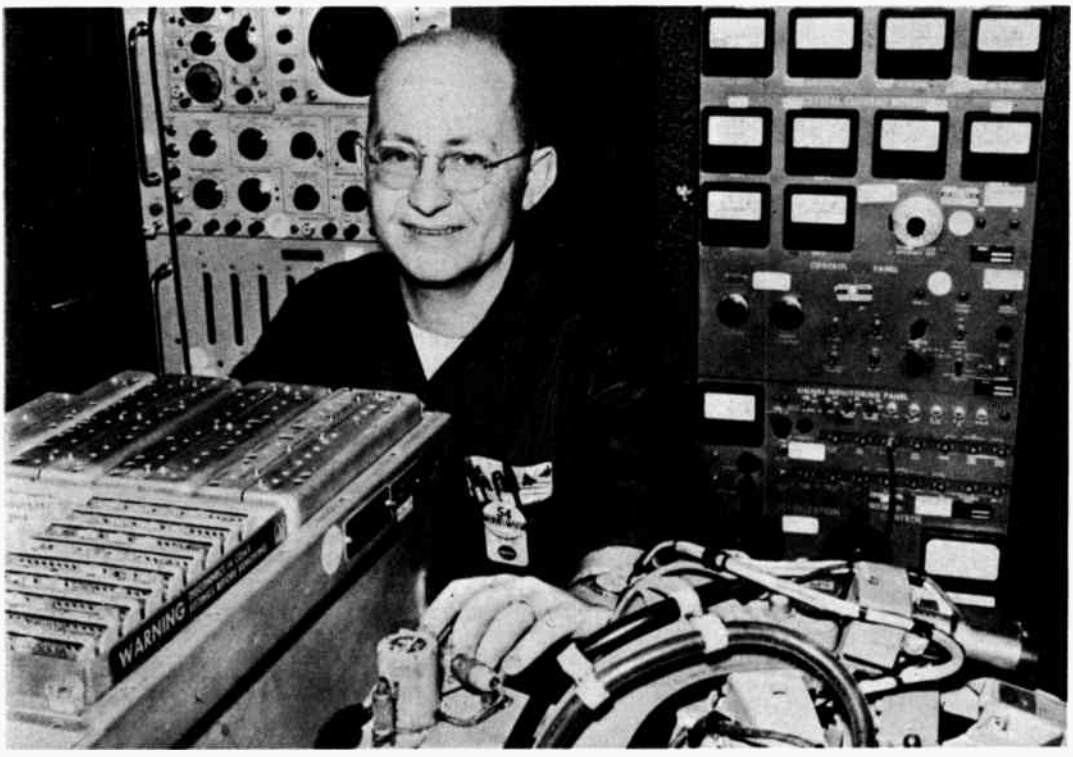
Gene Frost's wife shares his enthusiasm. "CIE training has changed our standard of living completely," she says.

"Our new house is just one example," chimes in Mr. Frost. "We also have a color TV and two good cars instead of one old one. Now we can get out and enjoy life. Last summer we took a 5,000 mile trip through the West in our new air-conditioned Pontiac."

"No doubt about it," Gene Frost concludes. "My CIE electronics course has really paid off. Every minute and every dollar I spent on it was worth it."

Why Training is Important

Gene Frost has discovered what many others never learn until it is too late: that to get ahead in electronics today, you need to know more than soldering connections, testing circuits, and



replacing components. You need to really know the fundamentals.

Without such knowledge, you're limited to "thinking with your hands" . . . learning by taking things apart and putting them back together. You can never hope to be anything more than a serviceman. And in this kind of work, your pay will stay low because you're competing with every home handyman and part-time basement tinkerer.

But for men with training in the fundamentals of electronics, there are no such limitations. They think with their heads, not their hands. They're qualified for assignments that are far beyond the capacity of the "screwdriver and pliers" repairman.

The future for trained technicians is bright indeed. Thousands of men are needed in virtually every field of electronics, from 2-way mobile radio to computer testing and troubleshooting. And with demands like this, salaries have skyrocketed. Many technicians earn $10,000, $12,000 or more a year.

How can you get the training you need to cash in on this growing demand? Gene Frost found the answer in CIE. And so can you.

Send for Free Book

Thousands who are advancing their electronics careers started by reading our famous book, "How To Succeed In Electronics." It tells of the many electronics careers open to men with the proper training. And it tells which courses of study best prepare you for the work you want.

If you'd like to get ahead the way Gene Frost did, let us send you this 44-page book free. With it we'll include our other helpful book, "How To Get A Commercial FCC License." Just fill out and mail the attached postpaid card.

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mended as the edges need not be covered or concealed. A good sanding will suffice.

You can save yourself a lot of work if you prepare a list of the lumber sizes needed and simply give it to your lumber dealer. Most will charge a nominal fee to cut the pieces to size, others will do it at no charge. Your task then will be to make only the necessary cutouts and assembly.

The rabbeted joints, if required, are best cut with the table saw. Set the fence to make the narrow or horizontal cut first then make the second pass to drop out the rabbet. If you do not have a table saw, you can get by with a portable saw. This is a little tricky. but it can be done. Here's how: Set the depth of the blade so it will cut up to the first layer of veneer. Lock the depth-adjusting screw tightly then proceed to make the first cut ¾ in. in from the edge of the board. Use a strip of wood tacked down to the work as a guide to be certain that the first cut will be parallel to the edge. The following cuts can then he made by advancing the saw crosswise a little at a time until the rabbet is produced. Clean out the cut with sandpaper wrapped around a small block of wood.

Assemble the top, bottom and sides with nails and glue. If clamps are available use them and eliminate the nails. Apply a coat of glue to the end grain and let it set about 10 minutes. Apply another coat and then join the parts. Be certain the ends line up before nailing or applying clamps. Wipe away oozed-out glue with a damp cloth.

Prepare the panels by making the necessary cutouts and holes for the speakers and the L-pad. The front panels are beveled on the lower edge as indicated. Fasten the panels with cleats which should be firmly glued in place. When installing the cleats for the rear panel, be sure to allow clearance for the foam weather-stripping seal.

The grille cloth is attached to the frame using a spray adhesive. Apply a coating to both the cloth and frame and while it's still tacky wrap the cloth around the frame pulling it tightly as you wrap.

If the enclosures are to be covered, do so before installing the front frame and rear panels. If the cabinet is to be finished, apply stain then follow the coats of laquer, varnish or shellac. The speaker mounting board should be painted flat black.

If you have built the high-cost system that uses one speaker, it is necessary to put only one rectangular hole in the rear cabinet panel for a two-lug screw-type terminal strip.

The two-speaker system requires two holes in the rear panel. One is the L-pad (Lafay-

Fig. 3—Interior view at right shows how diagonal baffle is mounted. Use screws and glue. Line rear cleats with weather stripping.

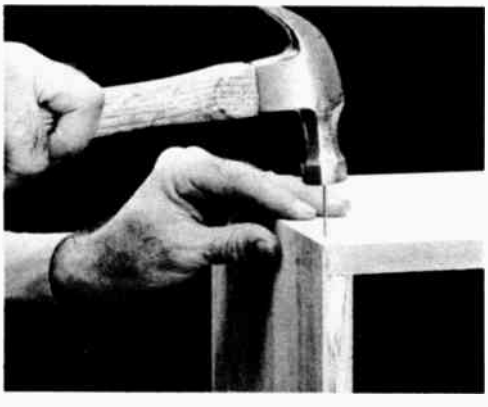
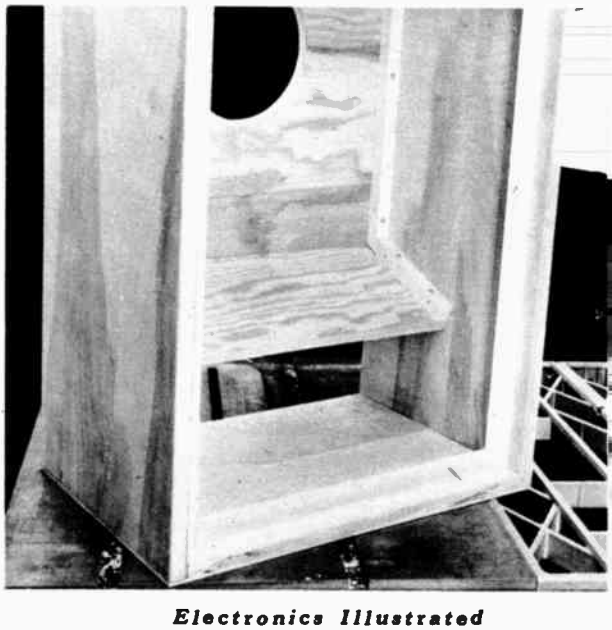


Fig. 4—Rabbeted joints are nailed and glued. Butt joints may be substituted if you're going to cover cabinet with material like Contact.



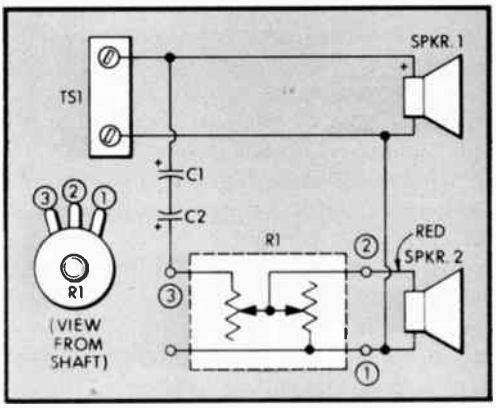


Fig. 5—Schematic of dual speaker system. Be sure to connect speakers correctly for proper phasing. C1, C2 are connected back-to-back.

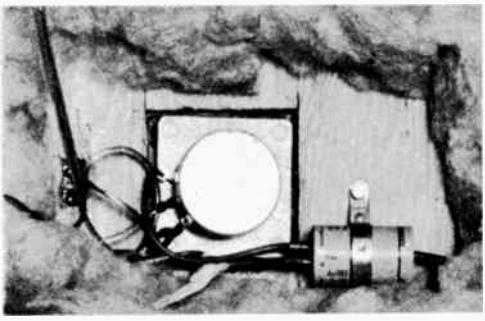


Fig. 6—Photo shows how L-pad and dual 8-μf electrolytic capacitor are mounted in back panel. Cut off negative lead of the capacitor.

ette 99 F 61343) and the other is for the terminal strip. By the way, the purpose of the L-pad is to let you adjust the output level of the tweeter for best balance.

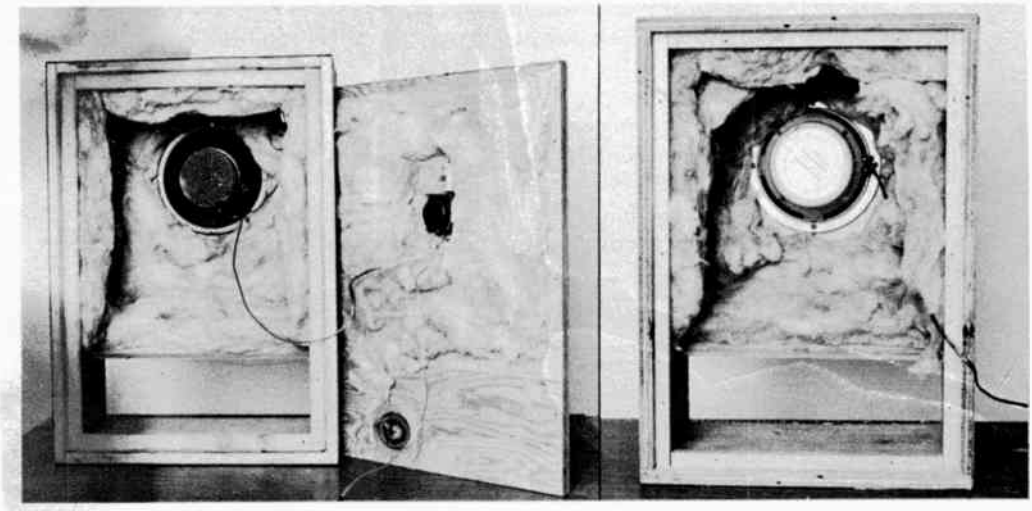
Capacitors C1 and C2 in the schematic in Fig. 5 are 8-μf, 50-V electrolytics. They form a simple high-pass filter that permits only high-frequency program material to reach the tweeter.

Be sure to connect the electrolytics as shown—negative end to negative end (not positive to negative). Connecting them his way makes them into a non-polarized capacitor. So connected, their total capacitance becomes 4-μf. You save money by doing it this way because a 4-μf non-polarized capacitor would cost about three times more than a pair of ordinary electrolytics.

A few words about the size of the wire you should use from the amplifier to the speakers. To begin with, both speaker systems have a nominal impedance of 8 ohms. You can use ordinary zip-cord lamp wire or clear plastic wire. But the size is important and depends on the length of the run.

For example, using No. 14 wire, the maximum length is 250 ft. If you plan to use No. 16 wire, you're limited to a length of 150 ft. Using No. 18 wire, the most common lamp-wire size, will limit you to a run of 100 ft. If the wire is No. 20, the maximum length you can use is 50 ft. –

Fig. 7—Left photo shows interior of dual-speaker system. Tweeter is in upper right corner. Cover interior (except bottom of back panel) with fiberglass. Single-speaker system is at right.



Big Noise in

BY ROBERT ANGUS

IF YOU'VE been to a hi-fi show or looked at an audio ad since the Beatles broke up you're already aware of four-channel sound for the home. Some boosters call it quadraphonic (incorrectly) sound and others go for quadriphonic (perhaps correct) and four-channel stereo.

In the unlikely event you're still uninitiated, we'll explain that four-channel claims to do to two channel what stereo did to mono. By providing four separate sound sources, one in each corner of a room, quadriphonic attempts to recreate at home, not only the width and breadth of, say, a symphony orchestra but the acoustics of the hall, as well. Or if rock is your bag you can sit in the middle of a room with one of these rigs and be surrounded by the Rolling Stones or Chicago.

Discrete. Simplest way to convey four channels to your home is to provide four pickup points in a recording studio (mikes to left and right of the performers up front and others aimed at the rear corners, for example) and maintain four discrete paths through your four-channel amplifier to four speakers. This is exactly what happens on tape. An eight-track cartridge which formerly held four pairs of stereo tracks now holds only two pairs of four-channel programs. This means either half as much music in the cartridge or double the amount of tape to hold the same amount of music.

On open-reel tapes or cassettes, it's means recording four tracks in one direction with a separate track for each speaker. Four-channel cartridge players are available from such manufacturers as Lafayette, Allied Radio Shack, Toyo, Motorola, Fisher and RCA, while four-channel open-reel decks and recorders come from Teac, Wollensak, Crown International, Astrocom-Marlux and others.

The advantages of four separate channels are obvious: it's possible to maintain the same fidelity standards that exist for two-channel stereo: 35db channel separation, full frequency response (50-15,000 cps or better), good signal-to-noise ratio, etc.

You can enjoy four-channel stereo from open-reel recorders right now . . . if you have $450 to $1,800 to shell out for the deck. Then there's the cost of tapes—$8.95 for approximately 32 minutes of music from Vanguard, which has a catalog of approximately a dozen titles. Then you'll need two more channels of amplification plus the two loudspeakers for the rear corners. If you decide to go ahead you'll find equipment available from Wollensak, Teac, Astrocom-Marlux and Crown International.

Or for $8.95 you can buy a four-channel, eight-track cartridge from RCA, and for an additional $170 you can buy something to play it on like the Toyo CH-702 (Fig. 1). Allied Radio Shack, Ampex, Fisher, Lafayette, Motorola, RCA and Toyo at press time were the only manufacturers with four-channel cartridge equipment on the market but more will be here by Christmas.

Four Channel

Four-channel cassette players have been demonstrated by Ampex, Astrocom-Marlux, Panasonic and Norelco but none was commercially available when this article was prepared.

Multiplex. Every audiophile knows you can make one FM channel (one assigned carrier frequency) do the work of two. Stereo FM is an example. Here the broadcaster adds left- and right-channel program material to form one of the transmitter's modulating signals. (To a mono FM receiver, this is a compatible or mono signal.) He also *subtracts* right from left to produce another signal that modulates a 38-kc subcarrier whose sidebands also modulate the transmitter.

A stereo FM receiver picks up this composite signal and is able to figure out what left and right were and, thereupon, recreates the two channels of information.

Quadriphonic FM, just now creeping up on us, has been produced by the teaming-together of two broadcasters, each transmitting two signals. One could be front, left and right; the other rear, left and right. Or one could transmit all left, the other all right. Two receivers are required to turn these signals into four channels.

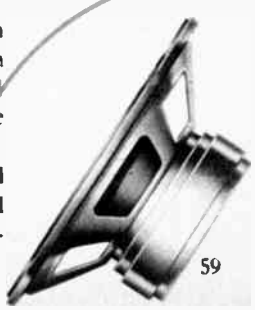
Another way of doing this (and a few FM broadcasters are now doing it) is to feed four signals into an encoder (such as one made by Electro-Voice) whose two composite output signals modulate the FM transmitter, as previously described. Connected to the output of an FM tuner, a decoder converts the two composite signals into a four channels of information.

Before the present stereo disc appeared on the scene, inventor Jerry Minter came up with a somewhat similar proposal for records: cut the sum of two channels into a conventional record groove, yielding a frequency response of, say, 50-15,000 cps. Then include an ultrasonic carrier signal, also in the groove, of say, 45,000 cps to carry the difference information.

