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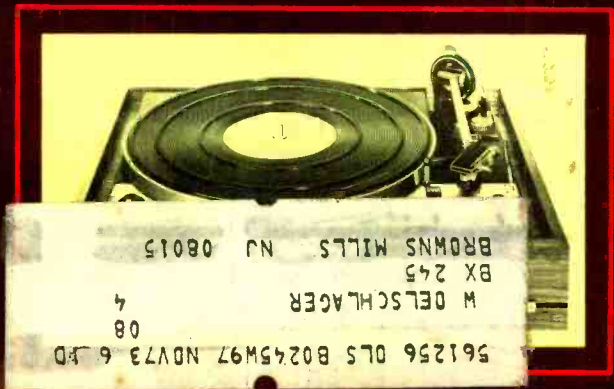
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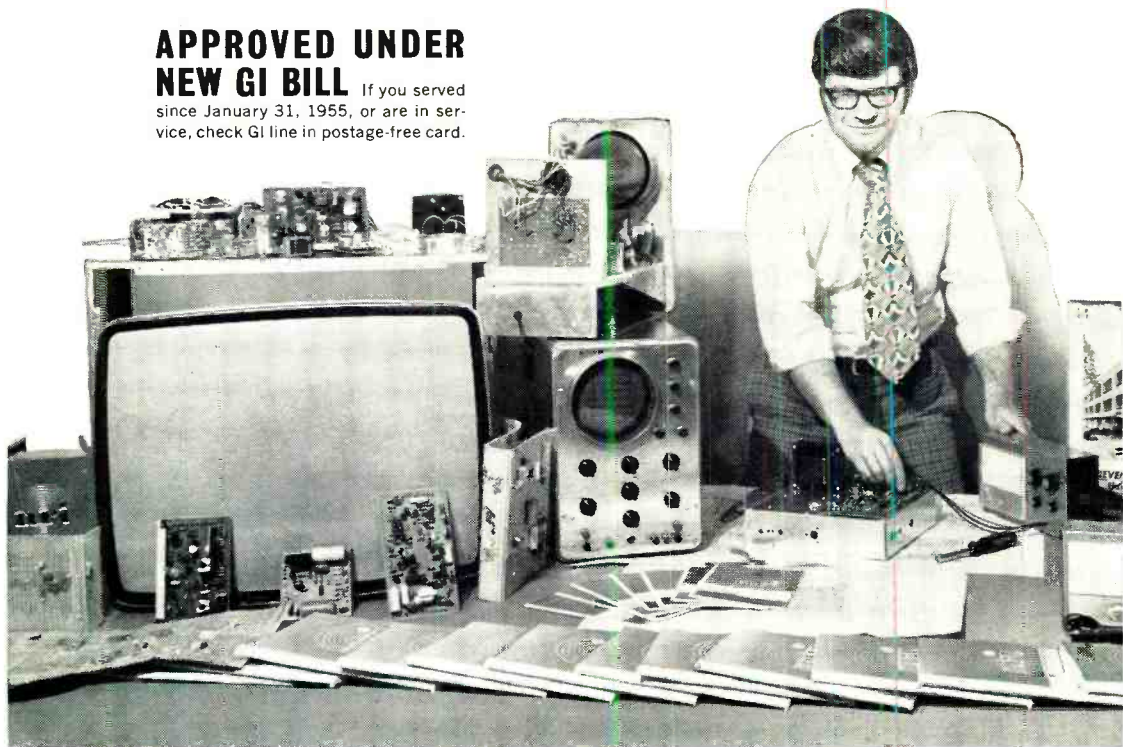
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# Editorial

By Milton S. Snitzer, Editor

## TRADE SHOWS FOR THE INDUSTRY

We've just returned from Las Vegas where we attended the NEW/COM (National Electronics Week, Components) Show. Manufacturers at the show all have one thing in common; they sell their products through electronic parts distributors throughout the country.

The show is important because it gives us a pretty good idea of the products we will be able to get at our local distributors. Antennas, test equipment, tools, speakers, turntables, R and C components, semiconductors, CB equipment, and fuses are just a small number of the large quantity of products that were on display.

This year's show was the biggest since the Electronic Industry Show Corp. has been producing them yearly since 1937. Some 227 companies exhibited their wares to the 7500 who attended or exhibited in the show. The Convention Center, where the show was held, was ideal for the product exhibits. The aisles were wide enough for comfort and everyone we talked to about the physical facilities was unreservedly satisfied with the hall and with the personnel that helped set up their exhibits.

We met quite a few old friends there and almost without exception they were happy and enthusiastic about the way the show went. Most were talking about a 20-percent increase in business written at the show as well as overall business throughout the year. What all this means to our readers is that they will find greater variety of better quality products on their local distributors' shelves.

Another show of interest is the June Consumer Electronics Show (CES) held June 10-13 at McCormick Place in Chicago. On the basis of our present information (this is being written before the show opens), there is expected to be more than 20,000 pre-registrants by the opening, and total show attendance is expected to be over 35,000, which would be a new record. About 375 exhibitors are expected to show more than 25,000 products on display, many of them for the first time. These will include radios, TV's, phonographs, audio components, tape equipment, electronic calculators and allied electronic products. All in all this will be a spectacular preview of the consumer products the public will be buying in the 1973-74 year.

Attendees to the show will include retailers, mass merchandisers, independent representatives, distributors, importers, manufacturers, and guests from allied industries. The Electronics Industries Association will hold its annual summer meeting during the show, and this will bring in more than 400 of the world's leading electronics manufacturers.

Still another show that our service technician readers will be interested in is the annual joint convention of NEA and NATESA. These national associations of service technicians (mostly radio and TV) will be meeting in Kansas City at the Crown Center Hotel on August 21-26.



# “If music be the food of love, play on.”

TWELFTH NIGHT. Act I, Scene i, Line 1

In past articles we have discussed the research and the technology behind the Bose Direct/Reflecting® speakers. It would indeed be misleading for us to imply that the unprecedented series of rave reviews<sup>1</sup> and the worldwide acceptance of these speakers is the result of only the research and technology that gave birth to their new design<sup>2</sup>. While these factors are absolutely necessary, they are far from sufficient to provide the performance for which these speakers are famous.

The more accurate the performance of any instrument or loudspeaker, the more apparent are small imperfections. Variation in the responses of individual speaker drivers, that might be masked by performance limitations inherent in the basic design of conventional speakers, can become annoyingly apparent with the accuracy of music reproduction associated with Direct/Reflecting speakers. The realization of this fact has led us to develop *quality control* measures that we think have no close second anywhere in our industry.

Here are some of the items we check:

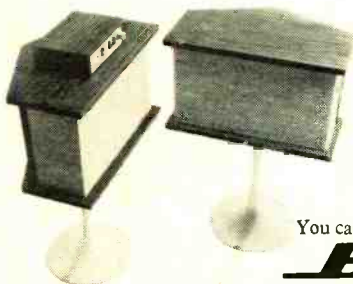
1. Acoustical properties of the cone material
2. Annulus material and doping
3. Thickness and bond of the critical glue joints where the cone joins the voice coil bobbin. Errors in either direction can cause audible coloration
4. Density of voice coil winding
5. Flux density in the magnetic circuit
6. Sixteen mechanical parameters are checked ranging from the length of the flexible voice coil leads to the centering tolerance of the voice coil
7. Power tests to check for possible thermal problems
8. Accelerated humidity tests
9. Power sweeps after complete assembly in cabinet to check for any extraneous noises
10. Extensive computer checking of all parameters in the 901 active equalizer

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Some of the items in this list cannot be directly tested after the speaker is assembled. For example, we can't see the glue joints or the voice coil. These tests and many others are made by our newly developed Syncom™ speaker testing computer. In addition, this computer selects matched drivers for each 901; and it matches the woofers and tweeters in each 501. One of the significant achievements of this computer is that its measurements are directly related to audible effects rather than to typical specifications whose correlation to audible performance has not been established. When the Syncom computer rejects a speaker, it means that a critical listener could hear the difference between that particular speaker and our standard of quality – more on this in a later issue.

When you couple this unique *quality control* system with all the technology behind the Direct/Reflecting speaker systems, you can appreciate our confidence in asking you to A-B the 901 with any speaker regardless of size or price. And while you're at it, audition the 501 against direct radiating speakers costing several times as much.

*Photograph of Shakespeare First Folio  
courtesy of Harvard College Library*



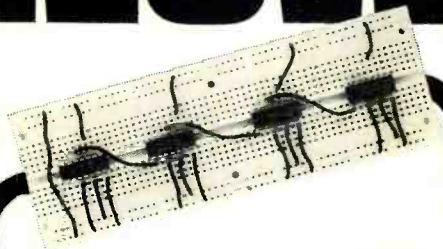
<sup>1</sup>For copies of the reviews, circle our number(s) on your reader service card.

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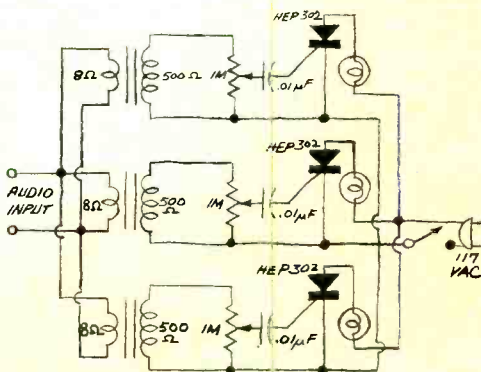
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## COLOR ORGAN THAT ISN'T

I've designed a system (see schematic) that delivers a lot better performance and reliability than the one presented in "Design Your Own Color Organ" (May 1973). My design can operate any number of channels, providing the



power capacity of the components is not exceeded. My overall cost for all three channels was about \$15.

NAME WITHHELD

*You haven't designed a color organ. What you show is a single-channel/multi-lamp, variable-intensity lighting system. It could be made into a multi-channel system if frequency-selective elements were included to make each "channel" respond to a different band of frequencies. As things now stand, your circuit will respond to all frequencies in all channels. We also question the use of 8-ohm-primary transformers connected in parallel across the driving amplifier. This arrangement can have disastrous effects on the amplifier's output stages.*

## FEEDBACK ON ELECTRONIC ORGANS

As an electronics technician and a professional musician, I was surprised to find no mention of the Hammond brand name in "How To Select An Electronic Organ" (June 1973). The Hammond Model B-3 is considered the organ by most professionals. Hammond organs have superior sound qualities, and the company's

method of tone generation never goes out of time.

I suggest in future articles of this nature that you consult with some musicians to determine what practical and musical values to look for as well as the electronics used. It is interesting to note that in most electric, or amplified, music, the electronically simpler equipment usually produces the most satisfactory sound.

BILL KENNEDY  
Albany, Ore.

P.S. I'm not a Hammond salesman or employee.

*Our regrets to Hammond, Mr. Kennedy, and musicians everywhere for our oversight.*

As an electronic organ serviceman I was very much interested in "How To Select An Electronic Organ" (June 1973). In this article it was stated that any knowledgeable electronic serviceman with a few tools could cope with these instruments. To that you had better add—providing he has a schematic and has studied the principles behind these organs.

For the past 10 years, I have attended organ servicing seminars on the average of one every 10 months. Without the help of these factory schools, I could not begin to cope with some of the problems that crop up. For example, the Wurlitzer 4037 has some of the most involved circuitry you can imagine. It would put a color TV receiver to shame in complexity.

I don't think that just a knowledge of electronics qualifies a man to cope with electronic organs. I have worked on some organs where such men have tried and failed.

VERN SMITH  
Terre Haute, Ind.

## HOW ABOUT . . .

"Light-Activated Slave Strobe Trigger" in the June 1973 issue of POPULAR ELECTRONICS was very interesting. But how about such a strobe light triggered by a Signetics 555 timer IC with a variable and a calibrated flash rate? I think many of your readers would find many uses for such a device; I know that I have.

EDWARD L. TOTTLE  
Baltimore, Md.

*Sounds like a good idea. We have nothing in the works right now, but stay with us and you're likely to find what you're looking for.*

## BUYER LOOKING FOR A SELLER

I would like to buy any issues of the *Electronic Experimenter's Handbook* (published by POPULAR ELECTRONICS) from 1966 to 1970 at a reasonable price.

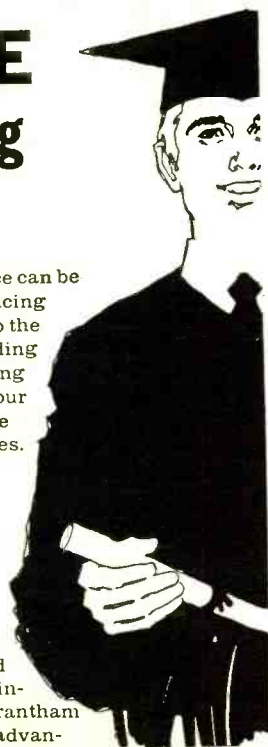
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AUGUST 1973

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**CIRCLE NO. 11 ON READER SERVICE CARD**



# Stereo Scene

By J. Gordon Holt

I AM SORRY that time doesn't allow me to answer readers' questions on an individual basis, but letters of general interest are answered from time to time in this column. This is one of those times.

## Alignment Tapes

In your May '73 "Stereo Scene," describing the alignment of tape decks, you refer to the use of a standard alignment tape for adjusting head azimuth and "zero" playback level. I've been unable to locate a source of such a tape. Can you recommend one?

Edwin R. Shambaugh  
Brooklyn Heights, N.Y.

North American Phillips (Norelco) and Nortronics both make alignment cassettes. Ampex Corporation makes alignment tapes for open-reel machines. A Norelco or Nortronics cassette can be ordered through any dealer who carries either brand. Ampex alignment tapes can often be purchased from stock from a dealer in professional recording equipment, or can be ordered through him. There is not, to my knowledge, anyone making alignment tapes for cartridge machines, but if I hear of one, I'll list it in a subsequent column.

Incidentally, open-reel alignment tapes should be purchased in the track configuration that matches that of your recorder (2 or 4 track), and for that running speed at which you do most of your important tapings.

If you have no reason to suspect that

## From the Mail Bag

your play head is out of alignment, you can save considerable money here by purchasing a Dolby level tape rather than a complete alignment tape. These tapes have only a single mid-frequency tone recorded on them, at standard zero VU level for open-reel machines and Dolby level for cassettes, and this can be used in lieu of the zero-level tone on an alignment tape for setting up your recorder.

## Fragile Ribbons?

Who's kidding whom? I've read, in articles you authored as well as in several other places, that ribbon microphones can be "very good," but are fragile devices that can be damaged or destroyed by dropping, blowing into them, and other harsh but conceivable mishaps. Yet at least one microphone manufacturer is claiming for their line of ribbons the kind of durability that I (through reading) associate only with moving-coil types. What's the story? Are *all* ribbons fragile? Or are some not so fragile?

Frank Sommer  
Tallahassee, Fla.

Revox Corp. took me to task for writing about the fragility of ribbon mikes, and sent me three of their Beyer ribbons to prove their point. They proved it; these mikes were indeed as rugged as moving-coil types, and also *sounded* better than most moving-coil designs I've tried. So there *is* a new breed of ribbon mikes, from Beyer at least. Doubtless there are others, which I shall probably hear from after having mentioned Beyer's line. All will be dutifully reported in a future column, too.

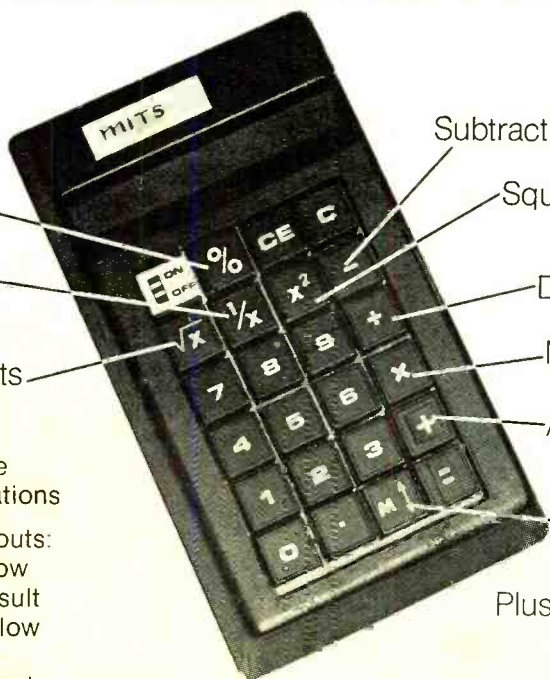
## High-Powered Damping

You have mentioned on occasion that some loudspeakers seem to perform better with amplifiers having extremely high damp-



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ing factors, while others do best with "moderate" amounts of damping. I have done some simple computations involving the rated damping factor of some of the amplifiers you cite as examples, and must conclude that what you are speaking of is *not* damping factor but something else.

The source impedance of the amplifiers you mentioned as having "moderate" damping is such a small fraction of an ohm that it would have to be completely swamped by the dc resistance of the wires running to the speakers. If there is in fact a difference in how amplifiers damp speakers (as you claim), it would have to be due to something other than damping factors alone. But what else?

Patrick R. Mullin  
Natick, Mass.

There *is* a difference, and since it involves the degree to which a given speaker tends to resonate at its normal bass resonance, it *has* to be related to amplifier damping.

I see your reasoning. I've heard that argument before, and I agree that there is no rebutting it. But how else to explain what the ears hear? Dynaco founder Dave Hafler (now head of Ortofon) has suggested that this is due, not to damping per se, but to the fact that by coincidence (?) most high-damping-factor amplifiers also happen to be high-powered amplifiers, and that the observed differences in low-end performance from a given speaker system are due to differences in available *power* at the low end. His idea is that, while damping factor determines how much corrective information is fed back from an amplifier's output to its input, available power determines how effectively the amplifier is able to apply the corrections (in this case, anti-resonant signals) to the speaker's motions.

I find it hard to see how an amplifier, working at far below its maximum-output level, could run out of speaker controlling power at the low end, but it is possible that the momentary current demands might be higher than anyone has ever guessed. This is just another one of those areas in audio where the need for additional speculation on the subject is far exceeded by the need for some basic research.

#### Four-Channel Stand

You have been running off at the mouth for over a year now on the subject of four-

channel sound without ever having stated unequivocally whether you are for it or against it. Where *do* you stand?