The problems were many. At the time, phono cartridges weren't capable of reproducing frequencies of 45,000 cps. Even if you could have multiplexed stereo on a record in this fashion, the disc would have played hob with FM multiplex equipment if anyone tried to broadcast it because of the conflict between the record's carrier signal and that of the broadcaster.

Now the Victor Co. of Japan claims it has a solution—a record which operates within acceptable tolerances yet which, the company says, can be broadcast. To play the record, JVC has a new cartridge it plans to sell for about $25 which has the necessary compliance to do the job. So we may yet have four-channel sound from a record—on the air.

Encoded-Decoded. Not everybody agrees yet that quad sound should consist of four pure channels of information. Engineers like Leonard Feldman, Peter Scheiber and others are convinced that pure four-



AUDIO SPECIAL

Fig. 1—Four-channel cartridge players. At top left is $79.95 Lafayette RK-48. At top right is $249.95 RCA YZD-440 (comes with four speakers). At lower left is Allied Radio Shack TR-284. At lower right is $129.95 Toyo CH-702.

Big Noise in Four Channel

channel, while ideal for Ping-Pong effects and spectacular to listen to for brief periods, can disorient the serious listener. In varying degrees, these engineers have blended left and right, front and rear channels to create what they consider a more acceptable listening environment. As it happens, blending channels makes it easier to matrix (or multiplex) on a record or over the air.

In the Scheiber system, for example, it works like this: the left front speaker reproduces 100 per cent of the left front signal. But it also includes 35 per cent of the right front and left rear signals. The right front speaker contains 100 per cent of the right front signal, plus 35 per cent each of the left front and right rear. And so on around the room. The result is less channel separation, left to right and front to rear, than is available from a pure four-channel tape.

The Electro-Voice system, which recently has incorporated the Scheiber approach and was developed originally by Feldman, front-channel separation is said to be only 12db—considerably less than the channel paration of 35db obtainable from :sent-day two-channel stereo records and cartridges. Instead, Electro-Voice has provided channel separation of something like 25db front-to-back.

Feldman feels that this creates an environment in which the classical music lover can enjoy the ambience he finds in a concert hall without the instrument isolation at the speakers and the pop or rock aficionado can enjoy the total environment of electronic music without the schizophrenic feeling that comes from extreme separation.

CBS Labs has a system using matrixing which it claims approaches discrete four-channel. The CBS *Stereoquad* record groove contains normal left- and right-channel information. The stylus is also modulated in a clockwise helical pattern for left-rear information, and counterclockwise for the right-rear. The result: left-to-right separation comparable to a stereo disc and 3db front-to-back separation.

According to Electro-Voice vice president Howard Durbin, the Scheiber and Electro-Voice systems are close enough that they can be merged for patent application purposes. Or they can act as a synthesizer to give the four-channel effect to some two-channel records, tapes or broadcasts.

The trouble is that neither Durbin nor anybody else really knows for sure. The synthesized-system sweepstakes is something

Fig. 2—Four-channel adaptors we tested. At top left is $29.95 Lafayette Dynaquad. At lower left is $199.95 Sansui Model QS-1. Above is $59.95 Electro-Voice Stereo-4. (Heath has a kit version of Electro-Voice for $29.95.)

like a poker game in which each player tries to keep the others guessing until he gets patents on his system or he gets some sort of industry acceptance.

In a bid to outflank the others, Electro-Voice has been providing radio stations and recording studios with encoders, other manufacturers (like Dynavoice and Allied Radio Shack) with integrated decoders and audio reviewers with home decoders to get that system under way. While Dorren has been working with one manufacturer (Mikado) and one radio station (KIOI in San Francisco), Electro-Voice has persuaded more than a score of FM stations to try its system and has a handful of record companies, including Ovation and Project 3, cutting records using their special four-channel encoder.

Believe it or not, it's also possible to get a four-channel effect—some audio experts claim it's more realistic than some of the *encoded-synthesized* product—from two-channel records and tapes. The cheapest way to get four-channel is with the Dynaco system, developed by Dynaco president David Hafler. According to him, there has always been four-channel information on stereo discs—the part of the program that's out of phase when the

Fig. 3—Our first four-channel listening tests started with discrete. We used a Teac reel-to-reel deck and two preamps (at the left).

Fig. 4—Records for encoded/synthesized- and derived-system tests were played on Empire Troubador turntable and 1000 ZE/X cartridge.

AUDIO SPECIAL

Big Noise in Four Channel

original two-channel master is cut. This out-of-phase information gets cut right on the record, along with the music you're used to hearing. To retrieve it, all you need, in addition to your present stereo rig, are a control box or two resistors and two more speakers. If you already own an extra pair of speakers and opt for a control box marketed by Dynaco, Lafayette or Eico, the total cost will be $29.95. If you're willing to put the control box together yourself, Dyna will sell you a kit for $10 less. Eico's kit is $17.95. (See MAKING 2 CHANNELS INTO 4 elsewhere in this issue.)

At its best, the Dyna system can provide good-quality quad sound. The reason: the front speaker separation remains what it is now in your stereo system. At no time do the rear speakers have the separation from the front that the encoded-decoded system gives, but the effect can be heightened or diminished by raising or lowering the volume of the rear speakers.

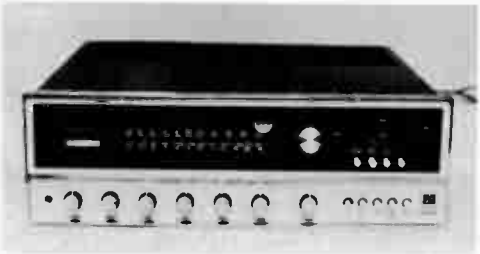


Fig. 5—For our tests we needed a four-channel amplifier. We used a Fisher Model 701 receiver rated at 40 rms watts per channel.

Unfortunately for Dyna, not all recordings contain the same amount of out-of-phase information—Dyna is trying to get record makers to include more out-of-phase information in future releases.

On the other hand, the Dyna system doesn't require an expensive outlay another stereo or a four-channel amplifier, new records or tapes. Even conventional stereo broadcasts provide program material for four-channel listening because the system

[*Continued on page 102*]

LISTENING PANEL REPORT

To evaluate the quadriphonic systems available today, EI convened a panel of experienced audiophiles. First question was what factors to consider. We arrived at three:

- DEFINITION: individual sound of each instrument and performer should be heard in its proper dimensions and clearly. (A singer should not sound like he has a mouth 5-ft. wide, and a violin should not sound like some other instrument.)
- SPATIAL PERSPECTIVE: the physical placement of sound sources. Correct placement should make the listener feel he's sitting in the orchestra of a concert hall. The sound of the orchestra should come from the stage and reverberations should come from the rear ceiling and sides of the hall.
- SPATIAL PERSPECTIVE AND LISTENING POSITION: the experience of a listener moving in the listening room should approximate movement in a concert hall. In adequate systems, the whole orchestra may seem to move or change size, shape as the listener moves.

Discrete Systems: Good on all three criteria. Our $2,000 system was composed of a Teac TCA40 four-channel, open-reel deck, two Teac RA-41 playback preamps, a Fisher 701 four-channel receiver and four Advent speakers. Resulting sound made for satisfying and sophisticated listening. We also tried an RCA (YZD-440) using Quad-8 cartridges and RCA's own speakers. Though the result was richer sound than produced by a stereo system, the instruments were not well defined and the general quality of the sound was not too crisp.

Encoded-Decoded Systems: The Electro-Voice EVX-4 system (requires a second stereo amplifier or a four-channel amplifier) lacked some of the clear definition of the $2,000 system, but then you can put together a system using it for about one-quarter the cost. (It sells for $59.95. There's a Heath $29.95 kit version, the Model AD-2002). With an encoded record, the sound very closely approximated that of the discrete system. We felt it was good to excellent on all criteria. The listening location was just slightly more critical than that of the discrete system.

When using the Electro-Voice to synthesize four channel from a two-channel source (an ordinary stereo record), the result was not as good as that of a discrete system, but quite acceptable. The definition was excellent, the spatial perspective fair, the listen-position requirement was fair to good.

In our opinion, the $199.95 Sansui Quadphonic Synthesizer (requires a second stereo amp) is a quadriphonic decoder and sound-effects processor. The operating manual doesn't make clear normal four-channel-decoder and special-effects operation. In the *Concert-Hall 1* position (four-channel decoder operation) of the six-position *function* switch, the sound equaled that of the Electro-Voice system. Other switch positions (except one for normal stereo from front speakers) produced exaggerated four-channel effects and made the listener feel surrounded by the performers.

The Dynaco four-channel system (can be used with a stereo amplifier), available from Dynaco ($29.95 assembled, $19.95 kit) Lafayette ($29.95) and Eico ($29.95 assembled, $17.95 kit) was checked two ways. Using encoded program material (special record), it had excellent definition, good spatial perspective, and the listening position was not critical. But when tested with unencoded program material (stereo record) the definition and spatial perspective were fair, and the listening position was critical. The listening experience generally was considered less satisfactory than with other systems.

AUDIO SPECIAL

Direct-Reading Power Meter

How much power is your amp really putting out? Our meter shows it directly up to 100 watts, with or without an external load.

By JOSEPH RITCHIE

AMONG the many things you must be able to determine when testing an audio amplifier is output power. You're doing the job the hard way if you calculate power using a voltmeter, formula and slide rule. It's certainly much faster to be able to read power directly from a meter scale.

Designed to handle anything from a pocket radio to a powerhouse stereo amp, our Direct-Reading Power Meter will indicate output power instantly without calculations, conversion tables or a slide rule. And you can use it to constantly monitor how much power the amp is delivering to speakers when listening to standard program material.

The meter has built-in 4-, 8- and 16-ohm loads and will handle up to 100 watts depending on the load. For example, the 4-ohm load is 50 watts, the 8-ohm load (two 4-ohm series connected 50-watt resistors) is 100 watts and the 16-ohm load is 100 watts. Load-selector switch S1 automatically calibrates the instrument so that only one meter scale is needed. If you need or prefer to use an external load (such as speakers) calibration is automatically provided by S1, which also disconnects the internal load resistors (R1-R3).

The worst-case overall accuracy is 10 per cent when 5 per cent resistors are used for the power-range divider. If 1-per cent divider resistors are used, or if the 5-per cent resistors are selected for exact value, the accuracy is about 5 per cent. The frequency response is ± 1db from 50 cps to 20,000

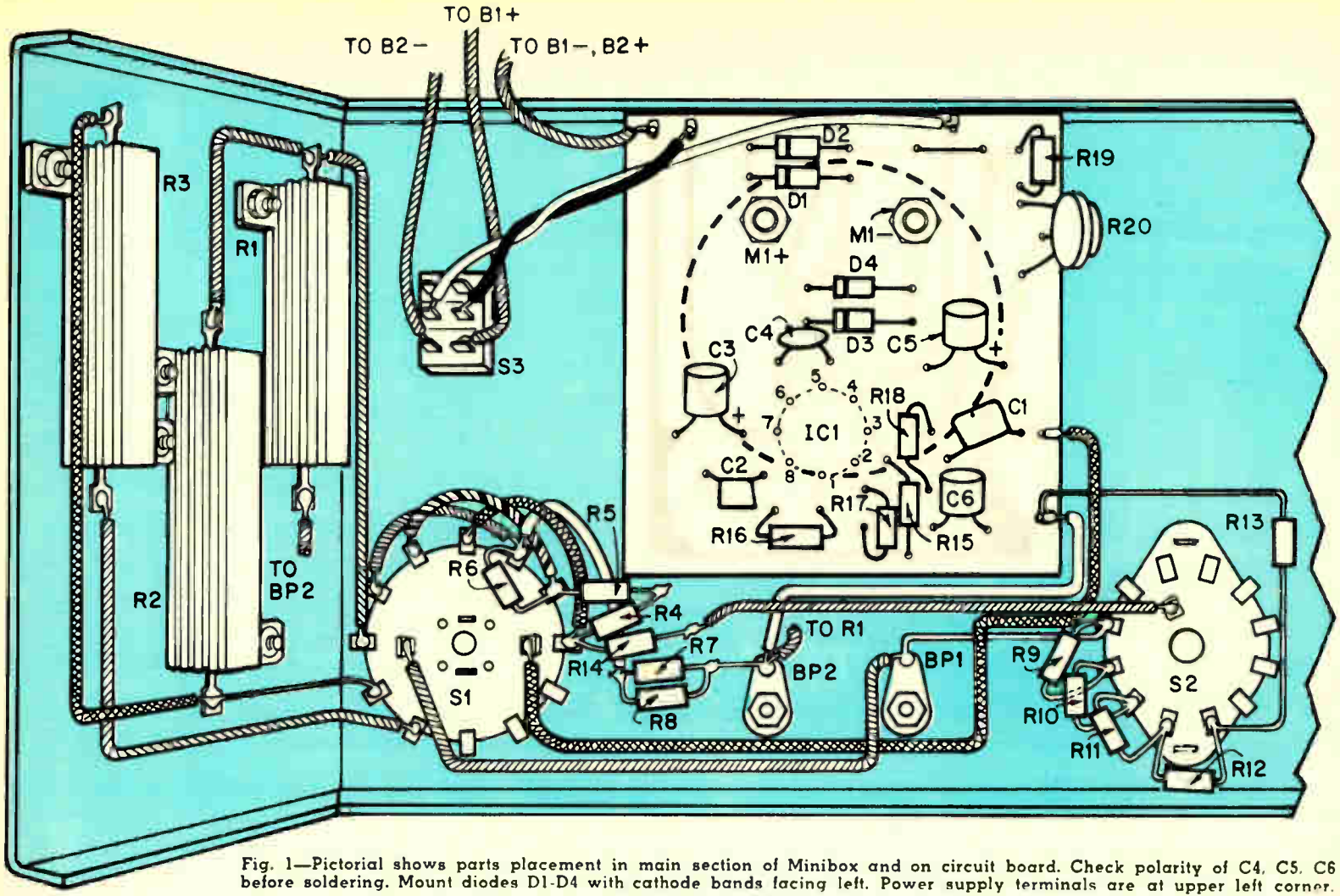


Fig. 1—Pictorial shows parts placement in main section of Minibox and on circuit board. Check polarity of C4, C5, C6 before soldering. Mount diodes D1-D4 with cathode bands facing left. Power supply terminals are at upper left corner.

Direct-Reading Power Meter

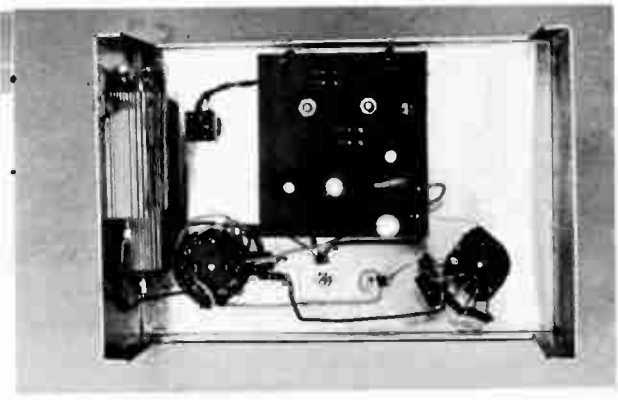


Fig. 2—Circuit board mounts directly on meter's terminal screws. Power resistors will fit on side of cabinet if center one is below adjacent ones.

Fig. 3—Meter amplifier is on circuit board. Note that hole spacing is for printed-circuit capacitors and end-mounted resistors. Diodes lie flat.

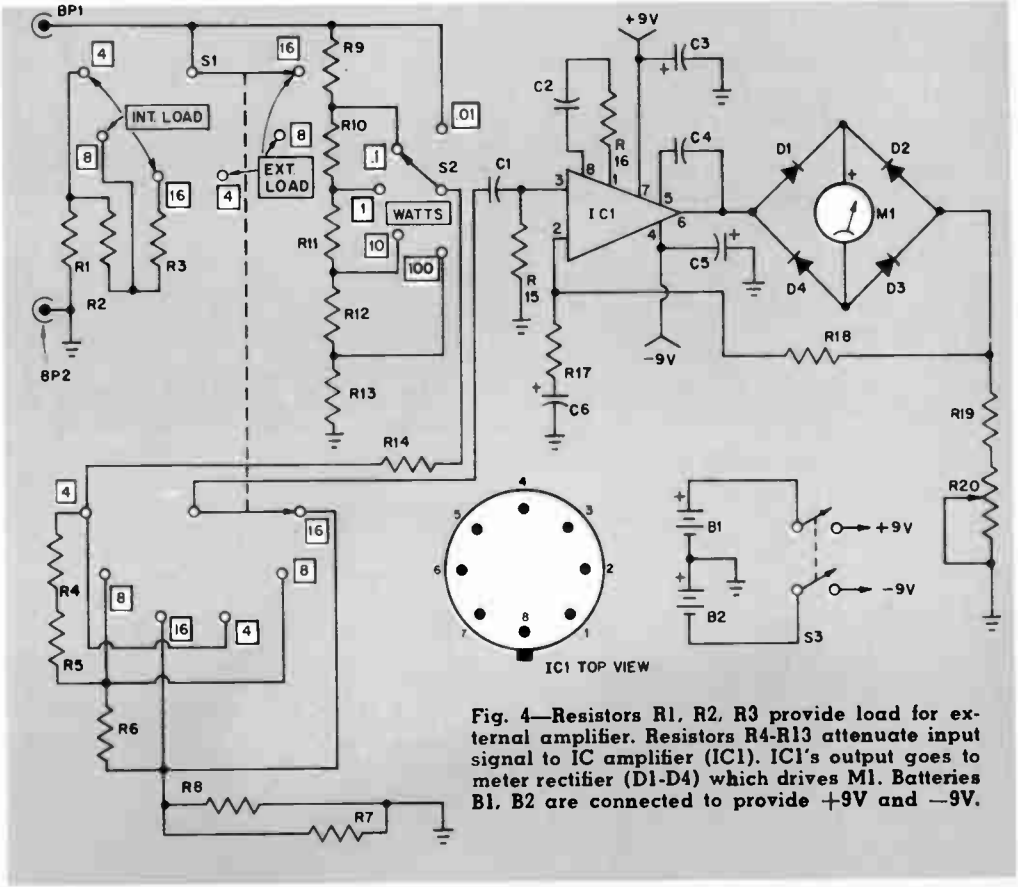


Fig. 4—Resistors R1, R2, R3 provide load for external amplifier. Resistors R4-R13 attenuate input signal to IC amplifier (IC1). IC1's output goes to meter rectifier (D1-D4) which drives M1. Batteries B1, B2 are connected to provide +9V and —9V.