Jimmy Paul  
Quebec, Canada

No one who claims commitment to the holy grail of realism can be against 4-channel sound, because it has the *potential* of providing greater realism in reproduced sound than anything that has come along to date. If I have seemed unenthusiastic on the subject thus far, it is only because the hi-fi industry as a whole has shown little interest in *using* 4-channel reproduction to enhance realism, and is instead treating it like an entirely new creative medium, which can be great fun but is hardly "realistic."

Of course, this is exactly what happened when mono went stereo. Everything was ping-pong, and the hole-in-the-middle proved to everyone that stereo was different from mono. Today, we fill the hole when reproducing sounds that are normally (that is, when heard "live") spread across a stage, and we reserve the ping-pong "creativity" for program material where realism is unimportant or irrelevant.

I believe—or at least, I *hope*—the 4-channel situation will eventually stabilize in the same way, with realism the goal for music that sounds best when heard live, and the hi-jinks reserved for material where realism has no bearing on the matter. *Then* I shall become enthusiastic.

#### Supertracking Pickups

I noted with interest the recent introduction of two new "super-tracking" pickups, from Shure and Ortofon, both of which attributed their improved trackability to reduced tip mass, and I suddenly had a thought: if tip mass is what determines the high-frequency resonance, and the higher the frequency of this, the better the high-end trackability, why wouldn't some of the new CD-4 pickups outrack them all?

The pickups designed for RCA/JVC's CD-4 quadradiscs must respond out to around 40,000 Hz in order to receive the ultrasonic carrier that has the rear-channel information. That means their high-end resonance must be at a much higher frequency than even the best of the non-CD-4 types. Doesn't this give even better trackability?

Ralph D. Doyle  
White Plains, N.Y.



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Yes, and no. While tracking ability at low and middle frequencies is almost entirely a function of compliance (the flexibility of the elastic suspension), high-frequency trackability is a function of both compliance *and* tip mass. And while the currently available CD-4 pickups have extremely low tip mass, they have considerably less *compliance* than the conventional "supertrack" types of pickups.

Comparisons using Shure's three trackability test records indicate that, despite the extended high end of the CD-4 pickups, they are less able to cope with extreme modulation levels at the frequencies where these are most likely to occur on conventional stereo discs. On the other hand, none of the non-CD-4 pickups I checked had quite adequate high-end range for use with CD-4 discs.

The word from the grapevine, though, is that designers are at work on both super-tracking CD-4 pickups and supertrack pickups with CD-4 high-end range. Soon, the twain shall meet.

### To Move or Not to Move

I have been reading a number of reports about new components that look much better than the ones I have now, and am wondering if now is the time I should make my move to trade in my pickup (or turntable or arm or amplifier or whatever) for a better one. Would the improvement in sound be worth the money?

Typical Reader  
Everywhere, USA

Dear Typical:

Your question is one I received with unflagging regularity from audiophiles all over the country (world, in fact), and the answer must always be the same: If you are dissatisfied with any aspect of the sound you get from your system, now is the time to upgrade it. If you upgrade the right component (that distortion could be your pickup *or* your preamp), the improvement will be well worth the cost to you. If you just have the feeling that maybe you'd better upgrade something because it's a couple of years old, my advice to you is: "Don't."

If you don't hear anything from your sound now that you either want to reduce (like distortion or flutter or honkiness) or improve (like bass range or treble detail), you will probably not even notice whatever

improvement is effected by replacing a component unless one of your present ones is actually defective and will be replaced by a properly functioning one. The most common cause of the sick-system syndrome these days is a dried-up stylus suspension in a pickup cartridge. If you care about money, change your stylus before considering anything else. *Then* figure out what, if anything, you wish to improve.

On the other hand, maybe you like "newness," and find that justification enough for upgrading things. That's okay; it's your checkbook!

### Mono A+B

The instructions for my stereo preamp advise me to set the mode switch to "A + B" when playing old monophonic discs, but when I do this there seems to be some loss of treble response in the sound. Is this normal, or do I have a problem? And what does that A + B setting do anyway?

R. Hagerty  
New York, N.Y.

The A + B setting on your mode switch simply blends the two channels together, eliminating all stereo channel separation.

On a stereo disc, sounds that are supposed to appear midway between the speakers are represented as lateral groove modulations, while directional (i.e., off-center) information is represented as modulations of the groove in a vertical direction. Obviously, for stereo, both the lateral *and* vertical output signals from the pickup must be preserved.

A mono disc, though, is modulated in a lateral direction only. The only vertical "modulations" in a mono groove are those caused inadvertently by embedded dust particles and by any tendency for the stylus to mis-track. Thus, mono discs are best reproduced with the vertical pickup output suppressed, and this is what is accomplished by setting the mode switch to A + B.

This should not however cause any loss of highs. There may well be an *apparent* treble loss because of the suppression of surface noise (which we usually associate with extended high end), but the only thing that could cause an actual treble loss when you blend the channels is very poor high-end response in one channel of the cartridge (which would pull down the combined high ends when blended). And if this is the case, you will notice a marked difference in the

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surface noise levels from the two channels when you play a mono disc with the blend switch in the *Stereo* mode. (I assume, of course, that both speakers are identical. For proper stereo, they *must* be.)

### Output Mismatch

As an old-timer in high fidelity, I am concerned about what must be an impedance mismatch between my solid-state power amp and my English-made loudspeakers. With tubed amplifiers, I was always careful to see that the rated impedance of the loudspeaker was matched by the amplifier output taps. Now I have 16-ohm speakers, an amplifier whose output power is rated in the specs only at 8 and 4 ohms, and no taps to fool with. Is this probable mismatch doing any damage, to the amplifier or the sound? And if so, how can I correct the problem?

John B. Shuster  
St. Paul, Minn.

I doubt that it is doing any damage to the amplifier, but it could be impairing the sound somewhat.

One of the contributing factors in the improvement of sound with solid-state amplifiers was the elimination of the output transformers. Unfortunately, this also eliminated the ability to include output taps for selection of the proper output impedance to match the loudspeakers. Consequently, solid-state amplifiers have had to be designed to match a *range* of loudspeaker loads around and about a central design value that is typical of what most loudspeakers provide. In the U.S., designers generally aim at 6 ohms as their design value, figuring this is half way between 4 and 8 ohms, which are the impedances of the vast majority of American speakers. (In England, where 4-ohm speakers are subject to the same excise tax as are radios and TV sets, speaker designers aim for 8 or 16 ohms impedance, and usually 8.) The result is a compromise, and usually an acceptable one.

Generally, a solid-state amplifier will deliver somewhat more than its "rated" power output into a 4-ohm speaker, but at slightly increased distortion at low power levels. Using a US-designed solid-state amp with a 16-ohm speaker may in some cases reduce distortion at low levels, but it will slice a considerable percentage off the amplifier's maximum power output capability. Some in fact will deliver less than half their rated power into a 16-ohm load; and if it is your

habit to listen at rather high levels, you may actually be overloading an amplifier that should by all accounts have some margin of safety.

There are several solutions. The most obvious one is to replace your speakers with 4- or 8-ohm types. If you'd rather not part with them, do some perusing of amplifier spec sheets. Some *are* designed to work well with 16-ohm speakers. A third alternative is to get an amplifier with about twice the rated power (at 8 ohms) that you *should* need, and just resign yourself to living with it at half-power output. The other half won't be wasted, though; it just won't be elicited from the amplifier. Clipping will occur first.

### Bias Compensation

A test record that I own has a grooveless section on it that is supposed to be used for setting a tonearm's bias or skating force adjustment, but I can't seem to use it properly. If I set the bias adjust so the stylus doesn't swing inwards when playing that test, I still get much more distortion in one channel of the system than in the other. And that is supposed to be the sign that bias adjustment is needed. Most of the distortion is in the left channel, if that's any help to you.

John Semerenko  
Altoona, Pa.

That *is* a help to me. More distortion in the right channel than in the left indicates *excessive* bias compensation, which is what you will always get if you try to adjust it using one of those ungrooved "test" bands.

The forces acting on a stylus that makes contact with a flat surface at one point only (as when riding an uncut disc surface) cause considerably more skating force than when it is tracking a normal groove. The ungrooved "test" is irrelevant, and should not be included on any test record. To adjust bias compensation, play some loudly recorded *monophonic* discs with your mode selector set for stereo (rather than for A + B), and note in which channel breakup is most severe. If neither breaks up, start reducing tracking force until one does. If the worst breakup is in the right channel, increase the bias compensation. If it is in the left, decrease it. When it is the same in both channels, and tracking force is high enough either to meet the manufacturer's recommended maximum or to eliminate distortion from most discs, all is set properly. ♦



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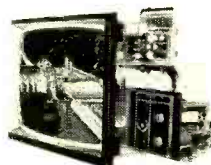
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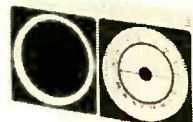
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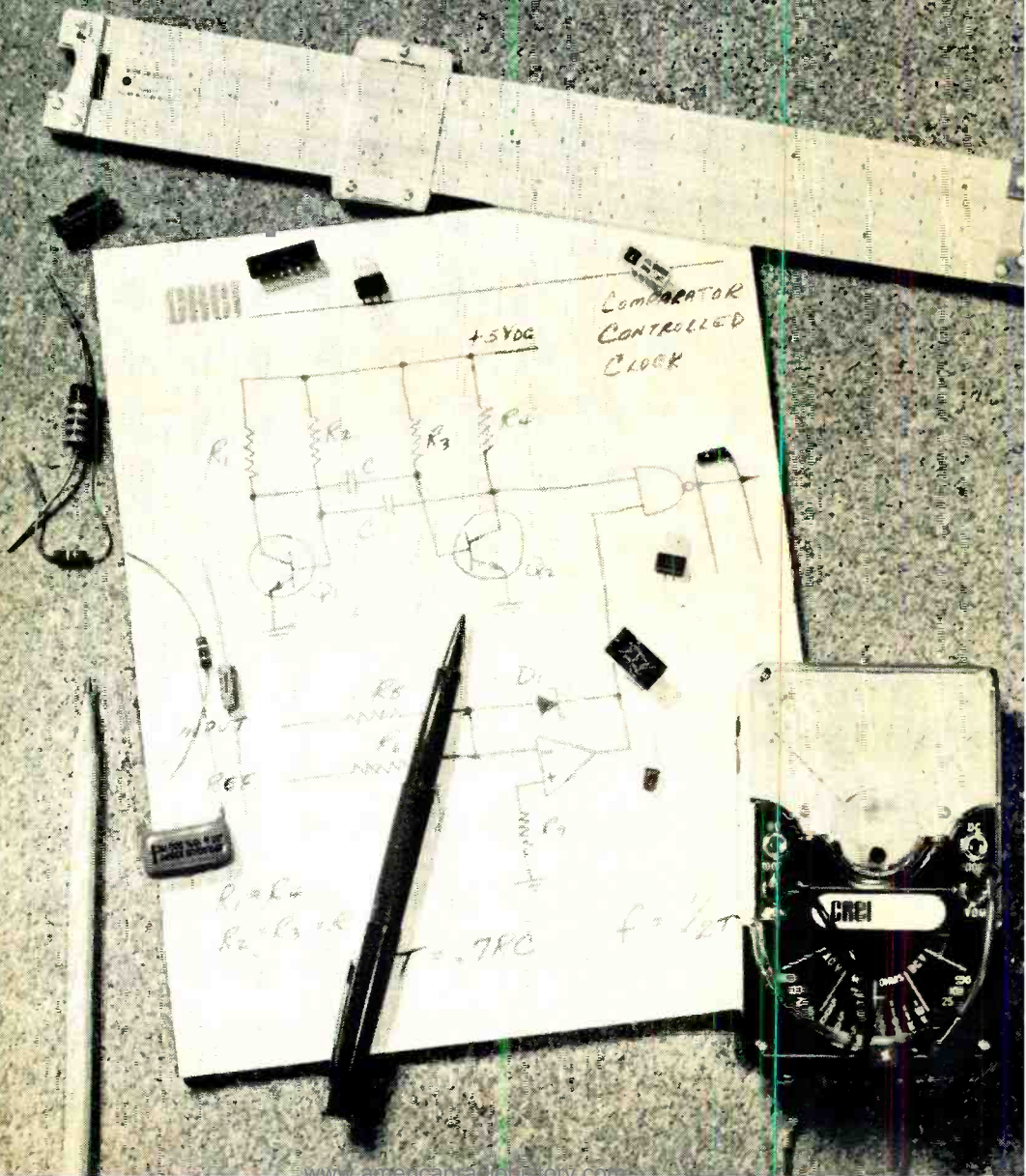
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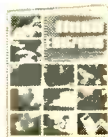
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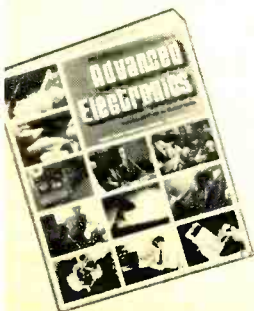


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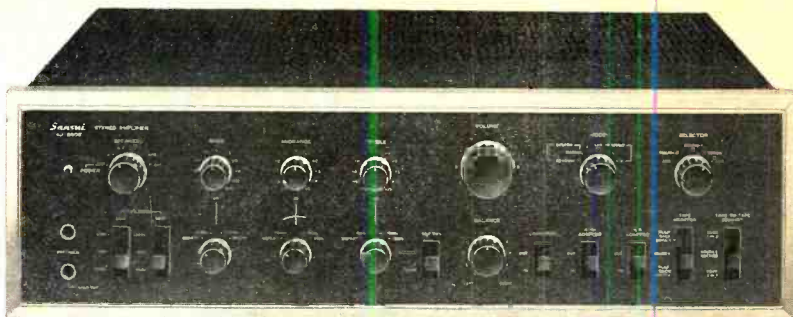
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Among the many exciting features of the AU9500 are a wide variety of conveniences, such as a 4-channel adaptor switch, for QS, SQ, or CD-4 add-on units, the ability to handle up to four tape decks, and provision for tape-to-tape dubbing. Triple tone controls allow even the fussiest listener to adjust the AU9500's response to his taste.

As eye-catching as it is functional, the AU9500's elegant front-panel styling is a standout in any audio display. And it has two counterparts, the AU7500 and AU6500, which offer many of the same features, the same quality engineering and manufacturing, but slightly less power. All three are powerful, quality units that are unequalled for fine high fidelity reproduction.



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# News Highlights

## A New "Spec-less" Power Amplifier

You won't find specifications accompanying the new Bose 1801 stereo power amplifier, except for its power rating of 250 watts rms per channel into 8 ohms. Bose's philosophy is to note only the minimum specifications necessary "to achieve audible perfection." For example, the company indicates that harmonic distortion of less than 0.5 percent below 5 kHz and less than 1 percent between 5 and 10 kHz will be completely inaudible on music and speech. Though its amplifiers are said to achieve substantially better specs than the foregoing, Bose feels that a specifications race is not meaningful since reliability and stability, which are not normally listed specifications, are directly related to the amount of distortion, damping factor, etc., exhibited by an amplifier. As an example, a trim pot on the new amplifier can be adjusted to lower distortion further, but the trade-off is running output transistors "hotter."

## Video Recorder Freezes TV Images

A video recorder has been developed that sequentially records and reproduces up to 15 still pictures of action from either a color or black-and-white TV screen. The video recorder, developed by Hitachi, can also record separate pictures not in sequence. The still pictures are recorded on a magnetic disc memory until they are called for by the operator. Reproduction time can be varied from 3 to 65 seconds, and the interval between stills in sequence can be adjusted by setting the recording time from a minimum of 1.5 seconds to a maximum of 255 seconds.

## Computerized Auto Emission Tester

One of the largest single vehicle emission testing computer systems ever built has been purchased by Toyota Motor Co. of Japan. The system was designed by Process Computer Systems, Inc. of Flint, Michigan, and uses hardware made by PCS and Hewlett-Packard. The new computer will automatically check auto emissions to see if they conform with both the Japanese and the U.S. standards. This sale follows the signing of an agreement between the two companies to the effect that HP will sell, integrate, and service the systems throughout Europe and Japan.

## Golden Anniversary of WWV

For over 50 years, one of the country's most popular radio stations has been the National Bureau of Standards station WWV. Its program consists of time ticks, voice announcements, and highly accurate standard frequency signals. The first broadcasts, early in 1923, originated from the laboratory radio station located in the NBS radio building in Washington, D.C. The broadcasts brought order to a burgeoning radio industry that was threatening to strangle itself on self interference. Today, the station occupies a 380-acre site near Fort Collins, Colo., with its own building, emergency power plant, and

antenna field. The original transmitter broadcast a number of standard frequencies from 200 to 545 kHz with an accuracy of 1 part in 10,000 and a transmitter power of 1 kW. Today's broadcasts include frequencies from 100 Hz to 25 MHz with an accuracy of a few parts in 10,000 billion at up to 10 kW of power.

### **Sylvania Produces Three-Billionth Receiving Tube**

The Electronic Components Group of GTE Sylvania has announced the production of its three-billionth electronic receiving tube. Such tubes were first produced by the company in 1924. Today, the Electronic Components Group operates eight manufacturing plants and four laboratories. In addition to receiving tubes, the group manufactures color and monochrome TV picture tubes, circuit assemblies, PC boards, and broadband communications equipment for cable TV.

### **New Quick-Heat TV Picture Tube**

A new 12-in monochrome picture tube that warms up so rapidly it can present a clear picture within five seconds of being connected to a heater supply was demonstrated recently by Mullard of England. The tube has a deflection angle of 110 degrees and operates with an anode voltage of 12 kV. It requires a heater supply of 11 volts at 140 mA and has been designed mainly for portable TV use.

### **Ten-Year Pacemaker Runs Off Body-Generated Power**

A cardiac pacemaker powered with electricity generated by the recipient's own body has been successfully implanted in a dog by Drexel University biomedical engineers. The power supply is expected to last ten years rather than two years as for a battery supply. The power unit is part biogalvanic cell, which consumes itself while producing current, and part fuel cell, which promotes the chemical action. The fuel cell uses oxygen present in the body fluid.