AUDIO SPECIAL

Direct-Reading Power Meter

cps. The low end can be improved to 20 cps by using a 0.47 μf capacitor for C1.

Because of the low current requirement of about 1 ma, and because the meter amplifier (operational amplifier IC1) will deliver essentially 100-per cent accuracy with a power supply as low as 3 V either side of ground, the batteries will last for their shelf life.

Construction. The meter shown is built in a 7 x 5 x 3-in. Minibox. A larger cabinet can be used as long as the parts layout and wiring are the same as shown in Fig. 1. Meter M1 can be any 0-1 ma DC type, though the supplied scale in Fig. 6 will match only the meter specified in the Parts List. If you use any other meter the scale must be hand calibrated, which we'll explain later. Also, spacing of the meter's terminal screws on the printed-circuit board might not be correct for another meter.

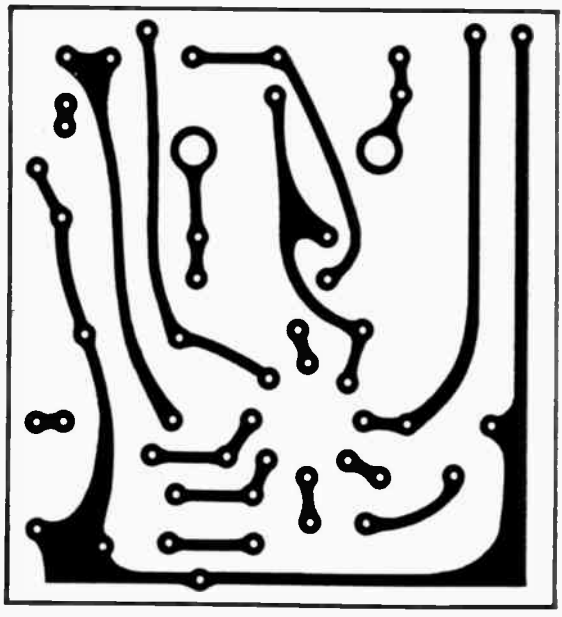


Fig. 5—Full-scale template for printed-circuit board.

First step is to make the printed circuit board. Cut a piece of copper-clad board to 3 x 2¾ in. and scrub the copper clean with steel wool or a household cleaner such as Ajax. Thoroughly dry the board and put a piece of carbon paper on top of the copper —carbon side toward the foil. Position the board and carbon under the template supplied in Fig. 5 and secure to the board with tape.

With a sharp-pointed instrument such as an ice pick, indent the copper foil at each component mounting hole by forcing the point through the template into the copper foil. Using a ball-point pen, trace the foil outlines on the template. Remove the board from under the template and carbon paper and using a resist pen such as supplied in the Allied Radio Shack printed-circuit kit (stock No. 276 B 1576) or a Kepro RMP-700 (Allied Industrial catalog No. 835-0497), fill in the copper foil outlines with resist.

Let the resist dry for about 15 minutes and then cover the board with at least ¼ in. of etchant solution. Allow approximately one hour for the etchant to remove the undesired copper. To insure even removal of the copper, agitate the etchant container every five or ten minutes. When all the unwanted copper is removed, rinse the board

PARTS LIST

B1, B2—9 V battery (Burgess 2U6 or equiv.)
C1—.25 μf, 75-V capacitor (see text)
C2—.001 μf, 75-V capacitor
C3, C5—50 μf, 15 V electrolytic capacitor
C4—50 μμf, 100 V disc capacitor
C6—200 μf, 6-V electrolytic capacitor
D1-D4—1N60 germanium diode
* IC1—Integrated-circuit amplifier (Fairchild μ5B770939X)
M1—0-1 ma DC milliammeter (Calectro D1-912)
Resistors: ½ watt, 5% unless otherwise indicated
R1, R2—4 ohm, 50 watt, 1% power resistor (Dale type RH-50. Allied Electronics Corp., 2400 W. Wash. Blvd., Chicago, Ill. 60680. Stock No. 767C2700. $2.75, plus postage. Specify resistance when ordering)
R3—8 ohm, 50-watt, 1% power resistor (Dale type RH-50. Allied 767C2800. $2.45 plus postage. Specify resistance when ordering)

R4—2,700 ohms	R7, R8, R14, R18—10,000 ohms
R6—2,000 ohms	
R9—680 ohms	R10—220 ohms
R11—68 ohms	R12—22 ohms
R13—10 ohms	R15—68,000 ohms
R16—1,500 ohms	R17—1,000 ohms
R5—200 ohms	R19—560 ohms

R20—1,000 ohm trimmer pot (Mallory MTC-11)
S1—Two-pole, six-position rotary switch
S2—One-pole, five-position rotary switch
S3—DPST toggle or slide switch
Misc.—7x5x3-in. Minibox, printed-circuit supplies.
* IC1 is available for $5 postpaid from Custom Components, Box 153, Malverne, N.Y. 11565. N.Y. State residents add sales tax. Canada add $1. No foreign orders.

under running water and remove the resist with a cloth saturated with acetone or rubber-cement thinner, or scrub with steel wool.

Use a No. 58 drill bit for the component mounting holes, a No. 21 bit for the meter terminal holes and a No. 50 bit for the power supply and input connections. To simplify final assembly, install Vector T-28 push-in terminals (or equiv.) at the power supply and input holes. If you use a meter other than the one specified, make certain the meter's terminal polarity matches that of our board's design.

Set the board aside until later. Next, install the new meter scale. Grasp the plastic meter face firmly and pry it off by first lifting one side and then the other. Remove the two screws holding the scale plate to the meter movement and very carefully slide the scale plate out from under the pointer. Cut out the scale in Fig. 6 and cement it over the old one. Take care to get precise alignment. Reassemble the meter.

Drill all the mounting holes in the cabinet. Load resistors, R1, R2 and R3, will just about fit on a side panel if the two end resistors R1, R3 are positioned as shown in Fig. 1.

Install all the cabinet components except the meter and board and wire them all except power switch S3. The only wiring left should be the power-supply wires, the input connections to the board and the ground end of R13 which connects from S2 to the board ground. Position all wires except the one from R14 to S2's wiper against the cabinets. The R14/S2 wire should be about ½ in. away from cabinet and other wires.

Install M1 and then mount the board on M1's terminals. Connect S1B's wiper (right lug, Fig. 1) to the amplifier input, positioning the wire about ½ in. away from the cabinet and other wiring. Keep this wire short and direct. Connect the board ground to binding post BP2. (Install BP1 with fiber insulating washers.)

Mount batteries B1 and B2 on the cabinet cover and connect the batteries in series so there is 18 V from end to end. Connect the remaining two battery leads to S3 and connect S3 to the board.

Checkout and Calibration. To keep costs low, electrical zero-center has not been provided. When power is first applied, M1 will kick upscale and will not return to zero. The pointer will rest very slightly above zero. Using a small screwdriver, turn M1's zero-adjust screw so the pointer indicates zero. (This adjustment has been taken into account in the dial calibration.) When S3 is turned off, the pointer will come to rest slightly below zero—this is normal.

Set S1 to 4 ohms *external* (all load resistors disconnected) and set S2 to the 1-watt position. Connect an audio signal generator to binding posts BP1 and BP2. Set the generator for a 2-V output. Set S3 to *on* and adjust trimmer pot R20 until M1 indicates 1 watt (full scale). Note that if your signal generator has a built in output meter it will not give an accurate indication because of the power meter's loading. Measure the 2-V generator output at BP1, BP2.

If adjusting R20 does not result in a full-scale (1 watt) indication, and if you are certain S1 and S2 are correctly wired, check that resistors R17, R18 and R19 are in their correct locations. Also check that their values are correct.

If M1 goes in a reverse direction when the test signal is applied, check the polarity of diodes D1 through D4. If you have used a meter other than the one specified make certain the polarity of its terminals matches the board's.

The use of 5-per cent resistors (to keep costs down) will result in very slight inaccuracy when decading from range to range (5 per cent maximum). If you want greater accuracy resistors R4 through R13 should be 1 per cent. The precise value for R10, if 1 per cent resistors are used, is 216 ohms.

Substitute Meter Calibration. Calibration for a meter other than the one specified in the Parts List is as follows: Set S1 to 4 ohms *external*, set S2 to the 1-watt range and apply a 2-V signal to BP1 and BP2. Adjust R20 for a full-scale meter deflection. Using the formula $E = \sqrt{WR}$, calculate the

[*Continued on page 102*]

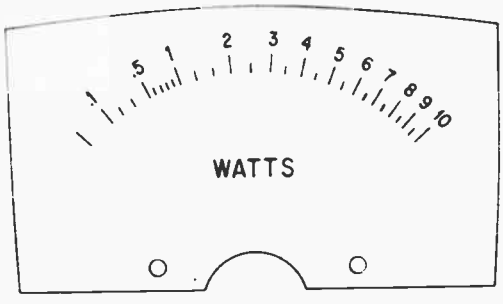


Fig. 6—Cement over specified meter's scale.

EI Evaluates the New Audio Cassettes

By ROBERT ANGUS

IN THE not-too-distant past when open-reel tape reigned supreme, it was a simple matter to judge the quality of tape yourself. You could look at the oxide coating and if it had a tendency to peel or flake you'd reject it. If the coating looked unusually rough or lumpy you'd know the recording wouldn't be good. And you could tell by scraping the coating with your fingernail and examining the amount of oxide under it how well the coating and base were bonded. Close examination of the tape would show up a tendency to cup and whether the base was polyester or acetate. By pulling the tape you could get an idea of tensile strength.

Then there were the recording tests. By splicing lengths of different tapes together and recording on them, you could quickly and easily make A-B evaluations with any combination of tapes.

The cassette has changed all that. Of course the tape still is perhaps the most important ingredient. But it's no longer possible to examine it physically as you could open-reel tape. Cassette-tape bases are simply too thin to permit scraping with a fingernail. Cupping isn't the problem it once was. Any cassette tape will stretch. And it's possible to put outstanding tape in a case that's too large to fit your recorder or in a case which doesn't contain

AUDIO SPECIAL

New Audio Cassettes

all the essential parts.

While such shortcomings may not show up on the first playing or two, they can affect long-term performance. The size and type of rollers (Fig. 2) in the corners of the cassette can affect wow and flutter or can cause the tape to jam. The type of anti-static sleeve (or absence thereof) affects not only the freedom of tape movement, but can add hiss to the sound.

After submitting 23 cassettes to our listening panel for an evaluation of recorded sound, we visually examined each one. We did this by unscrewing and disassembling those that were screwed together and breaking apart those that were welded together to check such things as the quality of the molding, whether the rollers or posts are used to guide the tape, pressure-pad construction and the type of sleeve used to prevent electrostatic-charge buildup and protect the tape pack. We discovered that generally, the quality of molding is very high, indeed. Absent from all of the samples reviewed are such defects as burrs which can interfere with tape movement, case halves which don't meet properly. Only the Ampex 362 exceeded standard cassette molding tolerances, but its performance otherwise was satisfactory.

One thing we couldn't check was the base material of the tape. While visual inspection of the tapes revealed many shiny, polished or calendered surfaces (which means that all the loose oxide has been knocked off during manufacture) we couldn't tell by simply looking whether the polyester base had been tensilized or not. Tensilizing, or pre-stretching the base material is a process which makes for strength. That, in turn, means less likelihood of breaks if the tape wraps around the recorder's capstan as well as less chance of tape stretching. Virtually all half- and quarter-mil open-reel tape was tensilized. But when the same base thickness was put in a cassette, some manufacturers found that they could buy untensilzed tape for a fraction of the price of the tougher variety.

As long as no problems develop with the tape-transport mechanism, it really doesn't make much difference—at least in the short run—whether the tape is tensilized or not. Among those manufacturers who reportedly do use tensilized tape are Audio Magnetics, Maxell, LRE, Memorex and Norelco. If you've assumed (as we did) that all cassette tapes are tensilized, take it from us—they aren't.

Some people feel that manufacturers weld the case to prevent you from seeing what parts have been left out. Speaking generally again we found no basis for this. Some of they very best cassettes (3M, Memorex) are welded. Others are screw-assembled. Some of the worst are sealed closed while average construction can be found in screw types. Surprisingly, one of the most expensive cassettes, Memorex, leaves out the most parts —rollers and head shield—while Certron and Audio Magnetics, who achieved reputations for manufacturing very cheap cassettes, included all of the parts found in the best cassettes.

All told, there are about 20 parts in a cassette (the exact number depends on the manufacturer, and the way you count). It is possible to dispense with some of them and to modify others without interfering with cassette performance. 3M, for example, has a large fixed post instead of a roller on

[*Continued on page 74*]

Fig. 1—Decks with Dolby noise-reduction circuit used for recording and playing cassettes were Advent 200 (left) and Harman-Kardon CAD-5 (right). One was used for special-bias cassettes.

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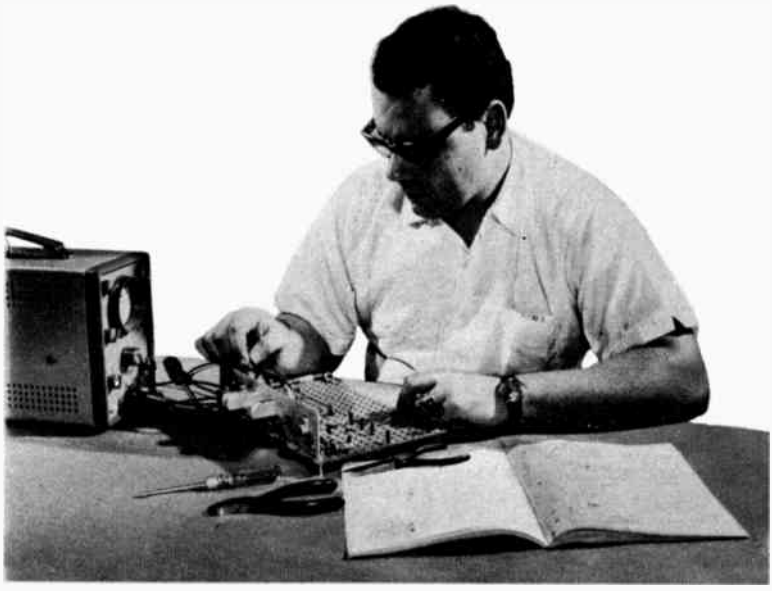

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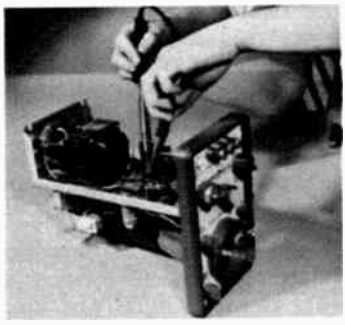
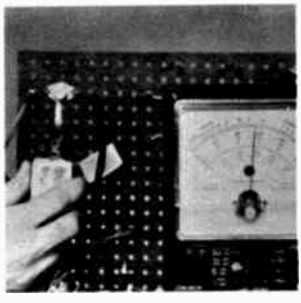
Construction of Multimeter.



Construction of Oscilloscope.

Temperature experiment with transistors.



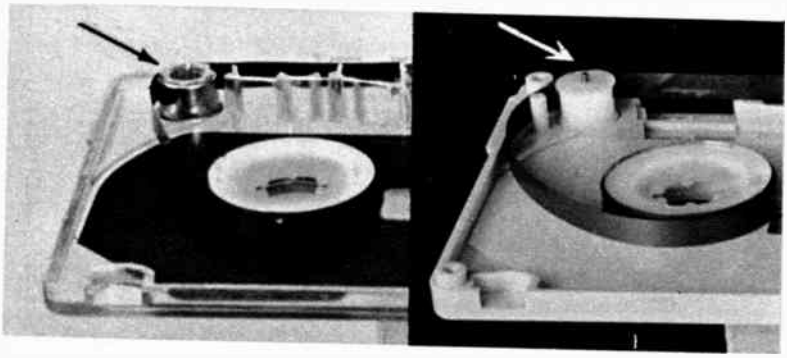


Fig. 2—In photo at far left arrow points to large fixed post used in a few cassettes. Dark material under hub is anti-static sleeve. In photo at near left, arrow points to a roller which is mounted on metal pin.

a steel pin to guide the tape.

Our selection of 23 tapes includes those you're most likely to find in stores. In addition, we've included a few best-selling private-label cassettes, such as Sears Silvertone, Sam Goody's SMG and Lafayette's Criterion. As it happens, each of these brands was manufactured by companies represented elsewhere in the tests. Though the panelists didn't know it, their opinions of the nationally advertised brand and the private label usually matched. We ruled out all of the so-called cheapie cassettes—those selling for $1 or less—and concentrated instead on the standard formulations of the leading national brands; on the premium-priced, premium-quality cassettes introduced last year; and on those few cassettes requiring a bias change for optimum results.

To test the cassettes, we used two decks (a Harman-Kardon CAD-5 and an Advent 200) equipped with a bias-adjustment switch and Dolby noise-reduction circuits. We recorded approximately two minutes of music on each cassette, beginning at the leader. To keep conditions as comparable as possible, each cassette featured exactly the same passage of piano music (Andre Watts playing the Liszt Paganini Etude in G) recorded with Dolby in at the same volume level. Naturally, the Dolby circuit was left on for playback, and all cassettes were played at the same volume level. Tone controls were left flat. Playback amplification was provided by a Fisher Model 701 four-channel AM/FM stereo receiver and two Advent speakers.

What surprised us was the consistency within each group. Hiss levels, even on standard formulations, are much lower than they were a year or two ago. And the difference between the poorest and the best cassette is not very great. The same can be said of the premium group and of the special-bias tapes, which means that the observations in the chart on the last page of this article are relative within each group. If you get the idea that our panel generally liked what they heard, that's the impression we're trying to convey.

Which is not to say that there were things we didn't like. For one thing, we found one of the most expensive, most highly advertised brands (Memorex) literally unusuable because of occasional fade-outs or loss of sound. We found that the bias adjustment for Crolyn tapes makes a significant contribution to reduction of tape noise.

More than half the samples exhibited poor sound in the first 30 seconds. This opening dropout can be caused by stretching the tape during high-speed loading of the cassettes, by splicing the leader tape at an incorrect angle to create tape skew or by grease from the fingers of the person that spliced on the tape during manufacture. Solution: begin a recording several seconds after the cassette starts. Because the incidence of this was so high, and because it occurred with such a large number of brands, we didn't include it in our chart.

Progress in cassette manufacture has been both persistent and dramatic. Norelco's best tape in EI's last cassette survey (March '69) has become Norelco 100, the cassette recommended for recording speech and low-fi music. Bell & Howell's first run of UHD cassettes was so bad that the tape refused to move within the case. Samples from the second run, reviewed here, compare favorably with others in the premium category.

It seems likely that progress will continue, and that the manufacturers represented in our survey will continue to upgrade their products so that the cassette you buy a year from now won't be the same one reviewed here.

AUDIO SPECIAL

New Audio Cassettes

CASSETTE APPRAISALS

Brand	Price	Sound	Construction
Standard Cassettes			
Ampex 361	$2.25	Good high-frequency response, some hiss. Midrange and bass only adequate.	Rollers, welded, quality molding. Two anti-static sleeves.
Audiotape C-60	$2.65	Good overall frequency response, generally low noise.	Large rollers, unusually good welding, average molding. Two teflon sleeves.
BASF C-60	$2.77	Excellent lows, some hiss. A good standard tape for average recording.	Quality molding with all necessary parts. Screw construction.
Norelco 100	$2.65	Excellent highs and lows, minimum hiss. Realistic piano sound.	Rollers, welded, precision molding. Teflon sleeves.
RCA Red Seal C-60	$2.75	Clean sound. Excellent for general recording. Low hiss level.	Rollers, welded, good molding. Anti-static sleeves.
Sears Silvertone C-60	$2.29	High hiss and noise level. Average frequency response.	Fixed posts, welded. Anti-static sleeves, good pressure-pad assembly.
Sony C-60	$1.89	Good frequency response but some background noise. About average performance.	Rollers, welded, excellent molding. Paper sleeves.
Soundcraft C-60	$2.95	Realistic sound with good highs and lows. Some tape noise.	Rollers, average molding. Anti-static sleeves, good pressure-pad assembly.
Scotch C-60	$2.75	Average high- and low-frequency response. Hiss higher than average.	Fixed posts, welded. Anti-static sleeves, good pressure-pad assembly.
Premium Cassettes			
Audio Magnetics QHFC-60	$1.50	Some muddiness in bass frequencies, and some noise. Overall average sound.	Rollers, screw construction, quality molding and good pressure-pad assembly.
Ampex 362	$2.95	Good frequency response but some wow and hiss.	Rollers and teflon sleeves. Welded, average molding. Good pressure-pad assembly. Sample larger than standard.
Bell & Howell UHD C-60	$2.65	Excellent frequency response with crisp highs and lows. Some hiss throughout.	Rollers, welded, quality molding. Anti-static sleeves.
Certron Deluxe C-60	—	Average hiss and good frequency response. Nice natural sound.	Rollers, screw construction, excellent molding. Combination sleeves and windows.
LRE Criterion C-60UD	$2.98	Wow. Frequency response generally below average, poor highs.	Rollers, screw construction. Quality molding and anti-static sleeves.
Maxell C-60UD	$3.75	Somewhat muddy sound with odd tonal balance.	Screw construction, precision molding with all necessary parts.
Memorex C-60	$2.19	Sound mushy and faded. Impossible to judge test cassette because sound was so bad.	Large rollers on plastic posts. Welded, molding good. No mumetal shield for head. Dual anti-static sleeves.
Norelco 300 C-60	$2.65	Good high-frequency response. Good sound, with fairly high hiss level. Generally good lows as well.	All parts including rollers. Screw construction. Pins and sleeves, good pressure-pad assembly.
Scotch C-60HE	—	When recorded at same levels as other tapes, played back 5db louder. Sound clean, undistorted and turning down play-back volume put tape hiss at extremely low levels.	Welded construction includes fixed tape guides, anti-static sleeves. Well molded with good pressure-pad assembly.
SMG C-60	$1.59	Hiss level higher than on other tapes. Lows and overall frequency response inferior.	Rollers and well molded with pins. Anti-static sleeves. Good pressure-pad assembly.
Sony UHF C-60	—	Excellent overall frequency response. Low noise good high and lows.	Rollers with precision molded shell. Anti-static sleeves and well made pressure-pad assembly.
Cassettes Requiring Special Bias			
TDK SD C-60	$2.99	Very good frequency response and very low noise. An excellent recording tape.	Well made from molding through all of the parts. Includes rollers, sleeves and pins, etc. Screw construction.
Advocate C-60 (bias out)	$2.95	Hiss and noise levels very high. Frequency response generally good.	Rollers, welded, sleeves. High-quality molding.
Advocate C-60 (bias in)	$2.95	Very good overall frequency response. Low noise, clean and clear.	Rollers, welded, sleeves. High-quality molding.
Memorex CD-60	$3.15	Very realistic sound, good high- and low-frequency response. Some hiss.	Rollers on molded pins, welded. High-quality molding. Large pressure-pad and good assembly (without tension spring).

Build a Sideband Adaptor for CB

By VINCE DANIELS

LIFE on 11 meters? Man, there's plenty of it and it's mainly congestion, interference and unending frustration. CBers say that the lack of clear channels is like the limited supply of seats on a bus or subway during rush hour. Since there are never enough to go around, everyone has to elbow his way in for a bit of space.

But help is on the way. It's called SSB—a method of transmission that means 46 CB channels instead of the present 23, effective radiated power about eight times greater than that of a conventional AM rig and no more heterodyne interference because of crowding. At this time there are about ten SSB CB transceivers on the market.

They cost more than conventional transceivers with which, by the way, you cannot receive or transmit an SSB signal. So while you're saving money to switch to SSB, why not at least be able to listen to what's going on? You can't listen to an SSB signal on a conventional AM rig but with the help of our inexpensive Sideband Adaptor you can do it.

In conventional AM, the carrier is transmitted along with the modulation and the receiver uses the carrier to extract the audio from the RF signal. An SSB signal contains only RF frequencies representing the modulation. To extract the audio a carrier must be inserted within the receiver. The device that generates the carrier inside the receiver (shortwave, for example) is called a beat-frequency oscillator (BFO).

If your CB rig is typical, it doesn't have a BFO, so a received SSB signal cannot be demodulated and it will sound like Donald Duck.

An SSB signal doesn't care where the carrier comes from so long as it gets added. You can, therefore, place our SSB Adaptor near your transceiver and the signal radiated from the adaptor will be used by the receiver as a carrier to demodulate SSB signals.

The adaptor consists of a stable oscillator (Q1) and a buffer amplifier (Q2) that prevents external connections from affecting the oscillator's stability. Transistor Q2's output is fed to pot R6 so the adaptor's output can be reduced to prevent a strong signal from blocking the receiver's AVC system and loss of sensitivity.

The coupling between the adaptor and receiver depends on the transceiver. For walkie-talkies, tube-type transceivers and some solid-state rigs, sufficient signal will be injected into the receiver if a length of wire connected to binding post BP1 is simply positioned near the antenna input. In some instances it will be necessary to slip the end of the wire into the transceiver cabinet through a ventilation hole. Some of

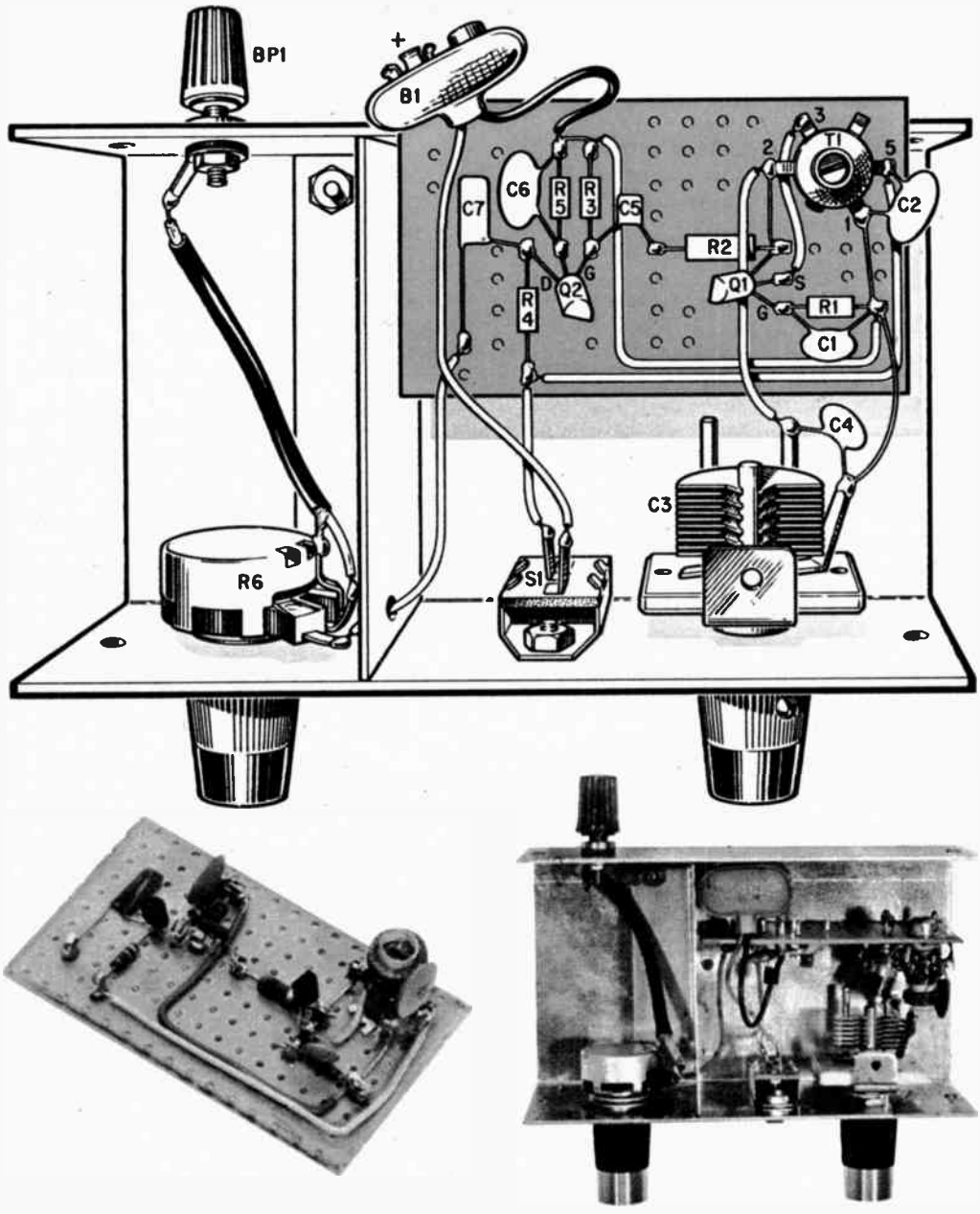


Fig. 1—Pictorial at top shows location of parts on perforated circuit board. Note tight-fitting metal shield between R6/BP1 and board. Photo at left shows completed board before installation. Photo at right shows completed adaptor with the board installed perpendicular to the cabinet base.

the latest solid-state transceivers, particularly those with IC IF strips, cannot pick up the radiated signal from the adaptor and it will be necessary to cement a pick-up wire near an IF transformer or transistor as shown in Fig. 2.

The adaptor will work with receivers having 455-kc IFs or IFs in the 1200- to 1650-kc range. The only difference in construction is that L1's slug must be removed for 1200 to 1650-kc operation. The adaptor is powered by a standard 9-V battery.

Construction

While the layout isn't that critical, the degree of shielding will determine final performance, and we suggest no modifications

Build a Sideband Adaptor for CB

be made to the shield or to the R6/BP1 connections. Our adaptor is built in the U-section of a 5¼ x 3 x 2⅛-in. Minibox. The holes for R6 and C2 must be located exactly 1 in. in from the left and right cabinet edges.

Mount the internal cabinet shield (see Fig. 1) after all component holes have been drilled. The shield must completely separate the left and right sides of the circuit when the cabinet cover is in place; it is better for the shield to be tight rather than loose. Position the shield so it is 2 in. from the cabinet's left edge. Prior to installation of the shield, drill a ⅛-in.-dia. hole ⅜ in. in from the shield's front edge and ¾ in. down from the top for the wire from C7 to R6. Secure the shield to the cabinet with at least two screws. Make sure there's no paint or dirt on the shield's mounting flange, or on the bottom of the cabinet. Steel wool is good to use to clean the aluminum.

The oscillator and buffer-amplifier are assembled on a 3 x 1¾ in. piece of Keystone G-pattern perforated board. Push-in terminals can be used for tie points. Oscillator stability, and therefore proper reception, is determined by mechanical assembly; therefore no components should be floating or twisted together in such a way that the wiring will be disturbed if the cabinet is moved. Solder everything to tie points.

Install oscillator coil T1 in the upper right corner of the board; the locking collar supplied with T1 fits a 5/16 in. hole. If the collar is not attached to the coil, simply push it on the end of the coil form; it will lock to the form when the coil is pushed in the mounting hole.

Note that T1 has a color dot between lugs 1 and 2. Holding the board upright with T1's hole at the upper right, insert T1 into the hole so the color dot is at the 7 o'clock position.

Install capacitor C2 across terminals 1 and 5, and then complete all board wiring. Use Q1's and Q2's leads full length, and use a heat sink on each when soldering.

For receivers with a 455-kc IF, screw in T1's slug so it is approximately ⅛-in. from the bottom of the form—the end with the windings. For receivers with IF's in the 1200- to 1650-kc range, remove the slug.

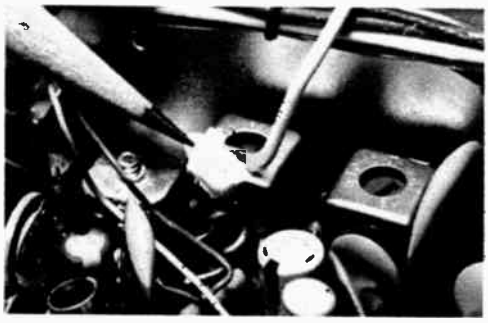


Fig. 2—Signal from adaptor is capacitively coupled into IF strip by cementing wire from adaptor to IF can with GE silicone adhesive.

Tuning capacitor C3 can be any 50 $\mu\mu$f miniature variable. Capacitor C4's value is determined by the receiver's IF frequency. Install C4 directly across C3 using short leads. For 455 kc IFs, C4 should be a 390-$\mu\mu$f silvered mica. For receivers with 1200 to 1650 kc IFs, C4 should be a 50 $\mu\mu$f silvered mica.

With the shield installed in the cabinet, temporarily place battery B1 in the rear corner as shown in the right photo in Fig. 3. Position the board so it lightly presses against B1 and cement the board to the cabinet with contact cement.

After you are certain the board's adhesive is dry, connect T1 to C3, wire power switch S1 and install R6. Position R6 so the input lug (lug at top in Fig. 1) is opposite the hole in the shield. Using ordinary insulated hook-up wire, connect C7 to R6. Connect the shortest possible length of coax between R6's wiper lug and BP1. Connect the shield to ground by soldering it, along with R6's ground lug, to R6's case. Cut off the shield at the BP1 end. It should *not* be grounded at BP1.

Alignment: 455 kc

Set C3's plates to half-mesh, position an AM radio next to the adaptor and turn on the adaptor. Using a plastic alignment tool, adjust T1's slug until you hear a beat note on a broadcast station. As the slug is adjusted the pitch of the beat note will get lower in frequency until it no longer can be heard. Continued slug adjustment will cause the beat note to rise in pitch. The proper adjustment for T1's slug corresponds to zero beat.