### **Motorola to Make Semiconductors in Japan**

A joint venture between Motorola's Semiconductor Products Div. and Alps Electric Co., Tokyo, has been set up to manufacture semiconductors in Japan. In 1972 Japanese semiconductor consumption has been estimated at \$900 million, compared to over \$1.3 billion in the U.S. By 1980, it is expected that the Asia/Pacific semiconductor market, of which Japan is the largest part, should equal the U.S. market.

### **RCA to Enter Cable TV Receiver Market**

The industry's first line of color TV sets with built-in capacity for cable TV will be offered by RCA. The receivers will have the ability to receive 24 cable channels in addition to conventional vhf and uhf channels. These sets eliminate the need for separate converter or selector devices to provide cable TV reception. The models also provide for wireless remote control, automatic fine tuning, and instant picture—features not available when converters are used.

### **Sony Wins Emmy for Trinitron**

The Sony Corp., Tokyo, has been awarded the Emmy by the National Association of Television Arts and Sciences for its development of the Trinitron color TV picture tube. The tube was introduced in 1968 and since then it has been employed in Sony TV sets marketed throughout the world. It is available in various sizes and employs a one-gun/one-lens system along with a vertically slitted shadow mask.



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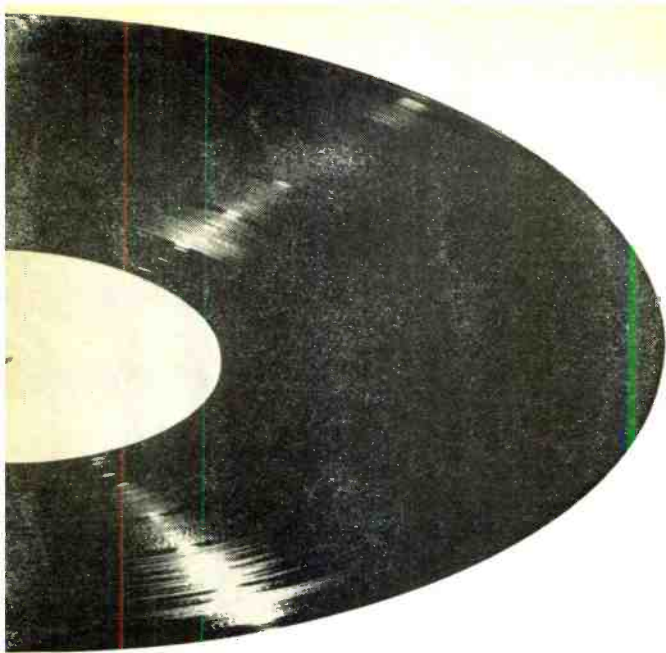
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*Phono discs with four separate channels are available. Here's what you need to play them.*

BY JULIAN D. HIRSCH  
Hirsch-Houck Laboratories



AS WE pointed out in "Comparison of Quadraphonic Matrix Decoders" (May 1973), the 4-channel stereo market is currently dominated by the CBS-developed SQ and the Sansui QS systems. It appears likely that both systems will continue to share the growing demand for 4-channel recordings for some time to come.

Meanwhile, the so-called "discrete" disc—the CD-4 system developed in Japan by JVC—has been carried to a point of commercial feasibility. With RCA supplying the discs (and other companies expected to follow in the near future), a number of phono cartridges have been developed in Japan by JVC and Panasonic. At this writing, a number of RCA "Quadradisc" 4-channel releases are on the market, although the hardware items are still not widely distributed.

Unlike the matrix systems, the CD-4 technique allows four essentially independent signals, or channels, to be recorded on a standard 2-channel stereo disc. Although the separation between channels is not equal to that offered on 4-channel tapes (figures of 20 dB are claimed), it is more than adequate for a fully satisfying quadraphonic effect. Furthermore, the 4-channel disc is not subject to the side-effects of the "logic" systems employed in some matrix decoders.

The two walls of the record groove carry the left-front plus left-rear ( $L_f + L_r$ ) and right-front plus right-rear ( $R_f + R_r$ ) pro-

grams so that the listener will be able to hear all four channels. Full frequency response up to 15,000 Hz is retained, and the recorded level is only about 2 dB lower than the current standards for 2-channel stereo records.

Also recorded on each channel is a 30,000-Hz frequency-modulated (FM) carrier. The left-channel FM signal carries the  $L_f - L_r$  program, while the right channel carries the  $R_f - R_r$  program. These signals are not heard by the listener with only 2-channel stereo equipment. His two stereo channels carry all four program channels, mixed in a manner that provides a normal 2-channel stereo effect.

**Special Equipment.** A special demodulator is required for recovery of the 4-channel information contained on a 4-channel disc. Low-pass filters separate the sum signals from the frequency-modulated difference signals. The latter signals, after limiting and amplification, are processed by FM detectors whose outputs are the  $L_f - L_r$  and  $R_f - R_r$  signals. These signals are then combined in matrices with the sum signals to recover the original  $L_f$ ,  $L_r$ ,  $R_f$ , and  $R_r$  programs.

The above is a considerably simplified description of how a 4-channel demodulator works. The CD-4 system employs special pre-emphasis and de-emphasis characteristics in its difference channels, plus a noise reducing system whose action is akin to



# STATUS REPORT ON DISCRETE 4-CHANNEL DISC EQUIPMENT

that of the well-known Dolby Noise Reduction System. These techniques are necessary to counteract the effects of record noise on the very low signal levels extracted from the record in the 20,000-40,000-Hz range.

A phono cartridge with a 45,000-Hz frequency response is required when using the 4-channel disc/demodulator arrangement. With the help of a specially shaped (Shibata) stylus, developed as part of the CD-4 program, a number of Japanese cartridges for discrete 4-channel discs are now available. Other cartridges will certainly be forthcoming from U.S. companies.

**Demodulators & Cartridges.** We recently evaluated the first two CD-4 demodulators and cartridges to reach the U.S. market. In our evaluation we used the initial RCA "Quadradisc" and a few Japanese CD-4 discs because there are no test records suitable for objective measurements of CD-4 demodulators at this time. Consequently, we depended almost entirely on extensive listening tests. Fortunately, the results were quite conclusive, even if they failed to yield back-up numerical measurements.

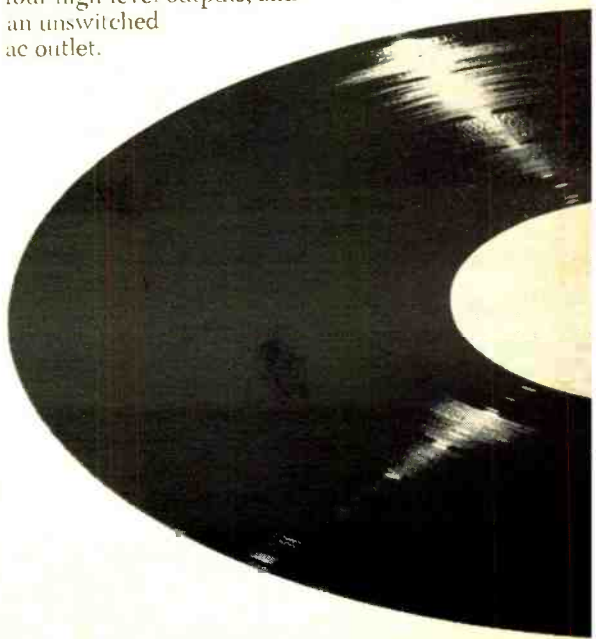
*Panasonic SE-405.* This was the first CD-4 demodulator to reach us. Its front panel has only two controls: a pushbutton power switch and a three-position function switch. When the function switch is placed in the STEREO position the demodulator circuits are bypassed for playing stereo discs (or CD-4 discs through a 2-channel sys-

tem). The 4 CH AUTO position sets up the system for either 2- or 4-channel listening, the mode depending upon whether or not the 30,000-Hz pilot carrier is present in the cartridge outputs. When the carrier is present, it triggers on a 4 CH RADAR indicator lamp. This is similar to the automatic stereo/mono switching found in almost all FM tuners. The 4 CH AUX position replaces the demodulated cartridge out-

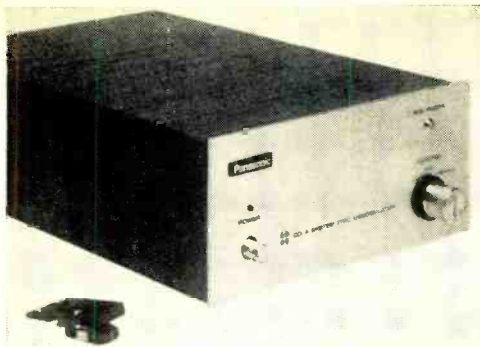
puts with an externally supplied discrete 4-channel program, such as from a cartridge or open-reel tape player.

The SE-405 is supplied with a special cartridge, the Technics 460-C. It uses semiconductor strain-gauge elements which act as signal-variable resistors, modulating a direct current supplied from the demodulator through the tonearm's wiring. The cartridge uses a Shibata stylus and is designed to track at 2 grams. (The demodulator can also be used with a suitable magnetic cartridge, in which case, the dc from the demodulator must be shut off via a switch located on the rear of the SE-405.)

The internal circuits of the demodulator provide all necessary equalization for 2- and 4-channel recordings and deliver a high-level output that is capable of driving the auxiliary inputs of a 4-channel amplifier or receiver. On the rear apron of the SE-405 are four AUX inputs, two phono inputs, four high-level outputs, and an unswitched ac outlet.







**Panasonic Model SE-405 Demodulator**

Each demodulator and cartridge must be adjusted as a pair for optimum front-to-back separation and carrier sensing threshold. A special test record is supplied for this procedure. The alignment, which is simple and rapid and is done entirely by ear, is required only when a new cartridge or stylus is installed.

The Panasonic Model SE-405 demodulator and Technics Model 460-C cartridge combination retail for \$135.

**JVC 4DD-5.** This demodulator is meant to be used only with magnetic cartridges and has no provision for switching into the system external high-level 4-channel program sources. In addition to the power switch and 4-channel RADAR indicator light (similar in function to that on Panasonic's SE-405), its only other switch on the front panel is a switch marked 4 CH AUTO and 2 CH. A 2-channel disc played with the switch in the AUTO mode produces identical front and rear outputs on either side of the room. If a 30,000-Hz carrier is present, the output jacks carry the separated programs, equalized and amplified to drive the AUX or high level inputs of a 4-channel amplifier or receiver.

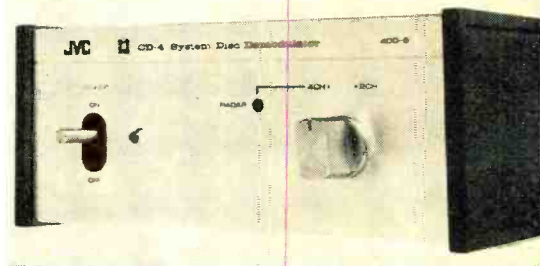
The 2 CH mode can be used in two ways, selected by a slide switch located on the decoder's rear apron. With the switch in the OFF position, the stereo program appears at the demodulator's outputs just as it would in the 4 CH AUTO mode with a standard stereo record. Moving the switch to ON bypasses the 4DD-5's circuits, connecting the cartridge outputs to a pair of jacks in the rear of the demodulator. The outputs from these jacks can be fed into the phono inputs of an external amplifier, utilizing the amplifier's existing equalizing circuits instead of depending on those in the 4DD-5.

Controls in the rear and on the bottom of the demodulator are provided for adjusting the carrier threshold sensitivity and separation (a test record is provided for this procedure). As with the Panasonic demodulator, no instruments are required for setting the sensitivity or separation, and these adjustments are required only during initial installation or when changing a cartridge or stylus.

The JVC model 4DD-5 demodulator retails for \$100. The high-quality JVC Model 4MD-20X magnetic cartridge equipped with a Shibata stylus tracking at 1.5 grams with which we tested the demodulator sells for \$70.

**How They Performed.** The demodulators were tested with the cartridges installed in a high-quality turntable operated at recommended tracking forces. A 4-channel preamplifier and power amplifier were used with several types of speaker systems. The records available at the time were the first three "Quadradisc" releases from RCA and three JVC discs; the latter (not available to consumers) were specially obtained for our tests.

Subjectively, we heard no differences between the two demodulators and cartridges so the following comments apply equally to both setups. The much-criticized low recording levels of CD-4 discs (to accommo-



**JVC Model 4DD-5 Demodulator**

date the 30,000-Hz carrier) were not particularly obvious, especially with the Quadradiscs which sounded almost as loud as most stereo records. The early JVC demonstration discs were cut at a lower level (by comparison to the newer releases), but in all cases the background noise was as low as we have come to expect from modern stereo records.

Another criticism of the CD-4 system has been a short playing time from the re-

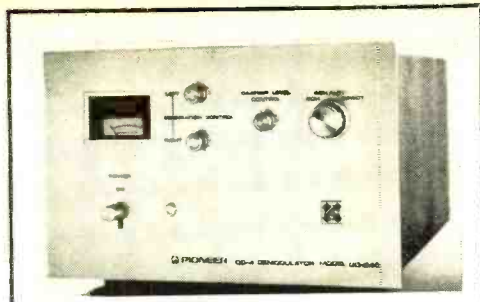
cordings. However, RCA's "Fantastic Philadelphians, Vol. II" was 25 minutes long on each side. This is comparable to most stereo recordings.

The differences between individual recordings are often much greater than those between competing systems. To a great extent, this was true of the CD-4 discs. Some of the selections did not seem to exploit fully the capabilities of the system and lacked the impact of the better matrixed records in our collection. On the other hand, the best CD-4 recordings were truly outstanding, with a positive localization of sound that one rarely—if ever—experiences with matrixed recordings. This could be appreciated when moving about the listening area, since a CD-4 program sounds "discrete" from any position, even outside the area enclosed by the speakers. Matrixed programs, on the other hand, are best heard within the speaker area, and preferably not too close to any one speaker.

Cleanliness of discs and styli is more important with the CD-4 system than with other records. A buildup of dust or dirt on the stylus can cause temporary drop-outs of the carrier, producing disturbing sounds. However, with even moderate attention to stylus and disc cleanliness, this problem will not arise.

Some critics of the CD-4 system contend that record life will be limited by erasure of the ultrasonic content during repeated plays. We were concerned about this possibility, especially in view of the 2-gram tracking force required by the Technics cartridge. We monitored the change in carrier level at the output from the cartridge during 100 successive plays of a portion of one of the Quadradiscs. After 100 plays, the level of the carrier was fluctuating slightly, down by 3 dB at times. But since the demodulator limiters are able to handle far larger variations, this had no effect on program quality. In fact, when playing the "worn" portion of the disc, it was impossible to hear the transition to a section that had been played only a couple of times. Obviously, wear is no more a problem with CD-4 pressings than it is with any other current type of disc.

**Conclusions.** Although the CD-4 demodulators are not exactly inexpensive at this time, they cost no more than a typical "partial-logic" SQ decoder and far less than a "full-logic" SQ decoder. Also, RCA has



#### EDITOR'S NOTE

Shortly after this report was prepared, Pioneer Electronic Corp. announced their Model QD-240 demodulator for use with CD-4 discs. According to the published specifications, the complex circuit yields a frequency range of 20-15,000 Hz, a greater than 70-dB signal-to-noise ratio, and left-to-right and front-to-rear separation figures of 50 dB and 30 dB, respectively. Pioneer recommends the use of their Model PC-Q1 phono cartridge with the QD-240 to obtain the full benefit of discrete 4-channel sound.

kept the price of their Quadradiscs at the standard LP price, while SQ discs are priced a dollar higher. The quality of the discs we tested was first-rate, and we have no doubt that future releases will be even better as a result of improved "mix-down" techniques.

Most of the feared weaknesses of the CD-4 system have not materialized. The only serious disadvantage, as we see it, is the inability of the CD-4 format to be broadcast from a single station over FM radio. Perhaps there will eventually be a discrete quadraphonic FM system of which the FCC will approve, but until then, the only way to enjoy the 4-channel sound of the CD-4 discs will be through your own record playing system.

Our feeling is that discrete and matrixed recordings (perhaps more than one type of the latter) will coexist for an indefinite period. As lower-priced demodulators and logic decoders become available through the development of new integrated circuits, we can expect to see amplifiers and receivers with the built-in capability to process any type of quadraphonic material, giving the listener the option of choosing any recording that satisfies his personal tastes—and enjoying it in four channels. ♦

# ELECTRONICS & INSECT CONTROL

*Exotic methods use high-frequency sound and lasers.*

BY L. GEORGE LAWRENCE

EVER since the scholar Plinius recommended the use of arsenic for chemical insect control back in 70 A.D., insecticides have assumed vital roles in world-wide agriculture. Today, however, it is becoming alarmingly apparent that these heretofore beneficial pesticides and chemical fertilizers have polluted our planet's biosphere and are in the process of contaminating our food, the soil, wild-life, and even ourselves.

Because of widespread public concern, research has been initiated to develop effective alternatives to chemistry-based insect controls. Particular attention is being directed at electronics, with the ultimate hope that electromagnetic fields can efficiently and effectively be combined with insect sex attractants—the so-called *pheromones*—which species readily seek out.

Currently, a good part of the work in the search for insecticide alternatives is conducted under the authority of Section 301 of the Public Health Service Act. Other concepts and ideas are being forwarded by electronics-oriented gardeners, farmers, and others. Let's look at some of the problems in this critical area of human survival.

**Insects at Large.** Roughly 90 percent of all non-vegetable land life forms on this planet are insects. In one way or another, a great many of them are beneficial to man, yielding such items as silk and honey and providing services such as soil aeration and pollination. Of the 500,000 or so species known to science, only a few hundred are really harmful (to man, that is). Because of their enormous mortality rates, insects reproduce rapidly, establishing extremely large populations in a very short time.

We have come to realize that possibilities for effective insect control reside in the areas of sex and feeding habits. We must consider the overall index of survival of each species: how they communicate, how they develop resistance to DDT and other chemical inhibitors, and how they function in electromagnetic and ultrasonic fields.