Alignment: 1200 to 1650 kc

Use the same set-up for 455 kc, but tune in a station at or near the CB transceiver's

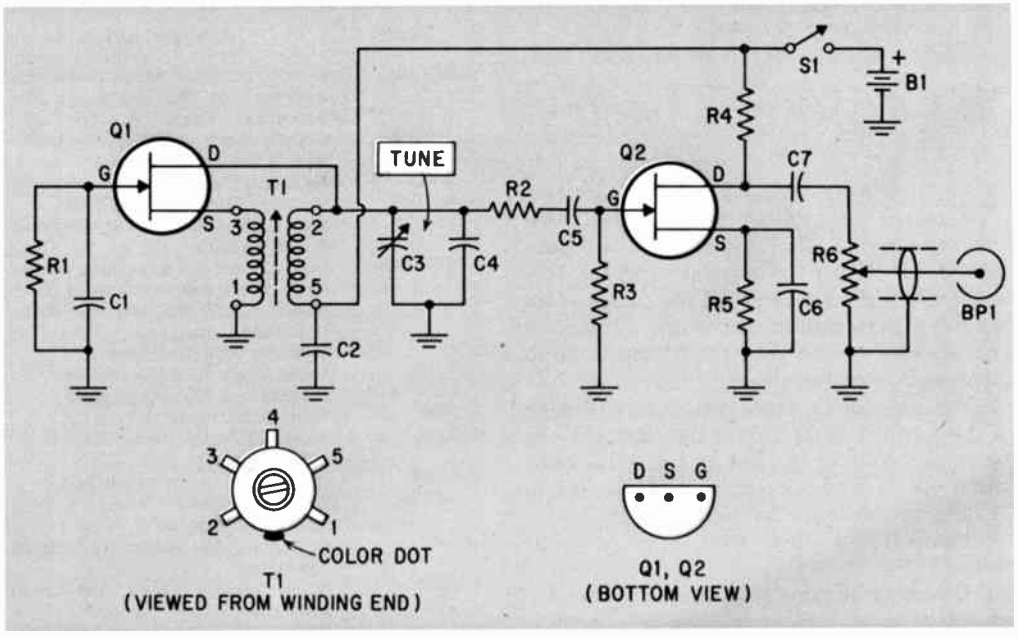


Fig. 3—FET oscillator Q1 operates around 455 kc with slug in T1. With slug out range is about 1200 to 1600 kc. Signal is amplified by Q2 which also acts as buffer to prevent detuning of Q1.

IF frequency. Turn on the adaptor and adjust C3 until the adaptor beats with the radio station. If a beat cannot be obtained, try to locate the closest station frequency to the IF frequency for which a beat can be heard. If the beat-station's frequency is above the transceiver's IF frequency, say 1380 kc, increase C4 to 100 $\mu\mu$f. If the beat station is below the transceiver's IF frequency remove the existing C4.

Using the Adaptor

Connect a piece of hookup wire between 15 and 25 in. long to BP1. Place the wire near the transceiver, tune in a CB signal and turn on the adaptor. Adjustment of C3 should cause a beat note to be heard. If you cannot obtain a beat note by adjusting C3, feed a few inches of the wire into the transceiver through a ventilation hole. If a beat note still cannot be heard you must install the pick-up wire inside the rig.

Remove the transceiver's cabinet and while holding the wire from the adaptor, move the wire near the IF transformers and transistors until you hear the beat note. When you have located the best position for the wire, secure to the top of a transistor of IF transformer with a drop of GE's RTV silicone rubber adhesive (use no other product).

PARTS LIST

B1—9V battery (Burgess 2U6 or equiv.)
BP1—Insulated binding post
Capacitors: 25V or higher
C1—.01 μf disc C2, C6—.05 μf disc
C4—3.7-52 $\mu\mu$f variable capacitor (Hammarlund HF-50 or equiv. Lafayette 40 F 28833)
C4—50 or 390 $\mu\mu$f silvered mica (see text)
C5, C7—.001 μf disc or mylar
*Q1, Q2—MPF-103 FET (Motorola)
Resistors: 1/10, ¼ or ½ watt, 10%
R1, R2, R3—1 megohm R4—3,300 ohms
R5—330 ohms
R6—50,000 or 100,00-ohm potentiometer
S1—SPST toggle or slide switch
T1—455-kc miniature oscillator coil (J. W. Miller 2022, Lafayette 34 F 87014)
Misc.—5¼ x 3 x 2⅛-in. Minibox, coax, battery connector.
*Available for $1.15 (each) postpaid from Circuit Specialists Co., Box 3047, Scottsdale, Arizona 85251

To tune an SSB signal, set R6 about half-open and adjust C3 until the chatter starts to clear. Then turn C3 very slowly until the chatter turns into intelligible speech. Finally, adjust R6 for the minimum amount of signal necessary for good speech reproduction. Keep in mind that if the injected signal is too great the receiver's AVC will block, and the sensitivity will fall.

If your receiver has both RF and AF gain controls, run the volume wide open and adjust volume with the RF gain control.

Notes from EI's Win-the-World Contest

OUR Win-the-World Contest is drawing toward an exciting finish. We've been talking about it for months now; we published the official announcement in the July issue and then we listed all the prizes again and ran the entry blank in the September EI. So who's going to be the person to go to the country of his choice?

Well, we don't know yet. The Listening Period ended several days ago and the entries are coming in. But it will take some time yet to find the chap who'll be off to Tahiti or Moscow or maybe even Kuala Lumpur (does that send you to your atlas?).

A contest of any kind usually generates a lot of questions from would-be contestants. Usually because a rule-writer forgets something. Our W-T-W Contest was a surprising exception. We received less than a handful of letters from confused contestants and most asked the same thing.

In the case of a broadcasting service with more than one transmitter, the question ran, will a QSL from each transmitter be accepted? The VOA with its many outlets was cited often as an example. The answer: yes, one QSL per transmitter is okay.

A couple of contestants confused the dating of a QSL with a postmark date. The rules say the QSL must be dated within the Listening Period. Postmark date is not involved. Then there was the reader who wanted to know whether he could count both ham and SWL cards (yes) and another who asked how we'd handle his valuable QSL cards if he became one of the finalists and we asked to see his collection. Carefully, we told him, very carefully. (By the way, no QSL cards are to be sent to us until more are requested to send them in.)

Lastly, our readers, when faced with naming a country they'd like to visit, don't always come up with some obscure bit of geography. Many asked: could I name the U.S.A.? The answer is sure, and we'll fly you either to the nearest neighboring city or to the country's most-distant point, including our possessions.

To remind those of you who've become contestants of what you may win, we'll repeat the prize list:

PRIZE	DESCRIPTION
GRAND	A trip to your favorite country anywhere in the world via Pan American World Airways, the world's most experienced airline
2nd	RCA G-2000 color TV set
3rd	Heathkit/Thomas Legato organ kit
4th-5th	Heathkit GR-370 color TV kits
6th-7th	Conar color TV kits by National Radio Institute
8th-13th	Your choice of home-study course from: Cleveland Institute of Electronics, CREI, ICS, National Radio Institute, National Technical Schools, RCA Institutes
14th	Hallicrafters SX-122A receiver
15th-19th	Hallicrafters SX-133 receiver
20th	Advent 201 cassette tape deck
21st	Sony STR-6055 stereo FM/AM receiver
22nd	RCA WO-505A solid-state scope
23rd	Lafayette Radio Telstat SSB-25 SSB CB transceiver
24th	RCA WR-52A Stereo FM Signal Simulator
25th	Allied Radio Shack Patrolman
26th	PRO-3 VHF/UHF receiver
	Sansui QS-1 Quadphonic Synthesizer
27th	Weston 666 solid-state VOM
28th	Courier Citation solid-state base-station CB transceiver
29th	Olson RA-280 stereo FM/AM solid-state receiver
30th	RCA WR-502A solid-state color-bar generator
31st-35th	Hallicrafters CR-44A Ranger portable shortwave receiver
36th	Avanti Moonraker CB base-station antenna
37th	Ameco R-5A receiver
38th	DeltaAlert ultrasonic intrusion detector
39th-41st	Hallicrafters S-240 entertainment/communications receiver
42nd	Two CB mikes from Turner
43rd	Edmund Scientific Deluxe Visual Effects Projections Set plus Rippling Color Accessory
44th-45th	Hallicrafters skip-band receiver
46th	Eico 3450 four-channel color organ
47th	$100 credit with Electro-Voice for any equipment in their latest catalog, including miniature 651C communications mike
48th	Complete library designed for hams and SWLs from the Howard W. Sams Publishing Co.
49th	$100 credit for any antenna in the latest catalog of Antenna Specialists
50th	Mallory MCR-1232 portable cassette recorder
51st	$100 credit with Shakespeare, one of the leaders in the CB antenna field
52nd	A library of the latest bestsellers from Tab Books Co.
53rd-100th	One year subscription to electronics hobbyist's favorite magazine—ELECTRONICS ILLUSTRATED

Update On Semiconductors

By RONALD M. BENREY WHEN you talk about semiconductors, you'd better talk quickly. Research labs are tossing out an amazing variety of solid-state devices into the eager hands of manufacturers. Whole TV mid-sections will be squeezed onto a tiny chip. High-power ham transmitters will lose their tubes. Sharp tuning circuits won't need bulky coils and pilots lamps will eerily glow without filaments. Even the hobbyist will soon try his hand at ingenious new circuits to be featured in EI projects. Here's a preview of what's to come.

Integrated circuits top the list. RCA's new IF system (Fig. 1) takes a tiny bit of silicon and creates a strip of stages that form the heart of a TV receiver. With dozens of transistors, diodes and resistors, a single plastic block contains: a three-stage video IF amplifier, two-stage audio IF and sound detector, video detector and amplifier stage, keyed AGC and noise limiter and a zener-diode regulator. Only a smattering of external components—mainly two IF transformers—complete the package. This mini-module, which cuts cost and size, is RCA's new CA3068.

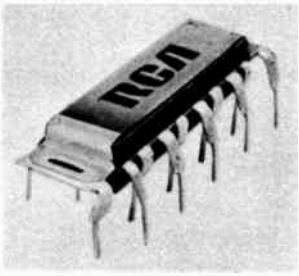
The dream of squeezing everything but the kitchen sink into a single IC is also hidden in Motorola's new MC1304. It's a complete FM stereo decoder. Earlier attempts merely placed the bare signal decoder on a chip, but the MC1304 goes further. It also provides interstation muting as you tune, automatic switching between mono and stereo programs and control of a stereo indicator lamp to boot. Not enough? Then step up to Motorola's MC1305. It tosses in manual adjustment of left- and right-channel separation. The only additional items to complete these decoders are 19-kc and 38-kc tuned circuits, and a few other parts that can't share the tiny slice of silicon.

As you may suspect, tuned circuits are the big IC hang-up. Any coil-winding table quickly shows that even a tiny 1-μh inductor may need 10 turns of wire spread over a ½ in. coil form. Coils are simply hundreds of times too large to fit inside an IC.

Designers once got around it with the hybrid IC, a combination of semiconductors and metal films which form tiny coils. But now they can brew a circuit that electronically simulates the inductor. This surprise is possible with a burgeoning class of semiconductors called the *operational amplifier.*

An op-amp (Fig. 2) is a high-gain amplifier with several inputs. A signal applied to an *inverting input* produces an output of reverse polarity. A signal applied to the *non-inverting* input drives the output in the same direction. You turn an op-amp into an electronic jack-of-all trades by adding a feedback network of resistors and capacitors. In connecting the amp's output back to its input through the network it becomes a *high-pass filter* that passes only signals above a specific cutoff frequency, a *low-pass filter* that cuts off signals above a specific frequency or a *band-pass filter* that

Update On Semiconductors



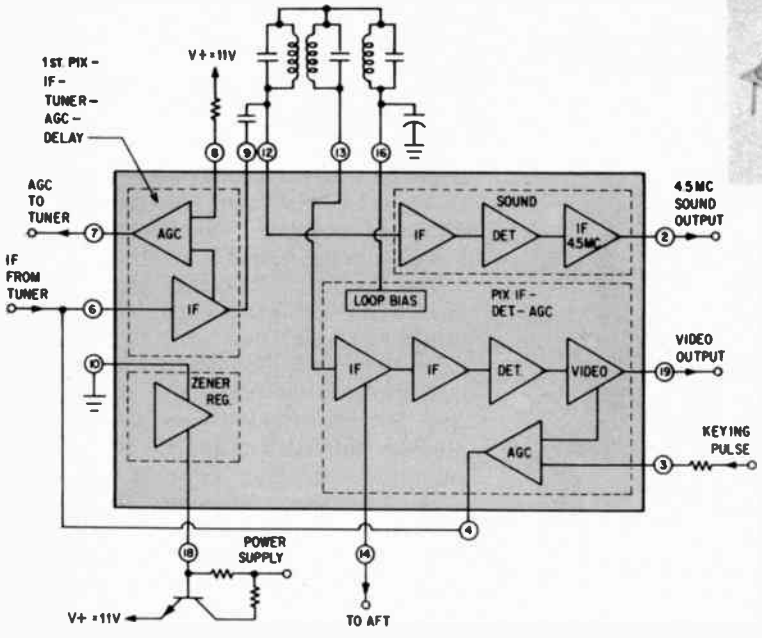


Fig. 1—IF circuit for TV set is inside an RCA CA3068. Block diagram of IC at left shows typical stages in a TV IF strip. Coils outside IC are still too big to chip-mount.

passes a whole frequency band. Thus, simple feedback helps simulate the action of inductors and transformers. Many tone controls in the latest stereo gear are active filter circuits built around such op-amps.

The engineers are also learning fresh answers to the IC's severe heat problem. Most ICs are limited to low-wattage applications because the tiny chip can't withstand much power. A new GE amplifier, though, breaks the heat barrier. The PA246 delivers a hearty 5 watts of audio into a 16-ohm load. The secret against overheating is an efficient way of mounting the chip with two metal tabs that protrude from the case. The tabs are soldered to a 2-in. copper heat sink when the IC is installed. Besides its appeal as an audio amplifier, the PA246 can be a power supply regulator, a servo motor amplifier or relay driver.

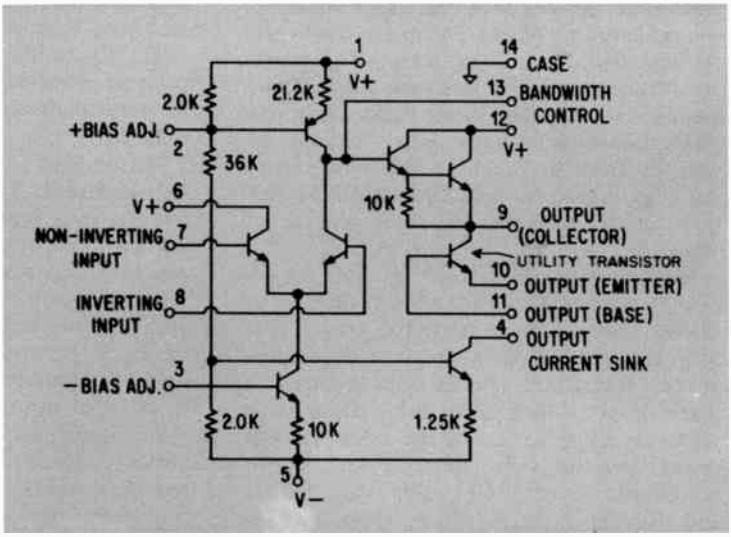


Fig. 2—Schematic of a typical operational amplifier. The IC chip has eight transistors and seven resistors. By using feedback and amplification, the op-amp becomes an active filter that can simulate the action of an inductor.

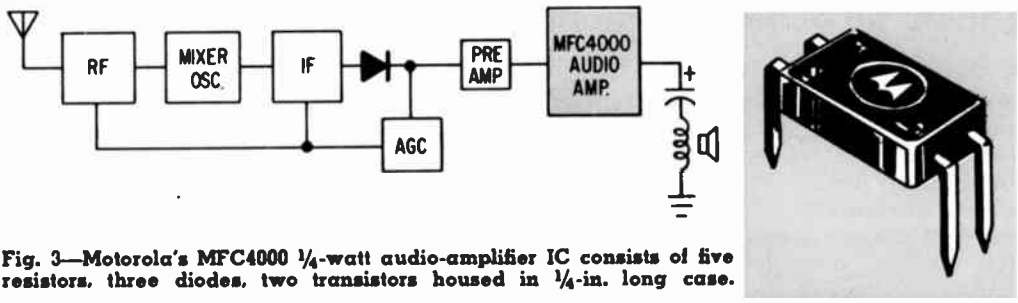


Fig. 3—Motorola's MFC4000 ¼-watt audio-amplifier IC consists of five resistors, three diodes, two transistors housed in ¼-in. long case.

As traditional barriers tumble, the IC is rising to its next role. It's LSI, or large scale integration. With an ability to crowd several hundred thousand parts on every square in. of silicon, one IC could soon contain almost all the circuitry of a color TV, stereo receiver or just about any other instrument fashioned from solder joints and discrete components. Take Motorola's family of low-cost building blocks for simple circuits. It includes audio power amplifiers (with up to 4 watts output); driver amplifiers, general-purpose signal amplifiers and voltage regulators. The circuits are mounted in plastic packages that are easily handled by automatic machinery since there are few external connections. You'll soon be seeing these LSIs in low-cost consumer products like radios and portable phonographs.

The hobbyist isn't overlooked, either. An IC that seems perfect for the tinkerer at home is RCA's new CA3062 photodetector and power amplifier (Fig. 5, left). It's a complete photo-relay system, replete with a light-sensitive detector, switching circuit and output stage that can drive a sensitive relay. At the builder's option, the IC can be connected through external resistors so it closes a relay when it sees either light or darkness. The IC wafer is mounted in a transparent-topped case so light can reach a pair of phototransistors.

ICs are hogging the spotlight, but discrete (individual) semiconductors also deserve attention. A fascinating new gadget is GE's programmable unijunction transistor (PUT). Conventional unijunction transistors have been around for years to trigger SCR circuits, generate tones or produce time delays. The operation of a standard UJT though, is frozen when the unit is manufactured. Not so with a PUT. It's programmable because a characteristic like triggering voltage may be varied by a couple of resistors. The designer can pick and choose his operation by selecting the right values. What's more, the PUT offers low-voltage operation (down to 2 V, instead of the usual 8 or 9) and direct line-voltage operation.

One of the most exciting areas of transistor development is happening in RF power. Until recently the frequency response of a transistor was limited by the unavoidable capacitance across its junctions. This imposes a snail-like speed limit called *transit time*. It's the time it takes for electrical charge carriers to move through the semiconductor material. This is fought by shrinking the transistor structure so both capacitance and transit time are decreased. Unfortunately, so is the ability of the transistor to handle power without overheating. For this reason, the development of high-frequency power transistors has been a juggling act which balances size against power.

One way to beat the system is to increase the *perimeter* around the emitter, but to hold the emitter *area* constant. This would prevent crowding of electrical charges and loss of power. Overlay geometry does just that. The emitter is constructed of many separate, but electrically joined, rectangles that float within the transistor base region (Fig. 4). It yields a far greater perimeter than is possible around the emitter cut from a single block.

This technique enables the latest RF power transistors to win impressive specs. Take RCA's 40675, a unit designed for ham and marine-radio applications. It delivers a blazing 80 watts of power at frequencies up to 30 mc on a 12-V power supply. The 40675 is expensive ($132 in small quantities) but prices should surely drop in the near future. You don't need a crystal ball to see that parallel 40675s will make a dandy final for a solid-state ham transmitter. The stage that should last a lifetime!

At lesser RF levels, lower cost is already

Update On Semiconductors

here. RCA's 2N5994, delivers 18 watts at a lofty 88 mc and costs $18.15. If 7 watts are enough, take the 2N5992 for $8.25. For higher-frequency circuitry, the 2N5996 delivers 15 watts at 175 mc, though at somewhat lower gain. It costs $11.60. Motorola, too, offers low-cost RF power transistors: the 2N5641, 2N5642 and 2N5643. They deliver 7, 20 and 40 watts (at 30 mc) for $6.40, $21.30 and $40.49 respectively. These transistors should quickly pervade all manner of communications gear.

Another power transistor making news is the Darlington amplifier. You might think of it as two transistors in one package or a super-simple IC. In the Darlington, one transistor acts as the emitter load for the other. The result is very high amplification (a current gain of over 10,000) and high input impedance of at least 50,000 ohms. GE's D40C in an inexpensive plastic case, has a power rating of 1¼ watts with a small heat-sink tab. Such semiconductors lend themselves to audio stages, voltage regulators, relay drivers and time-delay circuits.

Another semiconductor, the field-effect transistor (FET) is also getting a face lift. Only recently have materials and fabrication techniques been available for mass production of sophisticated FETs. One addition to the FET family that's winning enormous success in TV and FM tuners is the dual-gate MOS FET with internal gate protection. That's quite a mouthful, so let's start at the beginning. MOS refers to a

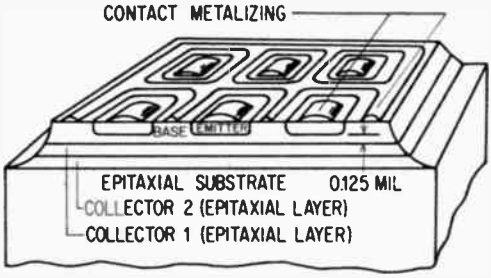


Fig. 4—Overlay geometry increases power, frequency ratings due to six emitter areas.

structure of metal, oxide and silicon layers deposited on a silicon base. Dual-gate means the devic has two input control elements that independently control current flow. (Like a vacuum tube, current flow is controlled by varying voltagc applied to the gate terminals.) In an RF amplifier, one gate receives the signal input, as the other gate is controlled by AGC voltage. This arrangement provides substantially higher gain and improved performance. Newer FET amplifiers suffer less interference pickup and offer better cross-modulation characteristics (an ability to ignore strong local stations while tuning weak ones).

Internal gate protection means the device has built-in diodes to protect the gate against voltage transients. The delicate gate can be destroyed by static electricity if you merely hold the transistor, or indirectly through nearby lightning when the FET is installed in a tuner. The diodes short-circuit voltage spikes before they do damage.

The next color TV you buy will probably

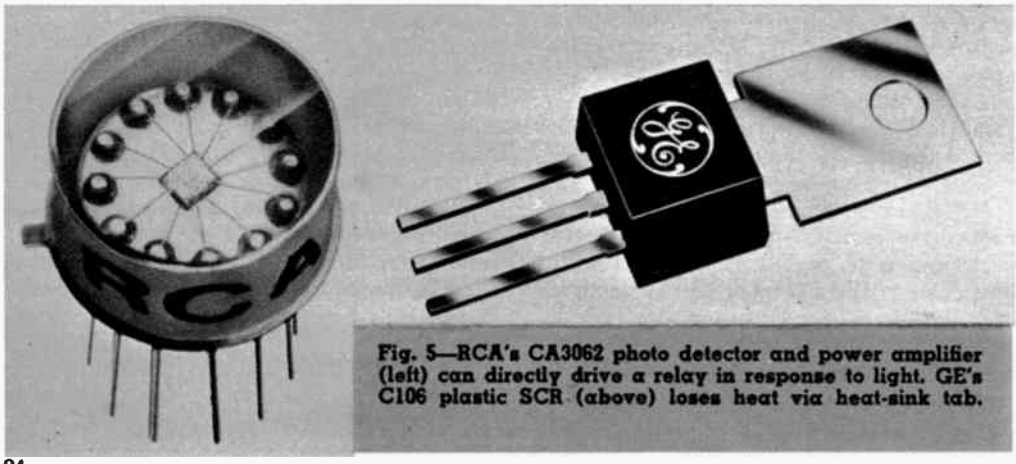


Fig. 5—RCA's CA3062 photo detector and power amplifier (left) can directly drive a relay in response to light. GE's C106 plastic SCR (above) loses heat via heat-sink tab.

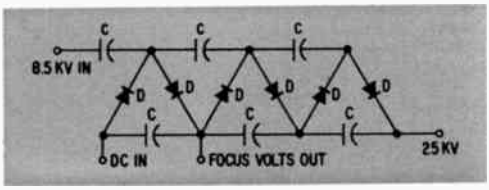


Fig. 6—Schematic of voltage tripler for simpler, cheaper high-voltage supply for color TVs.

have power supply with a high-voltage tripler (Fig. 7) instead of the conventional flyback system. The idea is simple: The tripler multiplies 8,500-V pulses from the horizontal-output transformer to a high-voltage output of 25,000-VDC. The circuitry is simpler and less expensive than a conventional power supply which handles 25,000 V in a flyback transformer. This is especially significant in a solid-state chassis since early semiconductor TVs needed vacuum tubes to withstand high voltage. The new tripler is an array of six high-voltage diodes and capacitors potted in a plastic case (Fig. 7). Another important advantage is that tripler voltage tends to be self-regulating over the normal range of picture-tube operation. Not only is complex voltage-regulating circuitry eliminated, but X-ray hazard also reduced.

Talking about diodes, a new wrinkle in the old cat's whisker is making news. It's the hot-carrier (or Schottky) diode. At the turn of the century physicists discovered that a signal detector could be made by tickling a needle against a galena crystal. The needle, or cat's whisker, soon formed the heart of the popular crystal set. Today's version is the point-contact diode with a metal whisker pressing against silicon or germanium. It's been almost unchallenged in radar and other microwave equipment but obsolescence is near at hand. It suffers a phenomenon called minority-carrier storage. When the diode suddenly switches from a conducting to non-conducting state certain current carriers produce a reverse pulse which interferes with high frequency performance.

But the hot-carrier diode is now solving that one. Instead of a point-contact arrangement, its junction is formed by a metal film spread over a semiconductor surface. Since current carriers can flow at high speed across the path, the diode is dubbed hot carrier. Compared to older diodes, hot-carrier offers excellent high-frequency response, low series resistance, lower noise and higher power. And their price is low. Some units cost less than 50¢ each.

The big news about the light-emitting diode (LED) is low cost and long life. Not too long ago the LED cost upwards of $100 but some now cost 50¢ each in large quantities. LEDS emit light because of carrier recombination. When current flows through the diode, electrical charges (electrons and holes) move through the structure and join at the diode junction. As each electron (—) mates with a hole (+), a bundle of energy called a photon is emit-

[*Continued on page 103*]

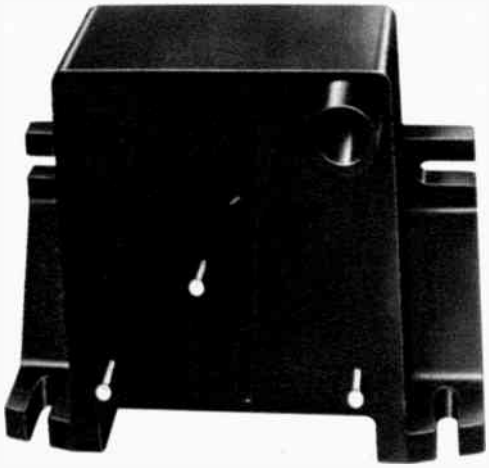


Fig. 7—Compact case, containing tripler in Fig. 6, replaces bulky parts in HV supply.

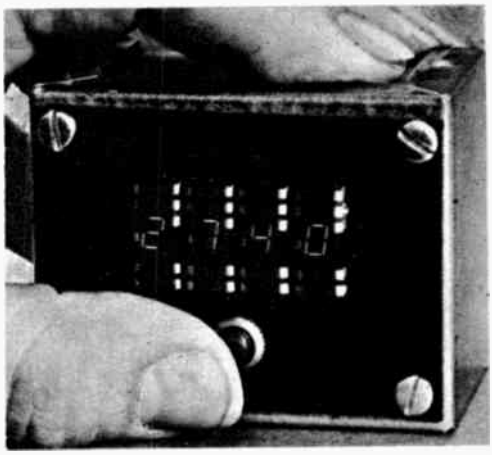


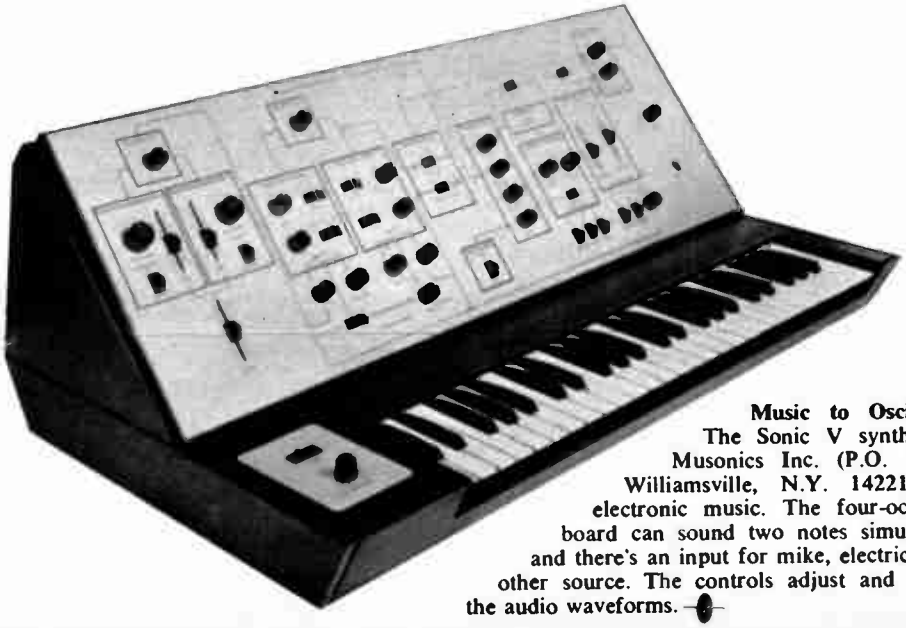
Fig. 8—Numerical display uses light-emitting diodes. It has almost endless life, is cool.

LOOK MA, NO HANDS! If the next phone booth you see is missing its handset, it may not be the victim of vandals. Bell Labs is placing 50 hands-free booths in the field for extensive tests. Instead of holding a conventional instrument, the caller merely talks in a normal tone and his voice is picked up by a microphone in the booth. The party's voice is heard through a loudspeaker concealed in the walls. After the call is completed, you'll press a button to hang up.

Electronics in the News

Touching Display. Put your finger on any city in the world and its time zone lights up for five seconds. The city's local time also appears in numerals (note 6:28:00 above). It's Panasonic's prototype Stereo Radio/Digital World Clock. The FM radio alsc tunes at a touch and its frequency is displayed in digits (88.1 mc). It's one of the first consumer products to use liquid crystals, an electro-optical material that forms glowing numerals on a transparent face.

TV on the Phone. RCA's new Videovoice will allow businessmen to exchange pictures, charts and other visual information over any circuit which now carries voice. To compress images for narrow-band transmission, the system is limited to one new view each 30 seconds. A picture may be displayed several minutes, or even stored on a conventional tape recorder for future playback.



Music to Oscillate By. The Sonic V synthesizer by Musonics Inc. (P.O. Box 131, Williamsville, N.Y. 14221) creates electronic music. The four-octave keyboard can sound two notes simultaneously and there's an input for mike, electric guitar or other source. The controls adjust and shape the the audio waveforms.

How to prepare for today's competitive job market, tomorrow's new opportunities in electronics

Competition for jobs and promotions is severe in the electronics industry today. But experts say that exciting new electronic products will create thousands of new jobs in the next few years.

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APPROVED FOR TRAINING UNDER NEW G.I. BILL

2-Meter Beam for 2 Bucks

By JIM WHITE, W5LET

PRICES aren't the only things that are going sky-high nowadays. Amateurs are, too. They're going to higher frequencies like 144-148 mc—the two-meter band. This 4-mc slice of the RF spectrum is becoming the favorite of repeaters and mobiles. And it's a popular hangout for many hams who have left the lower frequencies with their QRM and QRN.

But on two meters you can't simply use a short piece of wire for an antenna. On a mobile a whip cut to frequency will work fairly well, but at the base station a beam is a must for those long-distance contacts.

Our beam could be called the miser's delight. With many beam antennas costing up to about $40, it sounds ridiculous to suggest building one for less than two bucks. But it is true, our five-element beam costs $2.

How does it perform? It has a forward gain of 6 to 8db over a dipole. This is equivalent to increasing power by at least four times. The front-to-back ratio is excellent and by careful pruning of the driven element, it is possible to get the SWR down to 1:5 to 1.

The beam is a five-element yagi fed with 52-ohm coax. The driven element is matched to the feedline through a delta match and a balun. RG8A/U coax is used for the feedline rather than RG58/AU, because it has about half the loss of 144 mc.

Mechanically the beam consists of a wood boom made from a 69-in. piece of 1 x 2. The elements are made of No. 6 (0.162-in. dia.) hard-drawn copper wire.

Begin construction by cutting the boom to 69 in. Lay it on a flat surface and mark

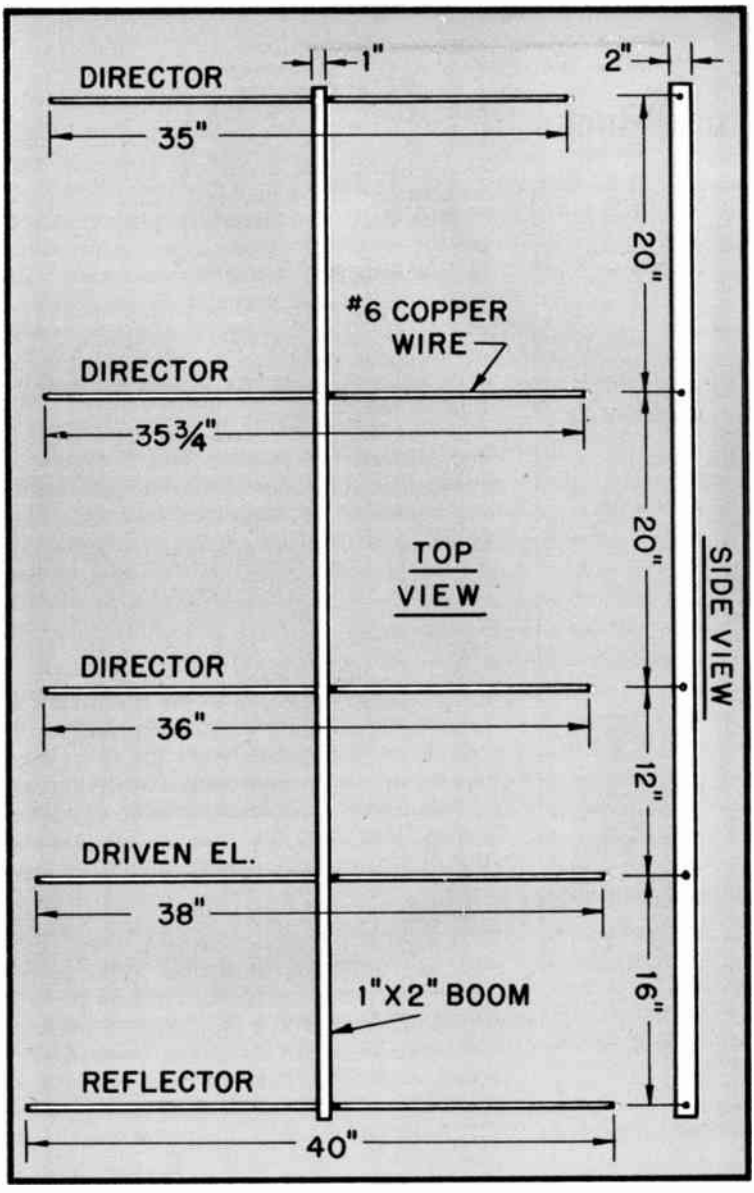

Fig. 1—Diagram shows overall dimensions of antenna and element lengths. Holes for elements are ½-in. back from ends of boom and are drilled through 2-in. side of boom. Holes for screws that secure elements should be drilled in the 1-in. side of the boom.

off the location of five holes as shown in Fig. 1. Drill the holes just large enough so the wire elements will pass through snugly. Note that the elements go through the 2-in. side of the 1 x 2.