Chemicals are discriminatory, attacking one species without affecting other species of insects. But electromagnetic and ultrasonic waves are non-discriminatory. Insects cannot develop resistance to them. Dr. Thomas J. Headlee studied the effect of

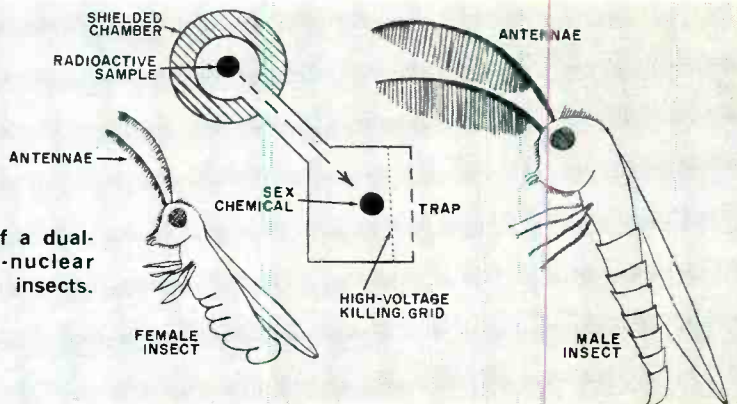


Fig. 1. Diagram of a dual-function electro-nuclear trap for killing insects.



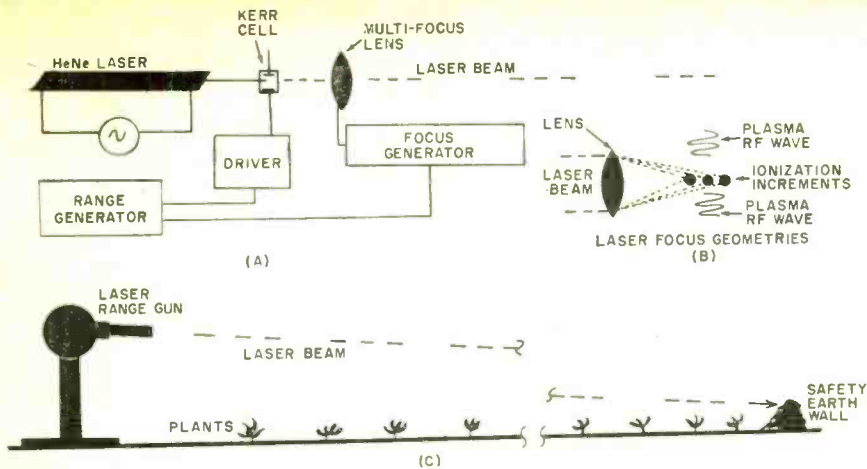


Fig. 2. (A) Laser-type field generator is one of latest methods of insect control. (B) Plasma phenomenon produced at varying focal points. (C) Setup of laser gun.

high-frequency currents on insects as long ago as 1928. He placed test tubes containing insects between the plates of a capacitor for predetermined time periods, feeding energy ranging from 750 kHz to 14 MHz to the plates. The insects were warm to the touch after they had been killed. This led to the knowledge that r-f energy has a thermal effect on tissue.

Another researcher, Dr. G.M. McKinley, worked with parasitic wasps of different age, sex, and conditions of feeding at a wavelength of 3.5 meters and with 1.8 amperes in the exposure circuit. The wasps were killed in an average time of 11.41 seconds. Dr. J. Hadjinicolaou contributed to this work by experimenting with adults, larvae, and pupae of insects feeding on stored products. His frequency was 1.09 MHz, while exposure time ranged from 2 to 2.5 minutes. He found that there is no uniformity in wavelengths and exposure times needed to produce lethal effects. Mites, for example, seemed to be more resistant than were bean weevils.

The above approaches are "brute force." Their obvious disadvantage when considering their use in the field is that large power densities and long exposure times are required. This prompted research into ultrasonic insect killers.

Sound and ultrasound are used by many insect species for a variety of purposes, including communication and predator detection. Their sounds frequently range from audible frequencies to as high as 150 kHz (250 kHz in the case of tympanate moths).

Killing insects with direct use of high-

intensity sound has inherent restrictions, especially in the way of safety for both man and domestic animals. However, it can be used to induce changes in behavior, perhaps moving insects to flight, disorienting them, or prompting them to enter destructive trapping devices. As reported by Drs. Kuhn and Offenhauser, success was obtained in recording the flight sounds of female mosquitoes and playing the sounds back in the field to lure males into traps where they were destroyed by electric grids.

A dual-function electro-nuclear trap is illustrated in Fig. 1. This device is furnished with a chemical and/or an electronic sex attractant. A high-voltage grid can kill outright; for even more effective control, a strong dose of radiation might sterilize the insects. Insect females frequently mate only once. If this mating is with a sterilized male, there will be no offspring. The classical success of this technique has been with the screw-worm fly, formerly a serious cattle pest in the U.S. Two other insects, the melon fly on the Pacific island of Rota and the Oriental fruit fly on Guam, were also eradicated by the sterilization method.

Certain pests—such as face, blow, and house flies—respond to very slight localized pressure waves and can be compared with ultra-sensitive electronic transducers. Pressure-wave fluctuations are apparently sensed by an organ located in the second antenna segment. If microelectrodes were implanted there for electrophysiological studies, it is easy to detect irregular series of electronic pulse trains—typically large,

spike-like potentials when the antennae are subjected to a gentle stream of air. An encoding phenomenon occurs in airborne sounds at up to 500 Hz, with maximum response (in the case of blow flies) occurring in the 120-180-Hz range.

Again, these responses are not uniform. Each group of species is geared to emit and receive distinct pulse trains that are correlated in the central nervous system. Unfortunately, because fields may be inhabited by many different insect species, electronics-based control schemes must be selective and wide ranging.

The laser-type field generator shown in Fig. 2 is one of the very latest development concepts in insect control. The apparatus is intended to produce, for diagnostic purposes, discrete sound patterns over the radius of a given agricultural area. Electronically, the system is made up of a continuous-wave helium-neon laser with power supply, a Kerr-cell shutter, and a multi-focus piezoelectric lens. Its purpose is to create a train of sonic or ultrasonic (r-f) waves at a considerable distance from the laser by focusing the beam into free air. High-energy lasers produce plasma phenomena at focal points, giving rise to the possibility of generating sound pulses of discrete frequency and magnitude at given points above an insect-infested plant population. Designers hope that this effect will trigger flight or behavioral changes. Current problems associated with the laser project reside in the areas of precise long-range focus control of the emitted monochromatic laser beam.

Long-ranging control devices have the advantage of being able to place energy at specific points in a field, perhaps in a scanning mode. Techniques of this type eliminate the dangerous necessity of having to radiate powerful blasts of ultrasonic energy.

**Sex Attractants.** The judicious combination of chemical sex attractants, electronics, nuclear forces, and carefully selected insecticides bears excellent prospects of long-range insect control. Most encouraging work has been done in developing strictly biological pesticides that depend on the dissemination of spores of pathological microorganisms. These however, have the innate hazard of possibly being able to attack organisms—insect or animal—other than the pest for which they are formulated.

In short, practical insect control implies many complexities and drawbacks.

Sex attractants are safe. Let us review some possible refinements.

First off, organic brains, whether animal or insect, cannot feel, see, or smell by themselves. They rely on biological sensors that feed electrical stimuli to them. What the brain actually "sees" are electrical pulse trains, for which the brain triggers motor activities that make an organism execute a given act. A *modus operandi* is easily discerned for evasive and other survival patterns of behavior, but electrophysiological profiles of behavior are much more difficult to discern when it comes to mating, hunger, and the like.

A compound of 2-methylheptadecane is excellent as a sex illusion maker, leading the tiger moth quickly to his doom. Typically, a box contains a wick wetted with the attractant chemical and a lethal insecticide, the latter being what kills the tiger moth. A large inventory of electronics-based machines is needed to develop the chemicals that other species of insects will find attractive.

For example, when Dr. M. Beroza conducted his pioneering work, some 500,000 abdominal tips of the female silkworm were needed to obtain 12 milligrams of attractive derivative, from which the structure was deduced. It is in the analytical area where mass, infrared, ultraviolet, and nuclear-magnetic resonance spectrometers are found. Equipment like this permits researchers to use some 1000-fold less sample materials than previously required. Such apparatus frequently allows work to be conducted with less than one microgram of sample substance.

**Summing it up.** We have seen that the best possibilities of effective insect control emerge in the form of combinations. Electromagnetic forces alone cannot yield the desired results, nor can ultrasonics. But if either of these is combined with harmless sex attractants and carefully applied insecticides, good results can be achieved.

We must bear in mind that many of the insects that are the object of control attempts are not really plant-damaging pests. We must not annihilate *all* species of pests, or even all of one species, else the ecological balance of the biosphere will be upset. In which case, predator enemies that are not pests will become extinct. ♦

# HIGH-QUALITY BENCH POWER SUPPLY



BY MICHAEL S. ROBBINS

*Single positive/negative  
supply has  
regulation better than 0.06%*

**I**F YOU are convinced that the op amp is here to stay and that two power supplies (positive and negative) are one too many, you need the compact single power supply described here. It uses a sophisticated IC to provide both positive and negative outputs which remain within 300 millivolts of each other; and it has line and load regulations of better than 0.06%. To keep the supply compact and easy to use, five pairs of switch-selected output voltages ( $\pm 9$ ,  $\pm 10$ ,  $\pm 12$ ,  $\pm 15$  and  $\pm 20$ ) and two current limits (10 mA and 100 mA) are provided instead of a control and a meter.

**Circuit Operation.** The IC used here is unique in that it contains two voltage regulators—one for positive and one for negative output. The portion that is the negative regulator is the key to the provision for variable-voltage outputs from both supplies. By varying the value of a single external resistor, the output can be changed over a wide range. Since the positive regulator "tracks" the negative regulator, the two outputs are the same—with opposite polarities.

Since the small pass transistors in the IC can dissipate only 0.68 watt, their outputs

are used to drive external high-power pass transistors, Q1 and Q2, as shown in Fig. 1. Current-limiting circuits in both sides of the IC regulator sense the voltage developed across R4, R5, R6, and R7. If this voltage exceeds 0.6 V, the output voltage drops.

**Construction.** Layout of the supply is straightforward and many variations are possible. The use of the printed circuit board shown in Fig. 2 is suggested, to avoid oscillations. Leads between the panel and the circuit board can be bundled, for neatness, as shown in the photograph.

The cabinet can be fabricated from two pieces of 0.050-in. thick aluminum, although a standard utility box can be used. The two pass transistors (Q1 and Q2) must be heat sunk to the cabinet, insulated with a mica washer coated with heat sink compound, and fastened with screw, nut, and lock washer.

If the Triad F-90X transformer is used, cut off or tape the blue, black, black/white, and black/green leads. The red and green are the ends of the secondary while the yellow is the center tap. The black/red and black/yellow leads are the primary.



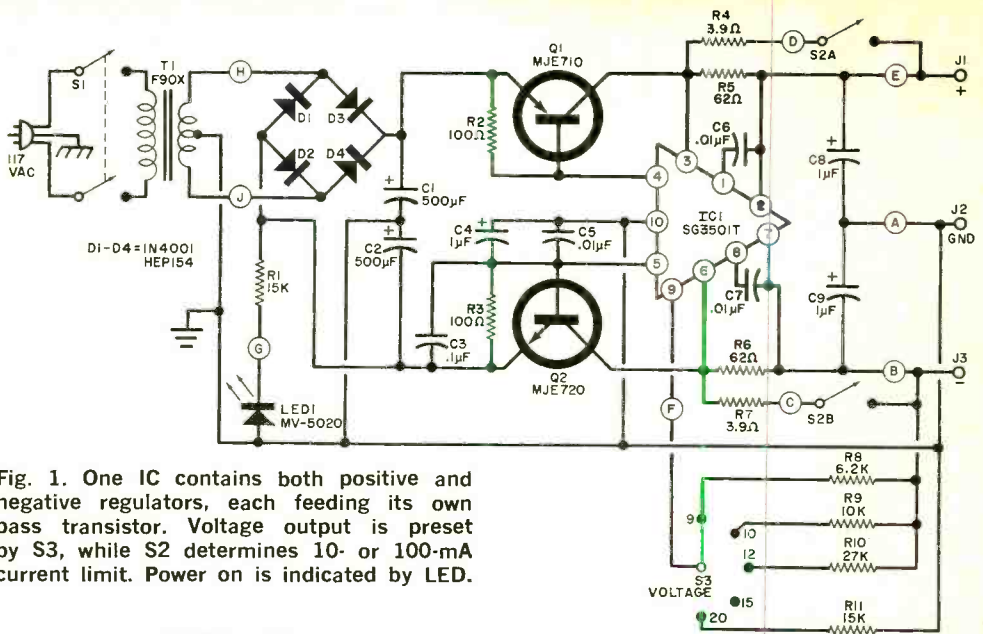
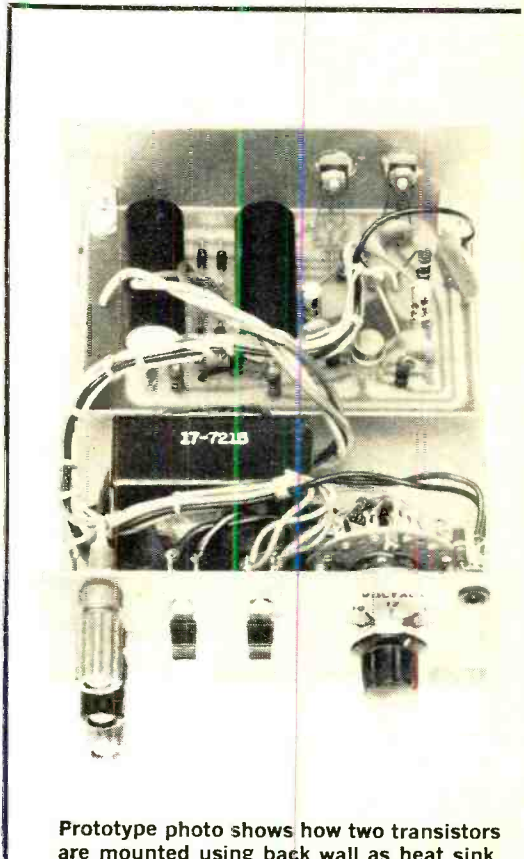


Fig. 1. One IC contains both positive and negative regulators, each feeding its own pass transistor. Voltage output is preset by S3, while S2 determines 10- or 100-mA current limit. Power on is indicated by LED.

### PARTS LIST

- C1,C2—500- $\mu$ F, 25-V electrolytic capacitor
  - C3—0.1- $\mu$ F, 25-V disc ceramic capacitor
  - C4,C8,C9—1- $\mu$ F, 25-V PC-type electrolytic capacitor
  - C5-C7—0.01- $\mu$ F, 25-V disc ceramic capacitor
  - D1-D4—Silicon rectifier (1N4001, HEP154, or similar)
  - IC1—Dual regulator (Silicon General SG3501T)
  - J1-J3—Binding post (red, black, and blue)
  - LED1—Light-emitting diode with mounting clip (Monsanto MV-5020)
  - Q1—Transistor (pnp) (Motorola MJE710)
  - Q2—Transistor (npn) (Motorola MJE720)
  - R1—15,000-ohm, 10%,  $\frac{1}{2}$ -watt resistor
  - R2,R3—100-ohm, 10%,  $\frac{1}{2}$ -watt resistor
  - R4,R7—3.9-ohm, 5%,  $\frac{1}{2}$ -watt resistor
  - R5,R6—62-ohm, 5%,  $\frac{1}{2}$ -watt resistor
  - R8—6200-ohm, 5%,  $\frac{1}{2}$ -watt resistor
  - R9—10,000-ohm, 5%,  $\frac{1}{2}$ -watt resistor
  - R10—27,000-ohm, 5%,  $\frac{1}{2}$ -watt resistor
  - R11—15,000-ohm, 5%,  $\frac{1}{2}$ -watt resistor
  - S1,S2—Dpdt switch
  - S3—One-pole, 5-position shorting-type rotary switch (Oak 399-418K or Centralab PA-1000)
  - T1—Power transformer (40 VCT @ 0.1A) (Triad F-90X or similar)
  - Misc.—Suitable cabinet, ac cord, mounting hardware, wire, solder, etc.
- Note—The following are available from Caringella Electronics, Inc., Box 327, Upland, CA 91786: PC board, drilled and etched, No. TPS-1PC, at \$5.95, postpaid in USA; set of all semiconductors at \$14.00, postpaid in USA; complete kit including cabinet, wire, etc., No. TPS-1K, at \$49.95 plus 1.50 handling and shipping. California residents add 6% sales tax on all items.



Prototype photo shows how two transistors are mounted using back wall as heat sink.

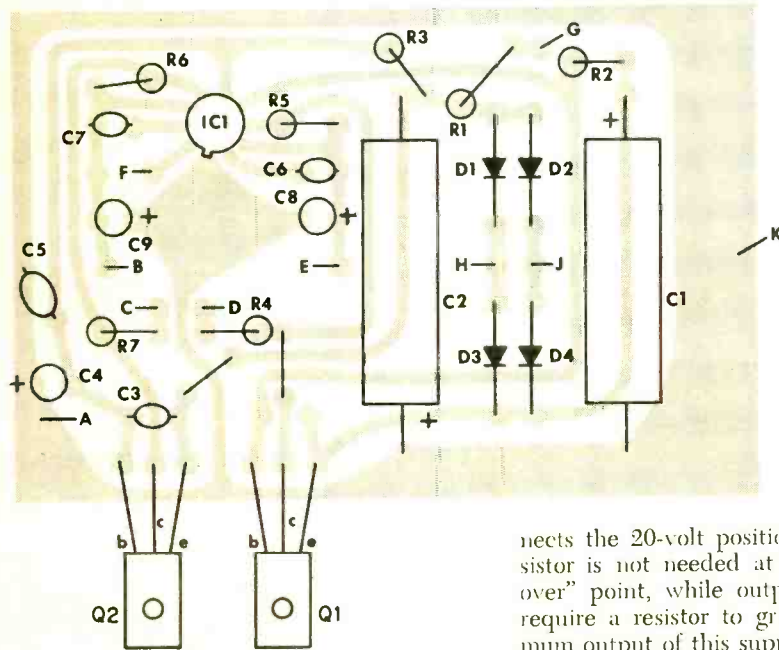
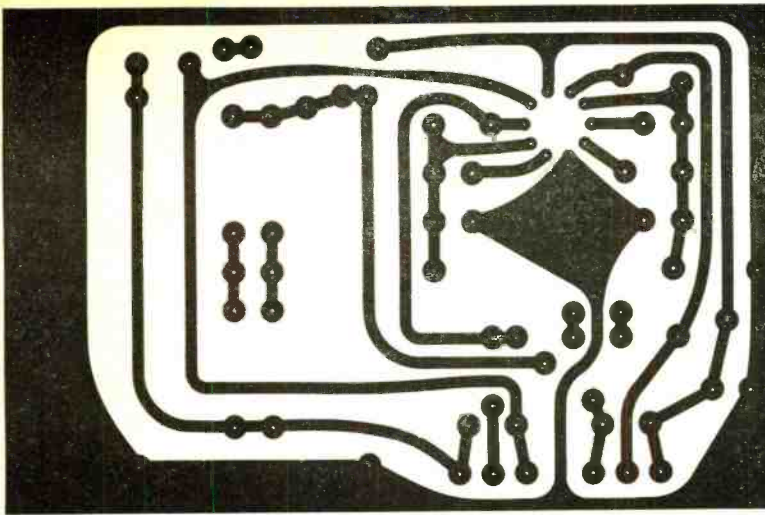


Fig. 2. Actual-size foil pattern and component installation for the power supply.

Care should be taken when mounting the electrolytic capacitors, diodes, transistors, and IC. The leads on Q1 and Q2 should be left full length so that the transistor body can be mounted on the metal chassis.

Output voltages other than the five provided are made possible by changing the values of R8, R9, R10, and R11. Note that R8, R9, and R10 connect between S3 and the negative supply, while the 15-volt position does not have a resistor and R11 con-

nects the 20-volt position to ground. A resistor is not needed at the 15-volt "cross-over" point, while outputs above 15 volts require a resistor to ground. As the maximum output of this supply is approximately 20 volts, the minimum value of resistor is used for R11.

The PC board is laid out so that it can be used independently of the switches. It can be used as the internal power supply in any piece of equipment and can regulate currents up to about 1 ampere with suitable resistors.

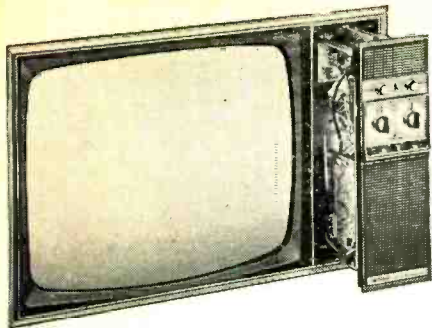
**Operation.** The supply is ideal for use with IC's and hybrid circuits requiring regulated positive and negative voltages. It can also be used single-ended, since balanced loads are not required. ♦

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# WHAT ARE ALL THOSE EXTRA COMPONENTS FOR

*They have practical reasons for being in the circuit.*

BY JIM HUFFMAN

**S**TUDENTS of electronics are often confused by how much more complex a practical circuit often turns out to be when it is compared to the classical circuit from which it was derived. Under such circumstances, the most often asked question is: "What are all those extra components for?"

Let us first assume that, in practical manufacturer circuits, every component used is there for very good reasons, specifically to obtain proper operation from the circuit. It then remains only to understand the function of each component and how it aids in the operation of the circuit.

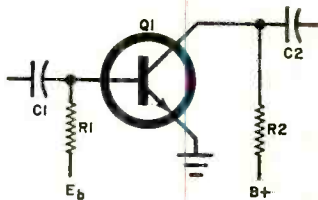
If proper understanding of classical and typical circuits is achieved, little difficulty should be encountered in analyzing the operation of practical circuits. Knowing the function and/or mode of operation of the circuit can provide the key to why a particular component or components are used in any given circuit.

**Classical vs. Practical.** In Fig. 1 is shown a typical common-emitter amplifier stage. The thing to remember with "classical" circuits used in textbook theory—and this circuit is such an example—is that an absolute minimum of components is ever shown.

Transistor  $Q1$  serves as a current amplifier. A small current applied to the base initiates and controls a much larger current flow in the collector circuit. The current applied through biasing resistor  $R1$  to the base of  $Q1$  is supplied by  $E_b$ . In the absence of an input signal at  $C1$ , the bias current is a function of the voltage level of  $E_b$  and the resistance value of  $R1$ .

Capacitors  $C1$  and  $C2$  couple the signal into and out of the circuit, respectively, while blocking dc to prevent upset of the bias on this stage and the next. Resistor  $R2$  is the collector load that allows the output signal to be developed between the collector of  $Q1$  and ground.

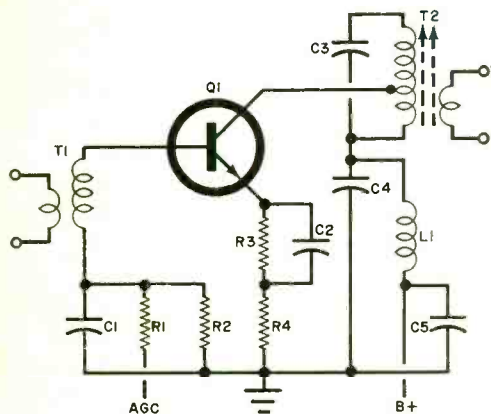
While the functions of the components in Fig. 1 are easy to see, a different frame of reference must be used when you are



**Fig. 1. Classical common-emitter circuit with basic, essential components.**

confronted with the practical circuit in Fig. 2. The key here is that this is an *r-f* amplifier stage of a type commonly used in radio receivers.

Once this is known, it is fairly easy to explain the existence of *L1*, *T1*, and *T2* as having something to do with providing



**Fig. 2. Practical r-f amplifier has much more complexity when compared to the circuit from which it was derived.**

proper operation at radio frequencies. But what about the extra capacitors and resistors?

By using some logic, you can see that the *R1/R2* combination performs essentially the same function as that performed by *R1* in Fig. 1. Note also that *R2* is grounded at one end and that *R1* is a special input for an automatic gain control (agc) signal. The agc is a voltage, the value of which depends on the level of the input signal at *T1*. When the agc voltage increases, bias on *Q1* increases and stage gain decreases. Consequently, the agc voltage is similar to biasing voltage *Eb* in the classical circuit.

Capacitor *C1* in Fig. 2 functions in a manner similar to *C1* in Fig. 1. That is, it blocks dc bias voltages. Also, it places one side of *T1*'s secondary at *r-f* ground, allowing the full output from the transformer to be impressed on the base of *Q1*. If *C1* were not in the Fig. 2 circuit, *R1* and *R2* would reduce signal level and diminish stage gain.

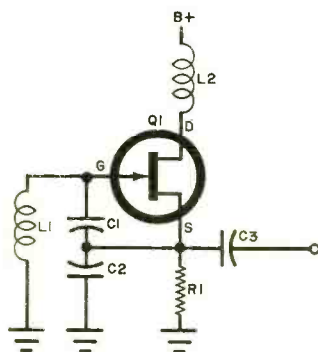
Although it is more complex, the output section of Fig. 2 corresponds in performance to the two-component output section of Fig. 1. Transformer *T2* provides dc isolation and matches the output impedance of *Q1* to the input impedance of the next stage. So, the primary of *T2* functions as

the collector load for *Q1*. The tap on the primary of *T2* is for matching the low output impedance of *Q1* to the higher impedance of the transformer's primary. This is done so that a practical value for *C3* (which forms a tuned circuit with the primary of *T2*) can be selected to provide a reasonable *Q* for the tuned circuit.

Capacitor *C4* is used to connect the lower end of *T2*'s primary to *r-f* ground and block dc. Coil *L1* has a large reactance to *r-f* and "chokes" any *r-f* that might get past *C4* into the power supply. A large value of capacitance for *C5* insures against variations in the output signal caused by agc action. These are low-frequency variations which, if they got into sensitive stages via the power supply leads, can really mess up the sound from the receiver.

There is one more circuit to call attention to—the emitter circuit of *Q1*. Here we see components that do not even exist in the classical circuit in which the emitter goes directly to ground. The differences in bias arrangements account for the extra components in the practical circuit. The classical circuit employs a separate biasing supply (*Eb*), but our practical circuit is self-biased. Resistors *R3* and *R4* should be treated as a single emitter resistor. Capacitor *C2* is there to by-pass *r-f* around *R3* so that it does not affect the circuit during biasing.

Resistor *R4* carries both dc and *r-f*. This is done to introduce negative feedback to the *r-f* signal. Some of the current flowing between the emitter and collector of *Q1* causes a voltage to be dropped across *R4*. This drop is wasted; so the presence of *R4* in the circuit decreases stage gain, a form of negative feedback. The obvious reason



**Fig. 3. Typical textbook VFO circuit has little practical use as it stands.**



for  $R_4$  being where it is, then, is to provide the circuit with a measure of overload protection. Enough gain can be obtained from later stages to cancel the losses introduced by  $R_4$ .

**Rules of the Thumb.** From the foregoing, we can establish some "rules of the thumb" that can help us in analyzing any circuit and clear up doubts about extra components. The first of these is that coupling capacitors are usually in series with the signal path. Also, in connection with capacitors, bypass capacitors route signals around a component or circuit. Next, coils without parallel capacitors are usually just chokes. Transformers represent output loads and perform the dc blocking function of capacitors. There are other rules you can add to this list as you become more proficient in analyzing circuits.

Let us take one more example of classical-versus-practical circuits. In Fig. 3, you see the classical representation of a FET variable-frequency oscillator (VFO). It is fairly

frequency determined by the values of  $C_1$ ,  $C_2$ , and  $L_1$ .

Coil  $L_2$  serves as the drain load for  $Q_1$  and its high reactance prevents the output signal from the FET from feeding into the power supply. Resistor  $R_1$  provides source bias. Capacitor  $C_3$  is a signal coupler that passes the output signal into the next stage while blocking dc.

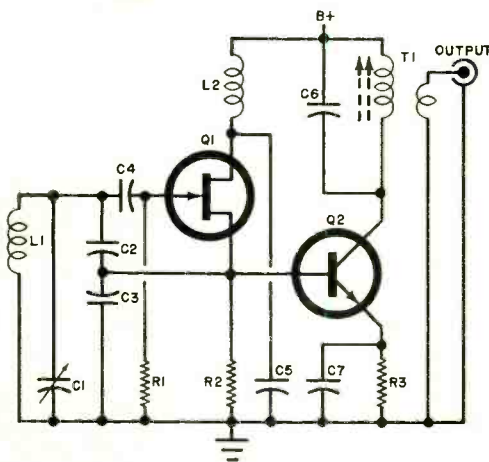
The practical VFO circuit shown in Fig. 4 bears little resemblance to the classical circuit. Probably the most confusing part of this circuit is the addition of an extra transistor stage. Obviously, to obtain good results, the Fig. 3 circuit needs some isolation; not to mention extra drive. For this reason, the buffer stage ( $Q_2$  and its associated components) were added to the circuit in Fig. 4.

Now, let us analyze the rest of the circuit as we did in the previous example. Variable capacitor  $C_1$  provides a means for accurately adjusting the output frequency of the oscillator. Resistor  $R_1$  connects the gate to the source of  $Q_1$ , providing both bias and a means for developing a signal voltage. Capacitor  $C_4$  and resistor  $R_1$  keep dc out of the tuned circuit, thus aiding in operational stability.

Capacitor  $C_5$  serves as a bypass that routes the signal on the drain of  $Q_1$  to ground. Note that  $Q_1$  is set up in a common-drain configuration. The gate is used for an input and the source for an output. Thinking of the oscillator in this light, you can see that the ground connection is the same as the connection in the classical circuit that led from the drain to the gate. Alternatively,  $C_5$  can be viewed as a coupler in series with the signal flow.

One more point on the circuit. There is no coupling capacitor between the source of  $Q_1$  and the base of  $Q_2$ . In this case,  $Q_2$  obtains bias from  $Q_1$  and  $R_2$  with both components serving as the bias resistance. Hence  $Q_1$  and  $R_1$  in Fig. 4 correspond to  $R_1$  and  $R_2$  in Fig. 2.

As we have demonstrated, classical or typical circuits are not always—and, in fact, rarely are—the same as the practical working circuits. But if you work on the assumption that every extra component used is there to aid in circuit performance in some way and you apply a few rules of thumb, you will be able to interpret a circuit's diagram quickly and be better prepared when it comes to troubleshooting and repair. ♦



**Fig. 4. Practical VFO uses an extra stage ( $Q_2$ ) for buffering and extra components to give stability.**

easy to understand the function of each component in this circuit. The drain and gate signals of FET  $Q_1$  are  $180^\circ$  out of phase with each other. Coil  $L_1$  is center-tapped by the  $C_1/C_2$  arrangement. Since  $L_1$  is tapped, the signal from the drain of  $Q_1$  undergoes another inversion in the coil, and actual feedback to the gate of  $Q_1$  is in-phase with the output signal. The in-phase condition causes the output to reinforce the input and oscillation occurs at a

**T**HE MOVE up to single sideband operation represents a major step forward for the user of the Citizens Band—especially one who is looking for relief from overcrowded channels in heavy-traffic areas. In terms of useful output power and utilization of available spectrum space, SSB gear provides a highly efficient means of communicating.

a great deal more powerful than AM transmitters.

The FCC has set aside 23 frequencies for the Citizens Band. This translates out to 23 channels on AM. But on SSB, the number doubles to 23 on upper sideband and 23 on lower sideband. For a full-facility AM/SSB rig then, a total of 69 channels can be available. This alone is a great incentive for

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## **CITIZENS RADIO**

# *Directory of Single Sideband CB Transceivers*

FEATURES AND CHARACTERISTICS THAT WILL HELP  
YOU MAKE A GOOD SELECTION

BY GLADDEN B. HOUCK, JR.

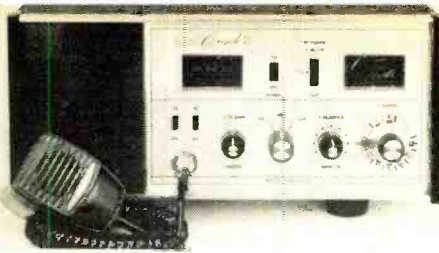
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To appreciate fully the advantages gained by switching to SSB, one must compare SSB equipment with conventional AM equipment. AM transmitters are limited to a maximum of 5 watts of power into the final amplifier. Most of the power transmitted from the antenna is concentrated in the carrier, while very little goes into the information signal. By contrast, SSB transmitters produce up to 15 watts (peak envelope power) into the final, and most of the radiated power is concentrated in the information sideband (very little wasted in a carrier). The result is that watt-for-watt (input power to the final), SSB transmitters are

the harried CB'er in a heavily trafficked area to switch to SSB.

Now that you know some of the advantages of switching, let us take a look at what is available in the SSB CB equipment market. To do this, we refer you to the directory given in the Table. (Note: Because of space limitations, we have omitted the features that describe the AM function of the equipment. In every case, AM performance is as good as—or better than—that obtainable from the better mobile AM units from the same manufacturer or supplier.) All information provided was obtained from manufacturers' literature.



Linear System SBE-16CB



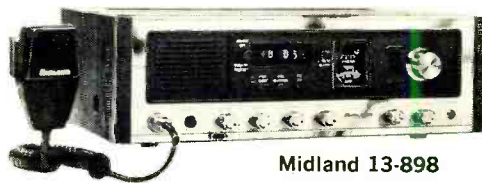
Teaberry Twin T



Lafayette SSB-50A



Palomar Skipper 73



Midland 13-898



Olson RA-510



Siltronix SSB-23

**Interpreting the Table.** The first four columns are self-explanatory, with two exceptions. But for the Browning "Golden Eagle Mark III," which consists of a separate transmitter and receiver, all models listed are transceivers. And the Fieldmaster Model 2000 has a built-in scan feature. (See the notes at the bottom of the Table.)

In general, dc-powered units are mobile rigs, ac-powered units are base stations, and ac/dc units can be used in either service. So, by looking under the column headed Power Supply and reading across to the Size column, you can determine just what

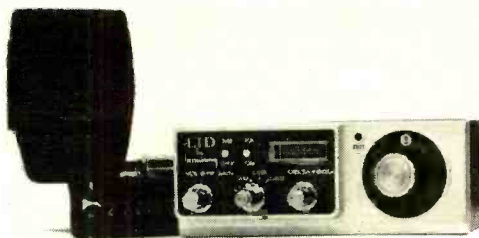
rig you want for a given power requirement based on whether it will be used in mobile or base station service.

All transceivers feature meter movements, the great majority indicating relative received signal strength in S units and power output in percentage. Some meter setups are designed to indicate standing wave ratio (SWR) or percent modulation (M) or both. In the case of the Golden Eagle, the receiver indicates S units and the transmitter meter indicates P and SWR. This information is supplied under the column headed Meter Indicates.





Robyn SS-747



Browning LTD



Tram Titan IV



Courier Gladiator



Radio Shack TRC-46



Pace CB-1023

Moving on to the next column, we come to Output Power. The figures listed in this column can be either one of two things: peak envelope power (PEP) into the final, in which case it would be 15 watts, or actual output power, presumably all figures not 15 watts.

SSB Carrier Suppression is determined for the most part by how well the modulator is balanced. The crystal filter might also contribute to carrier suppression. The figures given in this column indicate how many dB (decibels) below the transmitted sideband is the carrier.

Under Opposite Sideband Suppression, the figures tell how many dB below the transmitted sideband the unwanted sideband is. This is a function of the crystal filter design. The purpose of the attenuation of the carrier and opposite sideband is to concentrate the energy into the desired sideband. This also is a feature that reduces the interference presented to other CB units on the opposite sideband.