Next, drill five ⅛ in. holes in the 1-in. side of the boom so they intersect the holes drilled for the elements. The antenna can be used either in a horizontal or vertical plane. If you wish to vertically polarize the antenna, add an 8-in. piece of 1 x 2 as shown at the bottom of Fig. 2. This is not necessary if you plan to orient the antenna horizontally, in which case two ¼-in. holes should be drilled in the boom for a U bolt. For vertical mounting, drill the U-bolt holes in the 8-in. strip. To attach the 8-in strip, drill three small pilot holes all the way through the boom and into the strip. This will lessen the difficulty in tightening the screws and prevent splitting.

The elements. Cut five pieces of wire to the lengths shown in Fig. 1. They probably will not be very straight so take each one and lay it on a flat surface and roll it back and forth with your hands. You may not get them perfectly straight (note the slight bends in the photo of the antenna on the first page of this article) but this will not affect the antenna's performance.

You are now ready to assemble the beam. Place the 38-in. driven element in the proper

2-Meter Beam for 2 Bucks

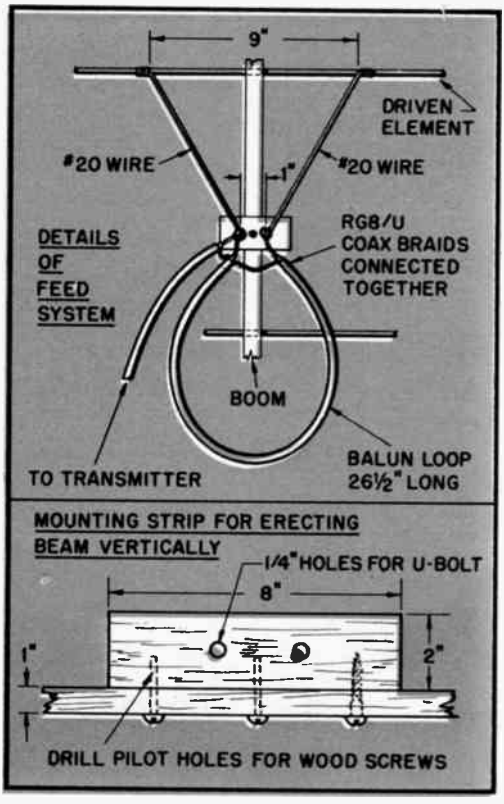

Fig. 2—Top sketch shows antenna's feed system. Solder driven-element wires and coax loop to lugs (spaced 1 in.) screwed on 1 x 3-in. phenolic board. Bottom sketch shows how 8-in. wood strip is used when installing antenna vertically.

hole, center it and secure it with a 1¼-in.-long wood screw in the intersecting hole. Don't tighten the screw too much or you will weaken the element.

With the driven element in place measure 4½ in. each side of center and solder 6½-in. pieces of No. 20 solid hookup wire to each side of the element as in Fig. 2. Mount a 1 x 3-in. piece of phenolic board on the boom so that these two wires will be 1 in. apart at the center of the board as in Figs. 2 and 3.

Secure the wires with two 6-32 screws and nuts on the phenolic board. Figure 2 shows how the transmission line and balun are connected to the driven element. The balun is made from a 26½-in. piece of RG8A/U coax. Note that each end of the inner conductor is connected to the screws on the board. Solder all three outside braids together. The inner conductor of the feed line to the shack can be connected to either screw. Secure the balun to the boom with a small cable clamp. With the driven element and balun completed, install the other elements and secure each with a wood screw.

Adjustment. The beam requires very little tuning. One thing that can help is pruning the driven element to the frequency you plan to operate on most frequently. To do this solder a 1-in. piece of No. 22 wire to each end of the driven element. Then connect an SWR bridge in the line at the transmitter. Measure the SWR and note it. Cut ¼-in. off the wire at a time taking a reading each time. Stop cutting at the lowest SWR. Tune up is done best with the beam in a clear spot pointed straight up at the sky. Erect the antenna as high as you can and if you want to, use a rotator.

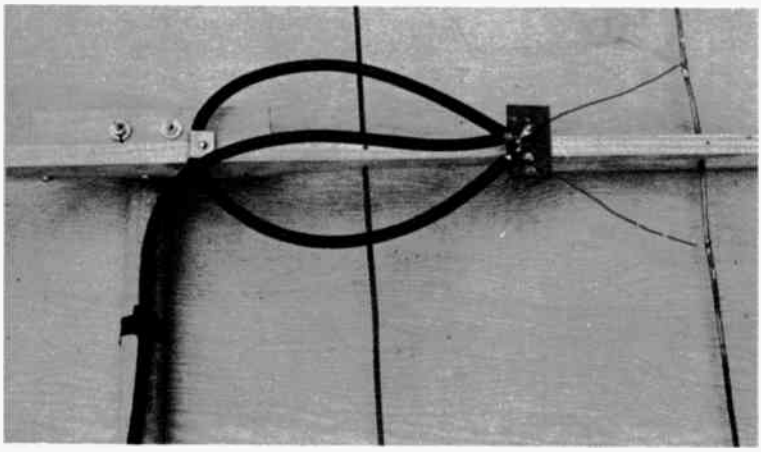

Fig. 3—Photo shows construction of feed system and balun loop. Note bracket holding coax at left side of loop and 8-in. strip of wood on boom. Strip was installed because antenna was vertically polarized. Give both the boom and wood strip several coats of marine varnish to weatherproof them.

The Listener

By C. M. Stanbury II

VOA, NASA & All That

THOUGH the Voice of America usually is given pretty good marks in the world of international broadcasting, they do slip once in a while. And they don't take kindly to criticism when less than perfection is suggested.

Our July issue carried a VOA letter attacking us for our assessment of their radio coverage of the near-tragedy of the Apollo XIII moon mission. We had said VOA coverage was tardy and foot-dragging without instant full programming that the situation seemed to call for. The Voice simply said we were wrong, and that they had "revamped . . . schedules immediately to provide round-the-clock coverage . . ."

Okay, maybe they did. But that leaves us wondering what immediately means to them. There's no doubt that the Voice had some reaction immediately after things got grim on the way to the moon. But it's a fact that they did not achieve all-out coverage until 1930 EST the second day, some 21 hours after one commercial radio net, the UPI's Audio Network, began feeding full coverage to such stations as WHDH, Boston plus WGN, Chicago and KHOW, Denver.

Voice of the Soviet. The picture given by Radio Moscow of Russian space adventures is a bit strange at times. Coverage of the tragedy in which three Red cosmonauts died was, on radio, much like that of print media. Early announcements were curt and short.

Some weeks earlier R. Moscow distinguished itself in quite a different way. At 2302 EST last April 24, R. Moscow was telling us all about Soyuz 10 and its orbits about the earth. At the same time other international shortwave nets, including the BBC, already had announced Soyuz 10's landing.

Beyond the call. Despite what all those terribly strict FCC rules would seem to imply, it is not really unusual to have one station appear more than once on the dial. And often the second signal—harmonic—has the sock of big power

For instance, during most of two years we listened periodically to a spur around 1166 kc which first caught our attention because that's about where Radio Americas used to hold forth. This signal turned out to be from a station on Long Island that specializes in rock and basketball.

As best we could determine, the spur was hitting the air at about 60 watts. At our listening post, some 300 mi. away, the reception wasn't the best but it certainly would have been enough to clobber a signal from Swan Island if the CIA were still playing games down there. Strangely, I heard nothing from other BCB specialists who were closer than I.

Hawaii O-Five. The Bureau of Standards has changed WWV (Colorado) and WWVH (Hawaii) time signals so VH, on the island of Kuaui, is IDing while V is on with tone. DXers thus have a new chance to pick up Hawaii by trying to dig out this ID-undertone. On the East Coast 2500 kc at around 0500 EST looks like a good bet . . . The new Malaysian transmitters coming on 4790, 4845 and 7110 kc are facing the challenge of a clandestine calling itself the Voice of the Malayian Revolution, which holds forth on 7305 and 11830. It's generally thought to be using a R. Peking transmitter site. Both sides in this new radio war can be picked up around dawn and in the East there's another possibility at sunset.

Propagation Forecast. In late fall and winter, peak daytime conditions are from before sunrise to after noon, local time when 13-meters will be good to excellent for DX, Ten meters will be good between the U.S. and Africa and Latin America. The band will open briefly to Europe after noon, but with declining sunspot activity, usefulness will decrease in the months to come.

Afternoons and evenings, 31 and 49 meters provide the only good DX openings from Europe. DX will be good between the U.S. and Africa and Latin America on 25 meters.

The Ham Shack

By Wayne Green
W2NSD/1

On the Rocks

NOVICES have historically been confined to a crystal-controlled transmitter. The reasoning behind this is that FCC engineers feels the Novice isn't technically equipped to be sure a variable-frequency oscillator (VFO) is operated within the assigned band limits. Since even Extra Class licensees sometimes manage to get out of their bands by accident, this is not an unreasonable assumption.

Unfortunately for the Novice, crystal control is more than a simple limitation. It is a way of life, and a frustrating one. It is remarkably similar to the way things were for everyone on the ham bands back in the mid-30s. In those days a ham receiver was broad as a barn, and if it drifted only 10-15 kc during warmup it was considered stable. Though we didn't have anywhere near as many amateurs on the air in those days, broad receivers made it sound as if we did. Everyone was crystal controlled and few had more than one or two crystals. They were expensive . . . darned expensive. A $3.50 crystal would cost about $20 or so in terms of the 1971 dollar.

Roundtable contacts and nets require everyone to be on the same frequency. But few hams could afford the luxury of a special crystal for a net or roundtable, so just about all contacts were on a one-to-one basis, with every operator on different frequency. Since contacts were initiated only by tuning up and down the band for calls, you had to send CQ long enough for someone to tune you in. And the chap calling had to make his call long enough for you to tune up or down to his frequency. The usual tuning practice was to start near your own frequency and then tune about 50 kc either way, but it was not at all unusual to make contacts with stations 100 or 200 kc away.

Once the VFO was invented the days of the crystal for frequency control were numbered. Early circuits drifted wildly and you had to chase them up and down the band with your receiver, but the advantages of calling on any frequency were so great that the idea caught on quickly. Nets and roundtables got going in quantity as VFOs proliferated. If you think of it in terms of band conservation, they make good sense. Two fellows talking on one frequency create less interference than when they are on two frequencies. If ever any group needed the benefits of the VFO, it is the Novices today.

Good news! The FCC has recently okayed the use of a crystal-controlled type of VFO. Effectively a variable crystal oscillator (VXO) these must be sealed units certified by the FCC and must not be capable of going outside of the Novice bands. This is the first time that any sort of type acceptance has been set up for ham man-

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CIRCLE NO. 19 ON PAGE 13

ufacturers and it's created a new and strange situation. An amateur must use a piece of commercial equipment and cannot build his own.

The variable crystal is not new. Well-heeled amateurs of the 30s will remember the Bliley crystal with a knob on the top which would swing the crystal up about 5 kc. This was done by varying the pressure on the crystal. War surplus addicts undoubtedly came across many of the FT-243 holder crystals with a little set screw on the front for zeroing the crystal.

With modern ICs it's simple enough to multiply a 5-kc variable crystal by a factor of nine and then beat it against another crystal to end up on the Novice band of your choice with 45 kc of spread. The day when most Novice rigs are variable seems to be around the corner. I suspect this could well transform those pile-ups of frustration into more orderly chaos and give Novices their much needed break.

I should add an obvious word of advice for the beginner about receivers. It is possible to go too far in getting a good receiver, but unlikely. Spend all you can for that first receiver. Every dollar invested will pay off handsomely when you are trying to separate weak ones from the strong ones. Later, if you want to go the transceiver route, you will have that much more trade-in to make your purchase of a really good transceiver possible. Please don't skimp on your receiver, it will be one of the poorest bargains you've tried to manage in amateur radio.

Frequency synthesis provides the benefits of crystal stability and the flexibility of variable control. It is not new, of course, but back in the tube days only the government could afford the mass of equipment it took to work the magic. With IC's it is complicated, but practical. It would take a long article to describe the details, but roughly a synthesizer adds frequencies, say in 100 kc at a time. Some new amateur units have 1 kc and 0.1 kc steps so they can move in 100 cps increments up and down the band. Another step would bring that down to 10 cps, but how far is far enough?

The variable crystal oscillator (VXO) can't help but improve the Novice bands.

[*Continued on page 98*]

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CIRCLE NO. 9 ON PAGE 13

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The Ham Shack

Continued from page 97

The ability to plunk a transmitter down on an unused channel is enough to make the whole idea worthwhile. Many a Novice has had to sit there gritting his teeth while some other very loud station was working on his only crystal channel. Even worse is when a General Class operator VFOs onto your crystal and opens up with his 1,000 watts, doing the Novices a favor by talking with them.

When contacts are all held on individual channels you can easily tell what frequencies are in use and which aren't. You don't have the frustration faced by virtually every Novice today of getting into contact with someone only to find that there is another station on your frequency that happened to be listening somewhere else in the band to his contact when you fired up. Suddenly you are out of action except when he is listening. When everyone uses VXO's on the Novice band you will normally hear both sides of the contact and know that a particular frequency is in use and avoid it.

Perhaps you have had the misery of trying to break in on a friend, but were unable to find the frequency of the chap he was working. With VXOs there is no more problem.

Come on, you ham manufacturers, let's get busy and make VXO units for the Novices. The first out . . . the chap that broke the ice . . . was Micro-Comm in Cupertino, Calif. His VXO sells for $40 for either 80 or 40 meters and it's okayed by the FCC. Coverage is to within 2 kc of the edge of the bands. Any other takers?

Strange Saga of Ivan the Terrible

Continued from page 31

for a time threatened the European airwaves with chaos.

The Italians immediately retaliated with their own voice. From a transmitter near Bolzano, he subjected the BBC home services on 391 and 449 meters to similar treatment. Harrassing Harry, as he came to be known, took swipes at Churchill, the aristocracy, even the food ministry. At times the hubbub was so bad listeners had to switch to

the domestic forces network station on 881 kc. But generally, Britons found Harry amusing and stayed tuned in.

His Majesty's government got uptight, though. If the Italians erred in blaming the British, London compounded the situation by assuming the Nazis were responsible for Harry's interruptions. Since Great Britain hadn't been jamming German channels, they felt the whole business wasn't quite cricket. Huffily, they threatened to equip RAF bombers with portable transmitters to air programming on Nazi frequencies during raids over the continent.

It wasn't long before this confusion was straightened out. Harry's real nationality was revealed when a slip-up allowed an internal studio comment, in perfect Italian, to go out over the air. Then, Rome matched up La Voce del Populo with some old recordings of an announcer—not original Ivan, by the way—who had broadcast for Moscow during the Spanish Civil War. Soon, Harry retired from the game and the British threat was forgotten. This left the field to Ivan, which was just as well since he was head and shoulders above the competition.

Who was Ivan anyway? Officially, the Russians never said. But British and American intelligence pieced the mystery together and issued a secret joint report. Today, though it's no longer classified on this side of the Atlantic, the American copy of this report has disappeared, apparently misfiled among the mass of government archives. Hours of searching the Washington catacombs have failed to unearth it. And the British copy—under the Official Secrets Act—cannot be made public until 1991.

But careful digging has turned up enough information to give a pretty good idea about Ivan's identity. Actually, it seems there were two men behind the Russian scheme. The originator was a beetlebrowed old Bolshevek named Solomon Abraham Lozovsky, deputy director of the Soviet Information Bureau. While the multi-lingual Lozovsky sometimes took to the air himself, usually the voice was that of Ernst Fischer, a one-time Austrian journalist. Both were fascinating characters in their own rights.

Lozovsky, born Dridzo, was scarcely known outside Russian labor circles before the war. Born in 1878, the son of a Hebrew teacher, he was working as a blacksmith's helper at age 11. A full-fledged revolutionary by 22, he adopted his protective pseudonym from the town of Lozovaya, where he toiled for the Party. [*Continued on page 100*]

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Strange Saga of Ivan the Terrible

Continued from page 99

Often imprisoned, he held the record for having escaped from jail more times than any other Communist. Later, in the twenties and thirties, he headed Profintern, the trade union international.

Just before the war he became Vice Commissar for Foreign Affairs and the USSR's chief spokesman to the world. His handling of press conferences led Western newsmen to grudgingly respect him. "He doesn't tell nearly as much of the truth as we correspondents would wish," noted Quentin Reynolds, *Colliers* magazine's man in Moscow, "but so far none of us has caught the Vice Commissar in a lie."

Polished and suave despite his beginnings, the 63-year-old Lozovsky was considered a witty man. This characteristic was a key factor in Ivan's success. Throughout the war, he was closely linked to the USSR's broadcasting organization.

After the war, he was caught in Stalin's murderous machinations, and during an anti-Semitic purge was arrested in 1949 on trumped up charges. In August 1956, the editor of a New York Yiddish daily reported he'd learned of Lozovsky's rehabilitation—Sovietese for exoneration—by the post-Stalin regime. Officially it was, "so sorry, Sol!" But this apology didn't do Lozovsky much good. He'd been shot seven years earlier.

On the other hand, Ernst Fischer, who must be considered the real voice of Ivan, fared better. Born July 3, 1899 in Komotau, now the steel center of Chomutov in northwestern Czechoslovakia, he attended Graz University in Austria and in World War I served in the Austro-Hungarian Army.

At 21 he joined the Austrian Social Democrat Party and worked his way through the journalistic ranks to become editor of Vienna's *Arbeiter Zeitung*. A brief civil war between Austria's major political parties in 1934 embittered him. The socialist then became a Communist and went into exile in Prague. He covered both Hitler's rise to power and the Spanish Civil War for various Russian journals.

In 1941, he was living comfortably in Moscow's Hotel Lux and working for the Russian radio. When Lozovsky concocted Ivan the Terrible, the German-speaking Fischer was tapped for the job. Later, Fischer's talents were used by a Moscow-based clandestine station, the Voice of Free Austria, which aimed its programs at Austrian troops in the German Army.

When the Red Army liberated Vienna in April 1945, Fischer and several fellow Communists were right behind, planning a takeover of Austria. Fischer briefly served as Minister of Education and Public Information in the Provisional government, but lost his job in the fall election. Later he was elected a deputy in the Austrian National Assembly, became foreign affairs spokesman for the Kommunistische Partei Oesterreichs, and twice bid unsuccessfully to become his nation's foreign minister.

The Austrian Communists lost their last parliamentary seats in 1956. Fischer then turned his attention to writing again, authoring literary works on Goethe and Kafka. The Czechoslovakian invasion caused him to break with the Soviets and with his own party over their policies.

Now, completely retired from politics, the 70-year-old Fischer lives quietly in Vienna.

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Strange Saga of Ivan the Terrible

Continued from preceding page

at Rustenschacher Allee 28. He has declined to answer any letters seeking first-hand information of his wartime activities.

As for Ivan, his interruptions ended in 1941, except for two occasions: on March 29 and October 26, the following year.

Why? Well, Moscow always knew that Ivan wasn't an effective jammer; he didn't actually block Deutschlandsender's frequency. His success lay in his ability to goad the Nazis into overreacting. He made them appear ridiculous in the eyes of their countrymen and the world. But Ivan was a novelty, and in time, even his best act became a bore. He died of overexposure during the long Russian winter.

A headline attraction in his time, today Ivan the Terrible, the Moscow mystery voice, rates only a postscript in history.

Making 2 Channels Into 4

Continued from page 48

three-gang pot to control the level of the rear speakers.

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For a listener-panel evaluation of these adaptors and more information about quadriphonic sound, read the article BIG NOISE IN FOUR CHANNEL elsewhere in this issue.

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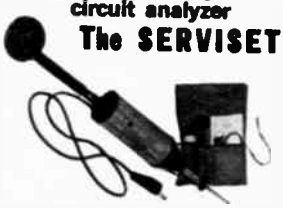

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CIRCLE NO. 20 ON PAGE 13

Big Noise in Four Channel

Continued from page 62

derives sound from two-channel sources. More sophisticated versions of the Dyna are built into Lafayette's LA-44 amplifier, which includes not only the phase-detection network, but four separate channels of amplification for true four-channel program sources. The LA-44 sells for $219.95.

Unlike the Dyna system, which claims to derive true quad sound from two-channel sources, a quadriphonic synthesizer admits to being no more than an electronic bag of tricks. But what a bag! A rig like Sansui's QS-1 and a Sansui encoded record can take even the most mediocre symphony orchestra and, by means of time delay, phase shift and other techniques, put you into Carnegie Hall. Well almost. To the best of today's rock, a good synthesizer can add that total, enveloping, psychedelic environment you'd like to enjoy while listening to the Beatles or the Rolling Stones.

The QS-1 has several sets of controls for creating concert hall sound and putting instruments at each of four speakers. You can adjust volume and tone of each speaker individually, or in groups of two or four. There are four VU meters to help you adjust volume levels. The QS-1 is only the first of its kind. Harman-Kardon and Hitachi are expected to have their own versions, perhaps available by the time you read this.

Until now, nobody's known for sure exactly how four-channel should sound, which may explain why there are so many different kinds of systems, each with its distinctive sound. Which one you'll like best—and which one will win public favor in the long run—is difficult to say.

Direct-Reading Power Meter

Continued from page 67

input voltage for 0.9, 0.8 and 0.7 watts, etc. Adjust the signal generator's output voltage to correspond to these power levels and mark the meter scale accordingly. For example, for a full-scale indication of 1 watt, (2 V across 4 ohms) set the signal generator for a 2-V output and mark M1's scale opposite the pointer 1 watt.

Using the Meter. The IC will be damaged or destroyed if it is blasted with excess power; at all times first set S2 to the 100-watt range, make all amplifier adjustments

and then adjust S2 *down* to the desired range. While IC1 can take a small overload, such as 15 watts when S2 is set to 10 watts, it cannot withstand an overload such as 50 watts when the meter is set to 100 mw.

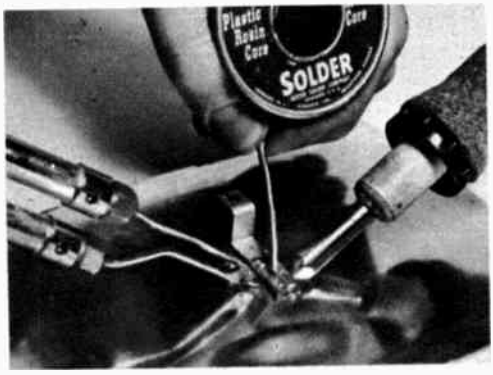
Update on Semiconductors

Continued from page 85

ted as light. Color depends on the structure and material of the diode (typically red, amber or green). Because there's no filament to burn out, LEDs have virtually unlimited life and some manufacturers predict it will take more than 100 years for an LED to dim to half its original value.

Light output from diodes won't replace Edison's lamp yet, but LEDs make fine indicators and pilot lamps. They're being widely designed into numerical displays (Fig. 8) to replace tuning dials in FM receivers. They may eventually replace the standard speedometer readout in your car, too. That's a sure sign that the emerging generation of semiconductors should leave almost nothing untouched.

TIPS



When a heavy soldering job comes along there sometimes just doesn't seem to be any way to get the solder to flow without resorting to a large iron or torch. Most electronics hobbyists own at least two medium- or small-size soldering irons or a pencil iron and a soldering gun. The easiest way to get lots of heat is to put both irons or a pencil and gun to work simultaneously. This speeds soldering and guarantees against a cold-solder joint.

Putting a lockwasher in a short screw that's in tight quarters is easy compared to starting a nut after the washer is in place. Easy way to do both jobs at once is to push the nut on the shaft of an ice pick then add the washer and hold it with your finger. Put the ice pick on the end of the screw, then let the washer slide down. Loosen the nut then let it slide on the screw. A little more wiggling does it.

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SAVE—BUY the world's finest floor standing speakers direct from factory. Unexcelled for studio monitor or home use. Free literature. 30 day money back guarantee. K.G.L.L. INC. Box 415, Biddeford, Maine, 04005.

• • • ELECTRONICS SUPPLIES & EQUIPMENT

KITS AND EQUIPMENT FM Wireless microphone transmitters, FM Telephone transmitters, Infinity transmitters. Security Electronics, P.O. Box 265, Huntington, W. Va. 25707.

• • • STAMP COLLECTING

OLD COINS—Early American Type Indian Cent, Liberty Nickel, Barber Dime, Quarter, Half. Make Ideal Gifts, only $6.98 Per Set. With Silver Dollar $12.98 H & R Coins, Box 17, Mason City, Iowa 50401.

• • • MUSIC

FREE CATALOG. Electronic musical accessory kits. PAIA Electronics, Box G14359, Oklahoma City, Okla. 73114.

SONGPOEMS URGENTLY Needed, Possible Recording/Publishing, 50-50 Agreement, Betty's Music Makers, 945H Central, St. Petersburg, Florida 33705.

ELECTRONICS ILLUSTRATED Classified Advertising Order Form

For information on terms, closing dates, etc., see heading at top of Classified Section.

INSTRUCTIONS:

50¢ a word
Minimum Ad 10 Words

WORD COUNT: Zip code free. Figure one word for name of state (New Jersey); name of city (Little Falls); sets of characters as in key (M-14); abbreviation of Northwest (NW); but note separate initials as in a name (M. D. Brown), 3 words counted as a word each.

DEADLINE FOR ADS: Copy must be in by the 20th day of the fourth preceding month for the issue in which the ad is to appear.

BLANKLINE: May be placed both above and below the ad, if desired. Each blank line is charged as 5 words.

TO: ELECTRONICS ILLUSTRATED • One Aster Plaza, New York, N.Y. 10036 • Att.: Classified Advertising Dept.

Gentlemen: Here's our copy for the Classified Section of ELECTRONICS ILLUSTRATED. Remittance of $_____ is enclosed to cover _____ insertion(s) in the _____ issue(s).

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25
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BUILD 20 RADIO
and Electronics Circuits

PROGRESSIVE "Edu-Kit"® HOME RADIO COURSE

Reg. U.S. Pat. Off.

Training Electronics Technicians Since 1946

Now Includes

- ★ 12 RECEIVERS
- ★ 3 TRANSMITTERS
- ★ SQ. WAVE GENERATOR
- ★ SIGNAL TRACER
- ★ AMPLIFIER
- ★ SIGNAL INJECTOR
- ★ CODE OSCILLATOR
- ★ TRANSISTOR (Solid State) CIRCUITS
- ★ VACUUM TUBE CIRCUITS
- ★ PRINTED CIRCUITS
- ★ HAND WIRED CIRCUITS

YOU DON'T HAVE TO SPEND HUNDREDS OF DOLLARS FOR A RADIO COURSE

The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. Our Kit is designed to train Radio & Electronics Technicians, making use of the most modern methods of home training. You will learn radio theory, construction practice and servicing. THIS IS A COMPLETE RADIO COURSE IN EVERY DETAIL.

You will learn how to build radios, using regular schematics; how to wire and solder in a professional manner; how to service radios. You will work with the standard type of punched metal chassis as well as the latest development of Printed Circuit chassis.

You will learn the basic principles of radio. You will construct, study and work with RF and AF amplifiers and oscillators, detectors, rectifiers, test equipment. You will learn and practice code, using the Progressive Code Oscillator. You will learn and practice trouble-shooting, using the Progressive Signal Tracer, Progressive Signal Injector, Progressive Dynamic Radio & Electronics Tester, Square Wave Generator and the accompanying instructional material.

You will receive training for the Novice, Technician and General Classes of F.C.C. Radio Amateur Licenses. You will build Receiver, Transmitter, Square Wave Generator, Code Oscillator, Signal Tracer and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for television, Hi-Fi and Electronics.

Absolutely no previous knowledge of radio or science is required. The "Edu-Kit" is the product of many years of teaching and engineering experience. The "Edu-Kit" will provide you with a basic education in Electronics and Radio, worth many times the low price you pay. The Signal Tracer alone is worth more than the price of the Kit.

THE KIT FOR EVERYONE

You do not need the slightest background in radio or science. Whether you are interested in Radio & Electronics because you want an interesting hobby, a well paying business or a job with a future, you will find the "Edu-Kit" a worth-while investment.

Many thousands of individuals of all ages and backgrounds have successfully used the "Edu-Kit" in more than 79 countries of the world. The "Edu-Kit" has been carefully designed, step by step, so that you cannot make a mistake. The "Edu-Kit" allows you to teach yourself at your own rate. No instructor is necessary.

PROGRESSIVE TEACHING METHOD

The Progressive Radio "Edu-Kit" is the foremost educational radio kit in the world, and is universally accepted as the standard in the field of electronics training. The "Edu-Kit" uses the modern educational principle of "Learn by Doing." Therefore you construct, learn schematics, study theory, practice trouble-shooting—all in a closely integrated program designed to provide an easily-learned, thorough and interesting background in radio.

You begin by examining the various radio parts of the "Edu-Kit." You then learn the function, theory and wiring of these parts. Then you build a simple radio. With this first set you will enjoy listening to regular broadcast stations, learn theory, practice testing and trouble-shooting. Then you build a more advanced radio, learn more advanced theory and techniques. Gradually, in a progressive manner, and at your own rate, you will find yourself constructing more advanced multi-tube radio circuits, and doing work like a professional Radio Technician.

Included in the "Edu-Kit" course are Receiver, Transmitter, Code Oscillator, Signal Tracer, Square Wave Generator and Signal Injector Circuits. These are not unprofessional "broadboard" experiments, but genuine radio circuits, constructed by means of professional wiring and soldering on metal chassis, plus the new method of radio construction known as "Printed Circuitry." These circuits operate on your regular AC or DC house current.

THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build twenty different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, hardware, tubing, punched metal chassis, Instruction Manuals, hook-up wire, solder, selenium rectifiers, coils, volume controls and switches.

In addition, you receive Printed Circuit materials, including Printed Circuits chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator, in addition to F.C.C. Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a High Fidelity Guide and a Quiz Book. You receive Membership in Radio-TV Club. Free Consultation Service, Certificate of Merit and Discount Privileges. You receive all parts, tools, instructions, etc. Everything is yours to keep.

Progressive "Edu-Kits" Inc., 1189 Broadway, Dept. 620AE, Hewlett, N.Y. 11557

FREE EXTRAS

- **SET OF TOOLS**
- **SOLDERING IRON**
- **ELECTRONICS TESTER**
- PLIERS-CUTTERS
- VALUABLE DISCOUNT CARD
- CERTIFICATE OF MERIT
- TESTER INSTRUCTION MANUAL
- HIGH FIDELITY GUIDE & QUIZZES
- TELEVISION BOOK & RADIO TROUBLE-SHOOTING BOOK
- MEMBERSHIP IN RADIO-TV CLUB: CONSULTATION SERVICE & F.C.C. AMATEUR LICENSE TRAINING
- PRINTED CIRCUITRY

SERVICING LESSONS

You will learn trouble-shooting and servicing in a progressive manner. You will practice repairs on the sets that you construct. You will learn symptoms and causes of trouble in home, portable and car radios. You will learn how to use the professional Signal Tracer, the unique Signal Injector and the dynamic Radio & Electronics Tester. While you are learning in this practical way, you will be able to do many a repair job for your friends and neighbors, and charge fees which will far exceed the price of the "Edu-Kit." Our Consultation Service will help you with any technical problems you may have.

FROM OUR MAIL BAG

J. Statnitis, of 25 Poplar Pl., Waterbury, Conn., writes: "I have repaired several sets for my friends, and made money. The "Edu-Kit" paid for itself. I was ready to spend $240 for a Course, but I found your ad and sent for your Kit."

Ben Valerio, P. O. Box 22, Magna, Utah: "The Edu-Kits are wonderful. Here I am sending you the questions and also the answers for them. I have been in Radio for the last seven years, but like to work with Radio Kits, and like to build Radio Testing Equipment. I enjoyed every minute I worked with the different kits: the Signal Tracer works fine. Also like to let you know that I feel proud of becoming a member of your Radio-TV Club."

Robert L. Shaff, 1934 Monroe Ave., Huntington, W. Va.: "Thought I would drop you a few lines to say that I received my Edu-Kit, and was really amazed that such a bargain can be had at such a low price. I have already started repairing radios and phonographs. My friends were really surprised to see me get into the swing of it so quickly. The Trouble-shooting Tester that comes with the kit is really swell, and finds the trouble, if there is any to be found."

UNCONDITIONAL MONEY-BACK GUARANTEE

Please rush my Expanded Radio-TV Course with "Edu-Kits"® to me.

☐ Send Course with Edu-Kits postpaid. I enclose full payment of $34.95.

☐ I enclose $5.00 deposit. Send Course with Edu-Kits C.O.D. for balance of $34.95 plus postage.

☐ Send me FREE additional information describing Course with Edu-Kits.

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CITY & STATE ..... ZIP .....

PROGRESSIVE "EDU-KITS" INC.
1189 Broadway, Dept. 620AE, Hewlett, N.Y. 11557

PRINTED CIRCUITRY

At no increase in price, the "Edu-Kit" now includes Printed Circuitry. You build a Printed Circuit Signal Injector, a unique servicing instrument that can detect many Radio and TV troubles. This revolutionary new technique of radio construction is now becoming popular in commercial radio and TV sets.

A Printed Circuit is a special insulated chassis on which has been deposited a conducting material which takes the place of wiring. The various parts are merely plugged in and soldered to terminals.

Printed Circuitry is the basis of modern Automation Electronics. A knowledge of this subject is a necessity today for anyone interested in Electronics.

CIRCLE NO. 10 ON PAGE 13

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- ■ MASTER COURSE IN ELECTRONIC COMMUNICATIONS
- ■ FCC LICENSE COURSE
- ■ MASTER COURSE IN ELECTRONICS TECHNOLOGY
- ■ INDUSTRIAL AND AUTOMATION ELECTRONICS
- ■ COMPUTER ELECTRONICS
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