Sensitivity is given in microvolts ( $\mu\text{V}$ ) for a 10-dB (S + N)/N. With SSB, the sensitivity is about one-half that for AM. This is because the bandwidth is also about

# SSB CITIZENS BAND

Manufacturer or Distributor	Model or Name	List Price	Size (in.) (L x H x D)	Power Supply	Meter Indicates	Output Power (W PEP)
Browning	LTD Golden Eagle MARK III*	\$360	6½ x 2½ x 10½	DC	P/S	7.5
		\$650*	15½ x 7½ x 9¾ (Tx & Rx Same Size)	AC (each)	S (Rx) SWR/P (Tx)	15 (Tx Only)
Dynascan	Cobra 132	\$340	7½ x 2¾ x 10¼	DC	P/S	15
	Cobra 135	\$450	12 x 5¾ x 13¾	AC	P/S/SWR	15
Fanon-Courier	Gladiator Centurion	\$400	10½ x 2¾ x 11½	DC	P/S	10
		\$500	15¾ x 7¼ x 16¾	AC/DC	P/S	10
Fieldmaster	2000** MF1001	\$400	18 x 8 x 14	AC	P/S/SWR/M	15
		\$400	8½ x 2½ x 11	DC	P/S/M	15
Lafayette	SSB-25A SSB-50A	\$250	9½ x 3¾ x 11¼	AC/DC	P/S	15
		\$290	7¾ x 3 x 9¾	DC	P/S	15
Linear Systems	SBE-12CB	\$360	7½ x 2¼ x 9½	DC	P/S	15
	SBE-16CB	\$400	12 x 5 x 10¼	AC/DC	P/S/SWR	15
	SBE-18CB***	\$290	5¾ x 2¼ x 8¾	DC	P/S	15
Midland	13-894	NA	7 x 2½ x 9	DC	P/S	15
	13-896	NA	7 x 2¼ x 10½	DC	P/S	15
	13-898	NA	15 x 5¼ x 10	AC/DC	P/S/SWR	15
Olson	RA-510	\$350	11 x 2¾ x 12¼	DC	P/S	8
Pace	Sidetalk 23 CB-1023	\$330	8½ x 2½ x 10½	DC	P/S	15
		\$330	7½ x 1¾ x 9½	DC	P/S	15
Pearce-Simpson	Panther Simba Cheetah	\$300	7½ x 2½ x 9¾	DC	P	8
		\$490	16 x 6½ x 11¾	AC/DC	P/S/M	8
		\$380	8½ x 2½ x 10	DC	P/S	8
Palomar	Skipper 73	\$395	15½ x 5½ x 10	AC	P/S	15
Radio Shack	TRC-46	\$330	9 x 2¾ x 10½	DC	P/S	15
Robyn	SS-747	\$440	11¾ x 4 x 9	AC	P/S/SWR	8
Siltronix	SSB-23	\$395	8½ x 2½ x 10½	DC	P/S	15
Teaberry	Twin T	\$400	13 x 5¼ x 9½	AC/DC	P/S/SWR	15
Tram	Diamond 60 Titan IV	\$389	7 x 2½ x 9¾	AC	P/S	15
		\$627	18¾ x 8 x 11¾	AC/DC	P/S	8

\*Consists of separate transmitter and receiver. Price quoted is for both units.

\*\*Built-in scan feature in receiver section. Transmit section is standard.

\*\*\*Features SSB only on transmit, SSB and AM on receive.

# TRANSCEIVER DIRECTORY

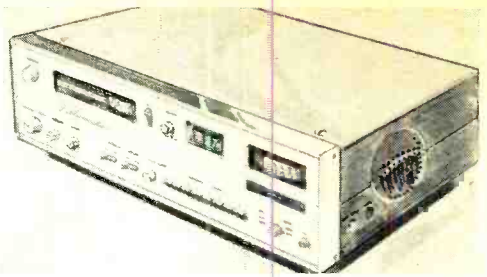
SSB Carrier Suppression	Opp. Sideband Suppression	Sensitivity (Microvolts)	Selectivity (dB @ kHz)	Image Rejection	Noise Limiters	Clarifier Range (Hz)
60 dB 70 dB (Tx Only)	55 dB 70 dB (Tx Only)	0.25 0.3 (Rx Only)	70 @ 5.5 65 @ 10 (Rx Only)	55 dB 55 dB (Rx Only)	B G (Rx Only)	600 600 (Rx Only)
40 dB 40 dB	40 dB 40 dB	0.25 0.25	60 @ 5 60 @ 5	50 dB 50 dB	B B	600 600
NA NA	NA NA	0.15 0.15	60 @ 5.5 80 @ 10	60 dB 60 dB	G G	600 600
45 dB 45 dB	45 dB 45 dB	0.25 0.25	55 @ 5.5 55 @ 5.5	70 dB 70 dB	B B	600 600
60 dB 60 dB	40 dB 40 dB	0.2 0.2	NA NA	65 dB 65 dB	B B	1300 1300
55 dB 55 dB 55 dB	50 dB 50 dB 50 dB	0.5 0.5 0.5	50 @ 3.5 50 @ 3.5 50 @ 3.5	60 dB 60 dB 60 dB	G(B) G(B) G(B)	600 600 600
60 dB 60 dB 35 dB	64 dB 64 dB 40 dB	0.25 0.25 0.25	6 @ 2.4 6 @ 2.4 6 @ 2.4	NA NA NA	B B B	600 600 600
40 dB	40 dB	0.2	60 @ 5.5	60 dB	B	600
40 dB 40 dB	40 dB 40 dB	0.25 0.3	50 @ 5.5 50 @ 5.5	60 dB 50 dB	G G	690 650
40 dB 40 dB 40 dB	40 dB 40 dB 40 dB	0.18 0.1 0.1	60 @ 5.5 60 @ 5.5 60 @ 5.5	102 dB 50 dB 50 dB	B B B	600 600 600
55 dB	55 dB	0.2	70 @ 10	60 dB	G	1000
NA	50 dB	0.2	100 @ 10	50 dB	B	400
40 dB	40 dB	0.25	60 @ 2.2	60 dB	G	800
50 dB	40 dB	0.2	80 @ 10	90 dB	B	500
NA	NA	0.7	60 @ 10	70 dB	B	300
55 dB 40 dB	60 dB 55 dB	0.2 0.1	75 @ 10 75 @ 10	70 dB 65 dB	B G	600 600

**Abbreviations:** B—Blanker; G—Series Gate; G(B)—Series Gate standard, Blanker available as an option; M—Modulation; NA—information Not Available at press time; P—Power; Rx—Receiver; S—Signal Strength in S Units; SWR—Standing Wave Ratio; Tx—Transmitter

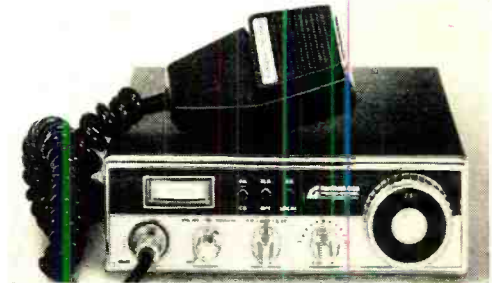




Dynascan Cobra 135



Fieldmaster MF1001



Pearce-Simpson Panther

one-half that of AM. For SSB operation, many rigs have an r-f gain control that can be used to reduce the incoming signal level for clearer reception. In some rigs the action is strong.

The various manufacturers and suppliers use different bases for rating selectivity. Be that as it may, we have listed the attenuation in dB for a given bandwidth in kHz (thousands of hertz). These figures are related to those in the Opposite Sideband Suppression column because, in most cases, the same crystal filter is used for both purposes.

The ability of the receiver to reject a signal outside of the Citizens Band, such as the image frequency, i-f frequency, etc., is known as Image Rejection. Such signals if present, limit the usable sensitivity. The figures given in this column can be related directly to how well a receiver's image rejection circuitry performs. For example, a 60-dB entry means that the unwanted signal can be up to 1000 times as strong as the desired signal before it becomes a problem.

Noise Limiters are most important for mobile operations but can also be useful in a base station. These can be one of two types—the series or shunt gate or the r-f or i-f noise blanker. Of course, noise is best

eliminated at the source if at all possible.

The clarifier is a fine tuning control that is needed to correct for slight changes in the oscillators in the transmitter and receiver. The tolerance for CB transmitters by FCC Regulation is 1.35 kHz, which is the maximum that this control should be able to shift. Note that most clarifiers shift 600 Hz; a few go higher, but none goes to the limit.

**Moving Up.** There is little doubt that SSB operation provides superior communication capability when compared with traditional AM operation. With SSB equipment, the CB'er gets greater signal punch to get through interference and a doubling of the channels available to him. Most SSB rigs also include facilities for AM operation as well, which is fortunate because the great majority of the rigs now in use operate on AM only.

For the advantages gained by making the switch to SSB (or SSB/AM), you can expect to make a rather sizeable investment in equipment. In general, your investment will be several times more than that required for AM-only equipment. However, this money buys a lot, not the least of which is more reliable communication. And, really, that is all that counts. ♦

# THE CHALLENGE OF SLOW- SCAN TV

*Coast-to-coast tests show how it works.*

BY RICHARD HUMPHRE

**T**HE ARRIVAL of slow-scan television (SSTV) to the amateur radio bands is making incentive licensing a workable proposition for the first time since its inception. Since SSTV can be used only on the portions of 80 through 15 meters set aside for Extra and Advanced ticket holders (see Table I), books are being cracked and rusty fists are practicing CW as General and Technician licensees bone up for the FCC exams to upgrade their tickets.

In this article we will be discussing some of the technical aspects of SSTV. We conducted some SSTV tests, the results of which, along with our observations, will be presented. Finally, non-ham applications of SSTV will be discussed, as will the possible role the ham will play in perfecting the system.



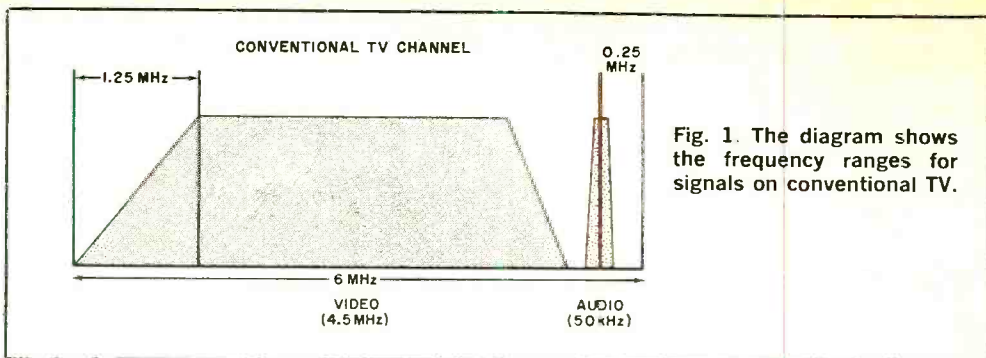


Fig. 1. The diagram shows the frequency ranges for signals on conventional TV.

**Technical Data.** Narrow bandwidth is the key to slow-scan TV. As a comparison, commercial, or home-type, TV channels are each 6 MHz wide (see Fig. 1), while SSTV is a mere 1100 Hz wide. The 525-line, 30-frame/second commercial system used in the U.S. requires a video span of roughly 4.5 MHz, even with the suppression of one

extras is that only "still" pictures can be transmitted and extra-fine detail is not possible. An example of an SSTV picture is shown in Fig. 3. Going back to Fig. 2 for the moment, sync pulses are on a 1200-Hz subcarrier; "black" rides on a 1500-Hz carrier (this means the sync signal is blacker-than-black, thus blanking out the retrace

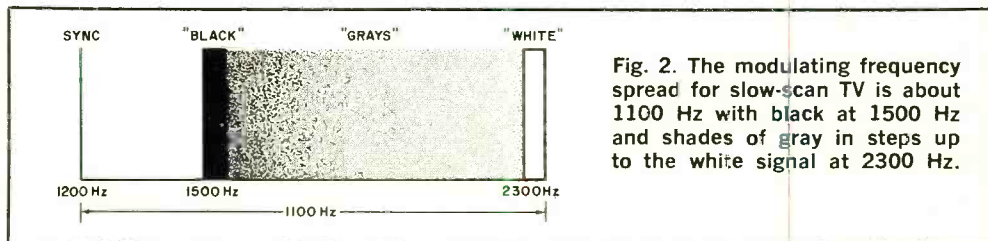


Fig. 2. The modulating frequency spread for slow-scan TV is about 1100 Hz with black at 1500 Hz and shades of gray in steps up to the white signal at 2300 Hz.

sideband, a 50-kHz audio bandwidth, and guard bands between the audio and video and at each end of the channel to prevent interference. By contrast, SSTV employs audio-frequency subcarriers for sync and black-and-white, 8-second/frame picture rate, and only 120-128 lines/frame (see Table II for more complete details). This results in a modulating frequency spread of 1100 Hz as shown in Fig. 2.

The width of the modulating frequency is dependent primarily on the number of lines per frame and the number of pictures per frame. By reducing both (via audio sync and black-and-white subcarriers), SSTV can be transmitted via SSB, it can be sent over conventional telephone lines without the need for special coaxial TV-quality cable, and it can be recorded on an audio tape recorder. With respect to the last, an inexpensive cassette recorder will do if the tape speed is constant.

The trade-off in SSTV for not being held to line-of-sight transmission and all other

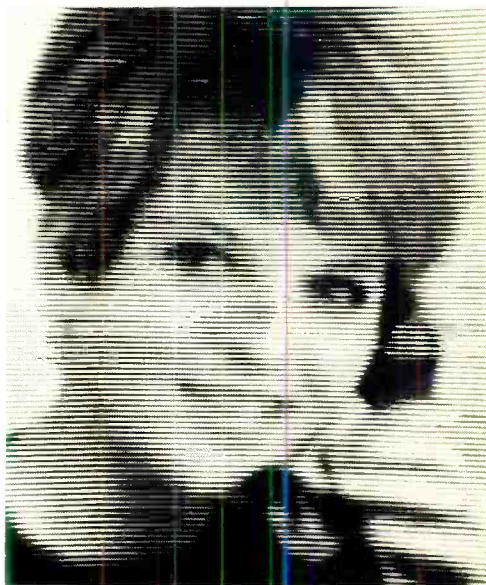
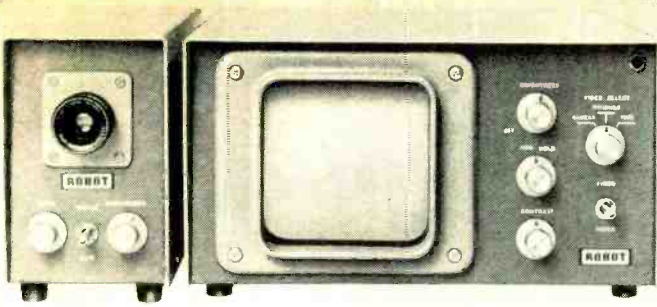


Fig. 3. An 8-second time exposure of an SSTV picture shows good linearity.





The Robot Research, Inc., Model 80 SloScan camera is shown at left with the companion monitor and receiver Model 70 at right.

as the beam returns to the left of the CRT), and "white" is transmitted at 2300 Hz.

An SSTV signal, when heard on the air, sounds like a science-fiction movie soundtrack. A black-and-white line drawing or black letters on a white background (or vice versa) yields an audio signal that alternates between 1500 Hz and 2300 Hz, while the 1200-Hz sync subcarrier remains constantly on. When pictures with various shades of gray are transmitted, black, white, and audio will vary in step with the shades of gray at intermediate steps between 1500 Hz and 2300 Hz.

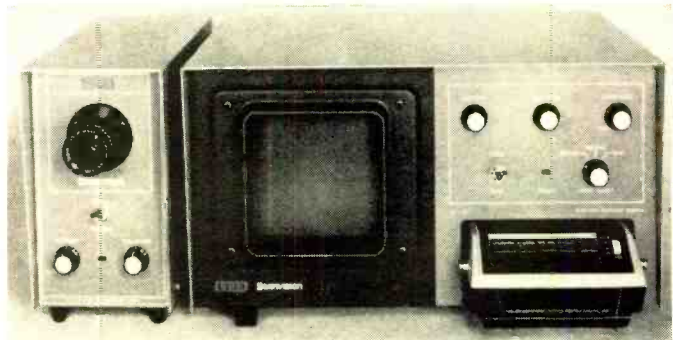
**SSTV Tests.** Our tests of the SSTV system were conducted coast-to-coast between Watsonville, California and Governor's Island, New York. The hookup was a combination of land-line (telephone) and microwave relay. The test was primarily intended to determine whether or not SSTV could be a workable tool in inland and maritime search and rescue work.

Using Linear Systems' "Scanvision" equipment on both ends and Linear Sys-

tems' Manager of Amateur Factory Services, Stuart E. Till, in California and an officer class of the National Search & Rescue School (including representatives of West Germany, Denmark, Canada, the U.S. Air Force, and U.S. Coast Guard) on the East Coast, test patterns, typescript text, and pictures of live subjects were exchanged. Here is some of the feedback from those tests:

Inevitably, there is an unconscious urge to compare SSTV picture quality with that of commercial broadcast pictures. However, one soon realizes that SSTV was never intended to provide commercial quality pictures, nor is such quality necessary. The 25-mm lens supplied with the camera provided the best picture quality. Subsequent tests with other lenses ranked a 35-mm unit high and a 180-mm one marginal. (This last lens was a "cheapie;" so, we cannot fault SBE's gear for the poor reproduction.)

The best lighting setup for three-dimensional subjects was two 300-watt bulbs with reflectors set at 45° on either side of the camera. For two-dimensional subjects (QSL



The SBE Scanvision, made by Linear Systems, Inc., features a built-in cassette tape recorder and 25-mm C-mount camera lens.

**TABLE I—FCC SSTV AUTHORIZATIONS**

Band Meters	Frequency Allocations (MHz)			Technician
	Extra	Advanced	General	
80	3.800-3.900	3.825-3.900		
40	7.200-7.250	7.200-7.250		
20	14.200-14.275	14.200-14.275		
15	21.250-21.350	21.275-21.350		
10	28.500-29.700	28.500-29.700	28.5-29.7	
6	50.100-54.000	50.100-54.000	50.1-54.0	50.1-54.0
2	144.100-148.000	144.100-148.000	144.1-148.0	144.1-148.0

**Note:** SSB on all amateur frequencies; DSB (AM) on 6, 2, and up only. Novices have no SSTV rights. Simultaneous (SSTV on one sideband, voice on other sideband) transmission permitted on all listed amateur frequencies.

cards, numbers and letters, and the like), one 500-watt bulb in a reflector, positioned directly above the camera, yielded the best results. It might be argued that this is a lot of light with the camera between 2 and 3 feet from the subject, but it did let us stop the lens down to f/22, cut the camera brightness down, and come up with the best picture on the monitor.

The Bell System's fantastic space-age service made it necessary to spend more than three hours getting a connection that was free enough of line noise, distortion, and with high enough audio level to transmit a suitable picture. This is not to say that SSTV is more critical of line quality than is the human ear; we could not hear each

other over the same lines. We did determine that while line noise could wipe out the picture completely, low audio could be countered by simply cranking up the brightness and contrast on the monitor/receiver.

Finding the proper connections inside the telephone is best done with headphones (when you hear a dial tone, you have it). It is important to monitor the signal level on both the telephone line and the radio transmission to prevent cross-modulation in the first case and "splatter" in the second.

Whether a cassette recorder (such as SBE's built-in unit) or an open-reel recorder is used is academic. Tests with an outboard recorder operated at 3 $\frac{1}{2}$  and 7 $\frac{1}{2}$  ips revealed little, if any, improvement over the built-in 1 $\frac{1}{2}$  ips recorder with reference to picture quality. Good motor speed regulation with no "wow" is the key to recording slow-scan TV signals. Since SSTV operates at between 1200 and 2300 Hz, frequency response is relatively unimportant.

**Other Uses For SSTV.** Presently, the main user of SSTV is the radio amateur operator. The staff and class at the National Search & Rescue School came up with some non-ham applications. One was the transmission of search patterns to quasi-military groups not familiar with the international search and rescue terminology as taught by the SAR School. This could include the Civil Air Patrol which performs more than 75 percent of U.S. inland searches on a routine basis, as well as sheriff's offices and others. To a certain extent, it could include the U.S. Coast Guard Auxiliary.



**SBE Scavision camera with 25-mm lens is priced at around \$500.**

Using SSTV to transmit schematic diagrams and other technical data to remote installations, such as Loran sites, to provide engineering aid to technicians was another suggestion. Uses by law enforcement agencies, banks, and other security organizations in need of quick transmission of identification were yet other possible applications for SSTV.

In connection with search and rescue, we found that maps and nautical charts did not

**TABLE II—SSTV SPECIFICATIONS**

Lines/frame*	128
Vertical scan time	8.5 s
Horizontal sync	5 ms
Vertical sync**	66 ms
Sync frequency	1200 Hz
Black frequency	1500 Hz
White frequency	2300 Hz
Bandwidth	1100 Hz

\*Up to introduction of commercial equipment, was usually 120.

\*\*Up to introduction of commercial equipment, pulses were usually 30 ms.

come through very well because of their lack of contrast and masses of small details. Typewritten text also suffered.

**The Ham's Role.** Slow-scan TV is at a stage where in-field operational experimentation is needed. This is one job at which the radio amateur is superlative. A body of literature on the use of different lenses (what about the feasibility of a three- or four-lens turret, for instance?) for different jobs is needed. The same applies to lighting arrangements. Too, the possibility of using the interlacing technique to obtain better picture detail—at a reasonable price, of course—can be investigated. A host of other questions must be answered, and the ham is in the best position to do the necessary investigation and experimentation.

The fascination of sitting in a dark room looking at the face of the SSTV receiver's CRT cannot be denied. Whether it is worth from \$600 to \$1000 to do it, not to mention the skull-cracking to get your Extra or Advanced ticket, is up to you. Of course, if you do not mind putting together your own system from basic components, you can probably reduce the cost considerably. ♦

## SURVEY ANALYZES CARTRIDGE AND CASSETTE BUYER HABITS AND PREFERENCES

**L**EISURE Time Research, a division of Audits & Surveys Inc., recently conducted a nationwide tape buying and musical preferences survey among male owners of cassette and cartridge tape player/recorders. Based on a national probability of 6000 males over 15 years of age, the survey—the first of its kind—analyzes tape customers by age, education, region, income, marital status, buying habits, and extent of involvement in the market.

More than 60 percent of tape units are owned by families with annual incomes of \$15,000 or more. Fully 26% of cassette and 20% of cartridge customers bought no tape at all during 1972. Discount stores attracted 29% of all blank cassette purchasers, department stores 25%, and hi-fi stores 20%. Among heavy tape users who bought at least seven times, 39% preferred department stores, 21% discount stores, and 16% hi-fi stores.

Some 24% of blank cartridge customers patronized hi-fi stores, 22% discount stores,

and 14% department stores. Heavy users bought from hi-fi outlets (43%), with discount stores and department stores coming in second (11% each).

About 3.6 million owners of cassette units bought both blank and prerecorded tapes. Another 2.4 million bought blank tape only, while 1.2 million limited purchases to prerecorded tape. About 20% preferred chromium dioxide coating, and 64% bought 60-minute cassettes. There are more than twice as many cartridge units in homes than in cars. Of the 6.7 million potential customers for cartridge tape last year, 2.1 million bought both prerecorded and blank tape, 2.8 million only prerecorded tape, and 500,000 only blank tape.

Popular music was the favorite with 30% of cassette customers, rock with 29%, classical with 20%, country/western with 13%, and show tunes with 3%. For cartridge buyers, the figures were 26%, 34%, 13%, 20%, and 4% respectively. ♦



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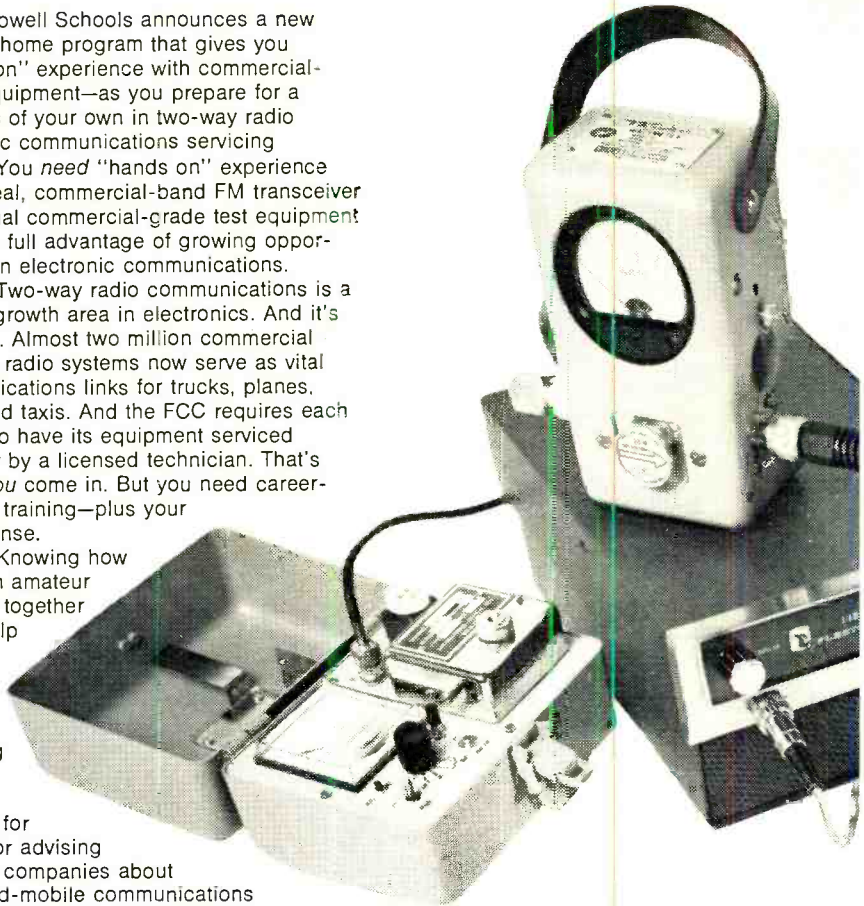
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# DO YOU KNOW YOUR BIPOLAR TRANSISTORS?

PART 1 OF A 3-PART SERIES ON  
BASIC TRANSISTOR THEORY

BY LOTHAR STERN, Motorola Semiconductor Products Inc.

**T**HE TRANSISTOR is the most versatile component of the semiconductor family. Its most important characteristic is current and/or voltage amplification. Because of this capability, it is the heart of most solid-state electronic circuits involving signal amplification and switching.

**Transistor Types.** There are two varieties of transistors: *unipolar* transistors, usually referred to as field-effect transistors (FET's), and *bipolar* transistors. The FET was invented circa 1930 but was not exploited commercially at the time. The bipolar transistor was invented around 1948 and rapidly became a practical product. The FET was finally developed as a commercial product by the early 1960's, many years after the bipolar transistor had already established itself. FET's, especially MOSFET's, are now used widely in low-noise front ends for TV and FM and are gaining importance in digital elements. However, in this article, we will discuss only bipolars.

**Transistor Basics.** The basic element of any bipolar transistor is the pn junction, or diode, formed by chemically uniting a layer of p-doped semiconductor material with a layer of n-doped material. When the junction is forward biased (p layer positive, n layer negative), the current through the device increases rapidly as the voltage is increased. When the junction is reverse biased, an increase in voltage causes only a very small amount of leakage current, until the reverse voltage be-

comes high enough to cause "break-down" of the junction. (See Fig. 1.)

A transistor is formed by sandwiching a very thin layer of n-doped material between two layers of p-doped material (pnp transistor) or a thin layer of p-doped material between two layers of n-doped material (nnp transistor). The characteristics of this 3-layer, 2-junction structure are achieved by varying the thickness and the resistivities and geometries of the three layers.

Theoretically, an npn transistor should operate at higher frequencies than does a pnp device because electrons (the principal current carriers of an npn unit) are more mobile than holes (the principal current carriers of pnp devices). In practice, however, both types have similar characteristics. The main difference is that pnp transistors operate with a negative voltage on the collector element while npn transistors operate with a positive collector voltage. This makes it possible to have complementary circuits that often provide

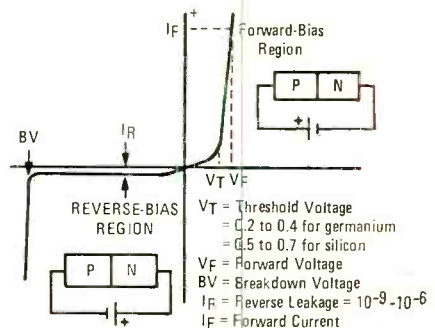
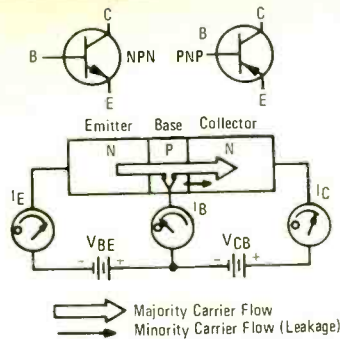


Fig. 1. Forward and reverse characteristics of typical junction diode.





**Fig. 2. Current flow in a transistor.**

improved performance over the single-polarity circuits that can be implemented with only one type of transistor.

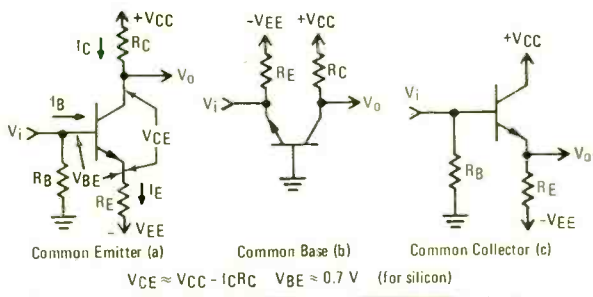
The three layers of a bipolar transistor (Fig. 2) are the emitter, the base and the collector. The emitter represents the current source, where the current carriers originate. The base is the control element, and the collector is the element through which the current carriers are transferred to an external circuit.

In operation, the collector-base junction is always reverse biased. If the emitter-base junction is forward biased, the emitter-base current is high, as in any forward biased diode junction. Instead of flowing out, however, most of this current diffuses through the very thin base region and crosses the collector-base junction, with only a small fraction flowing out the base lead. This action gives rise to the two commonly used expressions for current gain in a

transistor. The first,  $\alpha$ , is the ratio of  $I_c/I_e$  when the base-emitter junction is forward biased and is normally called the common-base current gain. It is always slightly less than unity (usually 0.95 to 0.998). The second gain expression is  $\beta$ , the ratio of  $I_c/I_b$ , called the common-emitter current gain. It can be quite high, depending on the value of  $\alpha$ , since  $\beta = \alpha/(1-\alpha)$ . Thus, if  $\alpha = 0.95$ ,  $\beta \approx 20$ ; and if  $\alpha = 0.99$ ,  $\beta \approx 100$ .

**Circuit Configurations.** There are three basic transistor circuit configurations: common emitter, common base, and common collector. They differ principally in the manner in which the signal is applied to the transistor and where the load is attached. Figure 3 shows these basic circuits. Since the common-emitter circuit is by far the most prevalent, most data sheets characterize the transistor in terms of this circuit.

Figure 4 shows the characteristics of a typical transistor in a common-emitter circuit. The input circuit curve in quadrant III shows that a base-emitter voltage ( $V_{BE}$ ) of less than approximately 0.5 volt (for silicon; for germanium, about 0.2 volt) causes virtually no base or collector current to flow, thereby keeping the transistor cut off. Above 0.5 V,  $I_B$  rises sharply, limited only by the ohmic resistance of the base region. Since the latter is very small, a very small rise in  $V_{BE}$  (beyond the threshold voltage) causes a large rise in  $I_B$  and



**Fig. 3. Three basic transistor circuits and their characteristic parameters.**

Circuit	Current Gain	Voltage Gain	Input Resistance	Output Resistance
(a)	High	High	Low	High
(b)	$< 1$	High	Very Low	Very High
(c)	High	$< 1$	High	Low

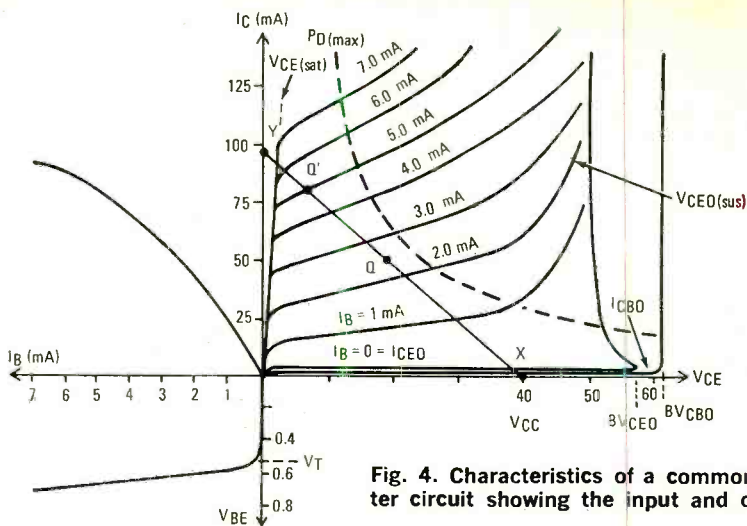


Fig. 4. Characteristics of a common-emitter circuit showing the input and output.

$I_c$ , as seen in quadrant II. From such a plot, the transistor current gain,  $I_c/I_b$ , can be established. It is also evident that considerable nonlinearity exists in the  $I_c/I_b$  curves. This indicates that distortion for large output signals can be quite high.

The collector curves in quadrant I are the most significant. They show, for example, that the maximum reverse-bias collector voltage that can be applied, before breakdown of the collector-base junction, is  $BV_{CE0}$ . The minimum collector voltage needed to keep the collector junction reverse biased, thereby sustaining transistor action, is  $V_{CE(sat)}$ . The maximum voltage excursion, therefore, is  $BV_{CE0} - V_{CE(sat)}$ .

When the transistor is cut off ( $I_b = 0$ ), a residual current,  $I_{CE0}$ , flows in the collector circuit. This leakage current can be reduced somewhat (but not to zero) by applying reverse bias to the emitter junction. The limiting value, with reverse bias applied to the emitter-base junction, is  $I_{CBO}$ . This is equivalent to the collector-base leakage current when the emitter is open-circuited.

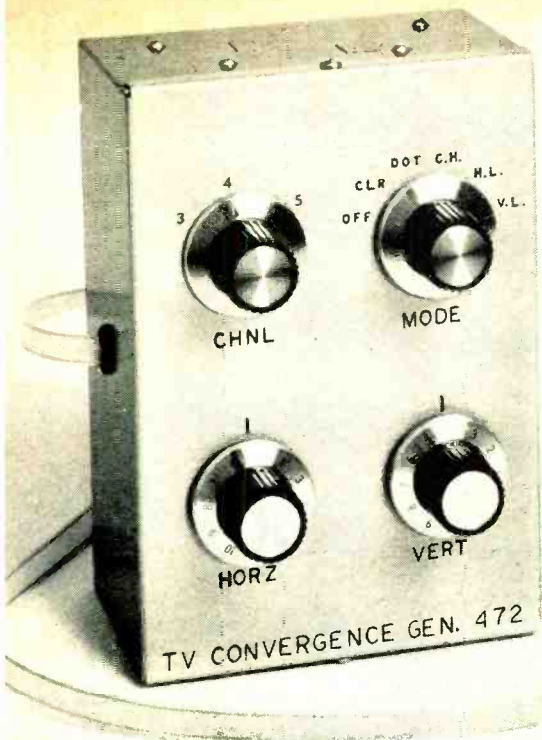
Collector current increases rapidly as the base is energized. The maximum  $I_c$  is that which would damage the internal transistor structure. This value of collector current is given as a maximum rating on data sheets. Thus, the

output current could range from  $I_{C(max)}$  to  $I_{CE0}$  (or  $I_{CBO}$  in the event of reverse bias), but usually  $I_c$  is limited to a value far less than  $I_{C(max)}$ .

Power dissipation,  $P_D$ , is the product of  $V_{CE}$  and  $I_c$  and it causes the collector junction to heat up. Beyond a critical junction temperature,  $T_{J(max)}$ , the device could be damaged. Thus the  $P_{D(max)}$  rating of a transistor limits the maximum  $V_{CE}$  and  $I_c$  that can be applied simultaneously. The locus of a  $P_{D(max)}$  rating is a parabolic curve on the  $V_{CE}/I_c$  plot. A load line, must be chosen to prevent steady-state operation to the right of the locus.

From the above it is evident that, when the voltage applied between base and emitter is less than approximately 0.5 V, there is only a very small current flow through the transistor. Between collector and emitter, therefore, the transistor represents a very high resistance, or open switch. When  $V_{BE}$  is raised above the threshold voltage, the internal resistance of the transistor drops to a very small value so that the device approximates a closed switch. As shown in Fig. 4, it takes a change of only 7 mA of  $I_b$  along loadline XQY to cause  $V_{CE}$  to change from  $V_{CC}$  to  $V_{CE(sat)}$ , that is, from an open switch to a closed switch. This switch action is accomplished by a  $V_{BE}$  of only a few tenths of a volt.

(To be continued.)



# LOW-COST CONVERGENCE GENERATOR

*Produces a clear pattern, dots, crosshatch, or vertical and horizontal lines, using RTL logic.*

BY MICHAEL S. CHING

**C**ONVERGENCE is that wonderful process by which the TV technician makes your color TV picture look like new again. It is actually a relatively simple set of checks and adjustments that are first made when the set is built and, of course, whenever the picture tube is replaced. However, component aging and mechanical shocks, particularly in portables, result in a gradual loss of the original adjustments. The change often takes place so slowly that many people don't notice the symptoms—color splotches, color fading, color fringes around figures on black and white, etc.

These problems can be easily detected and possibly corrected when you use the

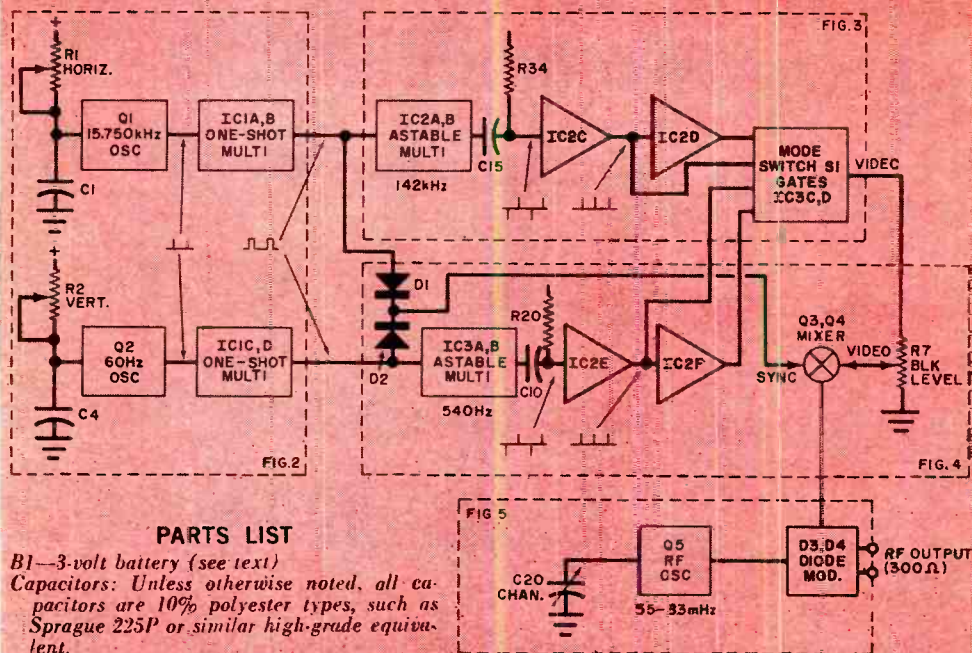
convergence generator described here. (Note that the generator is intended primarily as an aid in keeping the purity and convergence adjusted in an otherwise normally operating set. It is not meant to replace more complex color test equipment required to repair a malfunctioning set.) The generator is used simply by connecting it to the set's antenna terminals. The required adjustments can be made without removing the chassis from the cabinet.

**How It Works.** The generator circuitry can be divided into four major sections which use a combination of digital and linear techniques: sync oscillators, video, video/sync mixer, and r-f. An overall block diagram is shown in Fig 1.

The sync oscillator section consists of two UJT oscillators and their respective monostable multivibrators (one-shots). The circuit containing *Q1*, *IC1A* and *IC1B* (Fig. 2) produces horizontal sync pulses 6 to 9







### PARTS LIST

B1—3-volt battery (see text)  
 Capacitors: Unless otherwise noted, all capacitors are 10% polyester types, such as Sprague 225P or similar high-grade equivalent.

C1,C10,C24—0.0047- $\mu$ F  
 C2,C5,C7,C16—0.01- $\mu$ F  
 C3,C23—0.0022- $\mu$ F  
 C4—0.47- $\mu$ F  
 C6—0.22- $\mu$ F  
 C8,C9—0.033- $\mu$ F  
 C11,C19,C28—0.001- $\mu$ F  
 C12,C13,C14—100-pF mica (no substitute)  
 C15—10-pF mica (no substitute)  
 C17—200- $\mu$ F (minimum), 6-V electrolytic  
 C18—68-pF disc ceramic  
 C20—2.4-24.5-pF miniature variable (Johnson Type U, #189-569-1, or similar)  
 C21—33-pF disc ceramic  
 C22—10-pF disc ceramic  
 C25—7.45-pF ceramic trimmer (Centralab Type 825 or similar)  
 C26,C27—0.1- $\mu$ F  
 D1-D4—Silicon diode (1N914 or similar)  
 IC1,IC3—Integrated circuit (HEP570, MC724P)  
 IC2—Integrated circuit (HEP573, MC789P)  
 L1—5 turns of #20 bare wire, 1/4" diam. by 3/8" long. Tap 4 turns from collector end as described in text.  
 Q1,Q2—UJT (HEP310)  
 Q3-Q5—Transistor (2N3904, 2N4124, HEP55)  
 Resistors: Unless otherwise noted, all resistors are 10% carbon, 1/4 or 1/2 watt.  
 R1,R2—50,000-ohm potentiometer  
 R3,R4—500,000-ohm trimpot, horizontal mounting

R5,R6—25,000-ohm trimpot, horizontal mounting  
 R7—500-ohm trimpot, vertical mounting  
 R8,R14—1000-ohm  
 R9,R15—100-ohm  
 R10,R12,R17—4700-ohm  
 R11—5100-ohm  
 R13—15,000-ohm  
 R16—3900-ohm  
 R18—6800-ohm  
 R19,R34—39,000-ohm  
 R20,R24—22,000-ohm  
 R21—10,000-ohm  
 R22—47-ohm  
 R23,R25,R30—330-ohm  
 R26,R29—1500-ohm  
 R27,R28—680-ohm  
 R31—470-ohm  
 R32—27,000-ohm  
 R33—33,000-ohm

S1—4-pole, 6-position non-shorting rotary switch (Centralab PA-2011 or similar)  
 Misc.—Suitable chassis (7" x 5" x 3" will do but will not hold optional size D cells); 14-pin DIP sockets (3); TO-18 or TO-5 socket (5) (PC board is designed for 0.280" pin.); battery holder (2) for 3 penlite (AA) cells (Keystone #171) or optional holder for 2 size D cells (Keystone #176).

Fig. 1. This is the logic flow diagram of the convergence generator. The boxes in dashed lines show the four major sections: at left, the sync oscillators; upper right, horizontal drive; below that, the vertical drive; and, lower right, the rf section. Some typical waveshapes are also shown to indicate circuit operation.





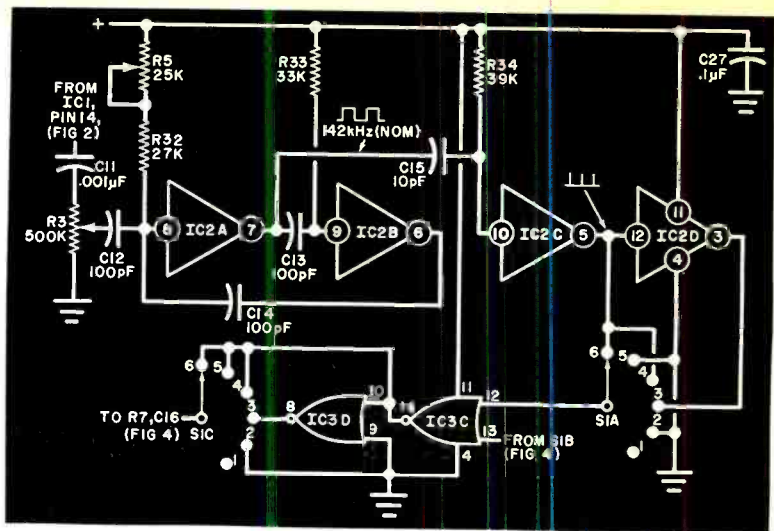


Fig. 3. Horizontal astable output determines width of vertical lines.

142 kHz (nine cycles between horizontal sync pulses). The 142-kHz rectangular pulses are differentiated by *C15* and *R34*. The resulting spikes are shaped and inverted by *IC2C*. The width of the output spikes from *IC2C* determines the width of the vertical lines on the TV screen.

A second inversion for the dot pattern is performed by *IC2D*.

The vertical astable (Fig. 4) is similar except that it is synced to nine times the frequency (540 Hz) of the vertical oscillator. The rectangular, 540-Hz pulse train is differentiated by *C10* and *R20* before shaping and inversion by *IC2E*. The width of the pulse from *IC2E* determines the width of the horizontal lines on the TV screen.

Generation of the actual video waveform associated with each of the five display modes is accomplished by sections of *S1* and NOR gates *IC3C* and *IC3D*. The video output waveform is then combined with the sync pulses at the common-collector junction of *Q3* and *Q4* (Fig. 4).

The sync pulses are added to the video waveform to produce a composite wave with negative-going sync pulses and positive-going video spikes. Diodes *D1* and *D2* comprise a diode gate so that either horizontal or vertical sync pulses can turn on *Q3*. With *Q3* saturated, its collector is at a potential less than 0.3 V. In the absence of either horizontal or vertical sync pulses, *Q3* is cut off and the collectors of *Q3* and *Q4* rise to a voltage determined by the setting of *R7*. (Thus *Q4* is biased in its linear region.)

When the video logic signal is high, *Q4* is biased to produce approximately 1.5 V at its collector. When the logic signal is low, *Q4* is cut off and its collector rises to 3.0 V. If the resulting composite video waveform were applied to the appropriate stage in the receiver's video amplifier section, the generator's test pattern would appear on the screen. However, to preclude the need to make internal connections to your set, the generator contains an r-f section.

The r-f section consists of an oscillator and a diode modulator (Fig. 5). Oscillator *Q5* is operated in the tapped Hartley configuration. The frequency is adjusted by *C20* and trimmed by *C25*. The r-f output is coupled by *C19* to the diode modulator.

With a high signal (3 volts) applied through *R31*, the output terminal has a low ac impedance to ground through *D4* (forward biased) and *C22* and a high impedance to the r-f oscillator due to diode *D3* (which is reverse biased).

When the modulating waveform goes low (less than 1.5 volts), diode *D4* is cut off and diode *D3* conducts. This allows the flow of radio-frequency current from the oscillator to the output terminal. The negative modulation convention used in American TV broadcasting translates an increase in the r-f amplitude into a decrease in brightness of the trace. In this way, the complex modulating signal is converted into a black-and-white pattern on the TV screen.

**Construction.** A printed circuit board us-



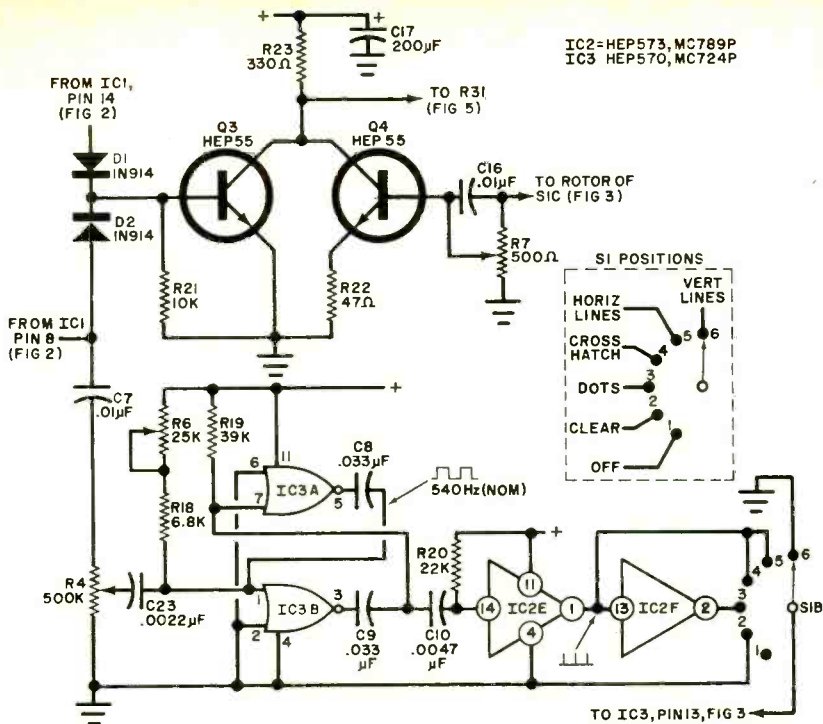


Fig. 4. A 540-Hz oscillator driven by vertical determines horizontal line width.

ing the pattern shown in Fig. 6 is recommended. The dots for diodes *D1* to *D4* designate the cathode ends. Diode cathodes can be identified by the end marked with a line or a dot. Be sure to observe polarities, especially on *C17*. Sockets should be used for all the semiconductors and IC's. Use heat sinks for *D1-D4* when soldering.

Note that *R1* and *R2* are wired so that resistance decreases in the clockwise di-

rection. Use minimum-length leads of about #22 solid wire. Use short lengths of stranded wire to connect the battery holder. In the prototype, two triple penlite-cell holders were used. These are OK for light usage of the generator (about ½ hr each time). If you expect heavier usage, two D cells will be needed—in an optional holder.

To wind *L1*, use any 1-watt carbon resistor as a form and five turns of #20 bare

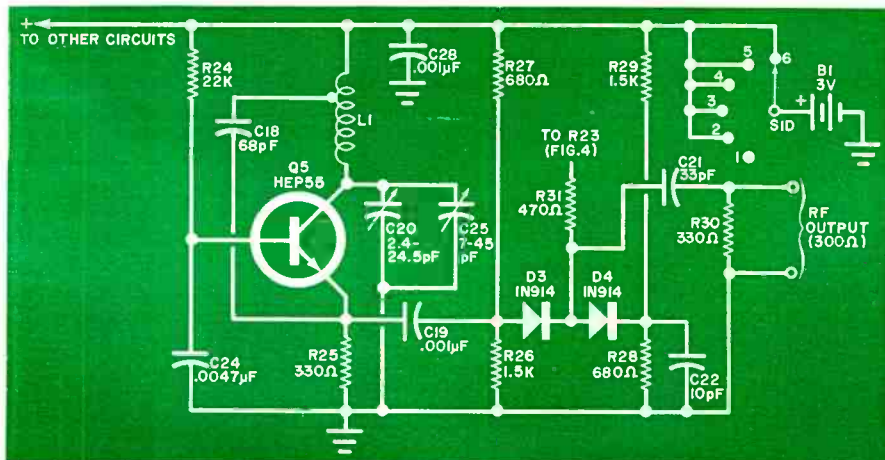
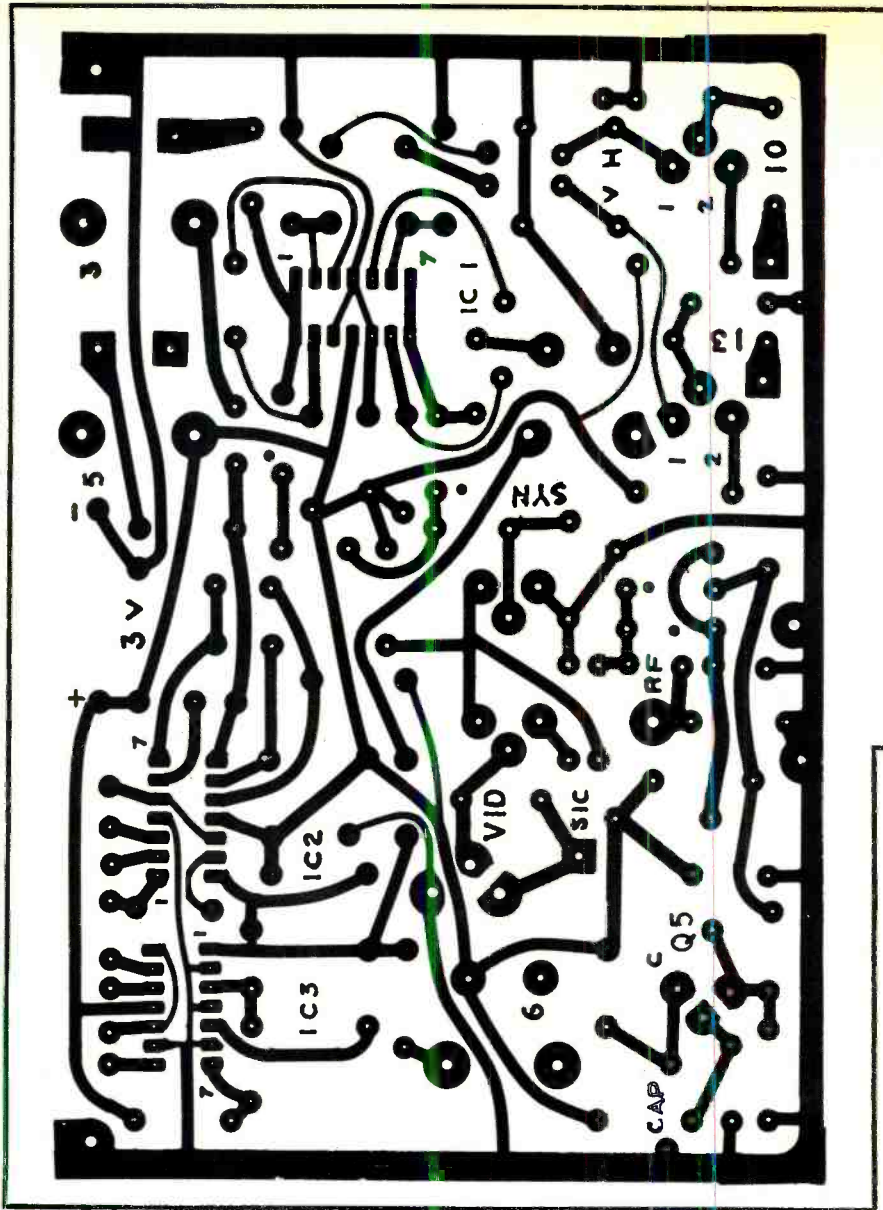


Fig. 5. Output of r-f oscillator and dual-diode modulator circuit drives the TV set.



wire (close-wound, with one turn touching the other). Then carefully spread the coil until the ends are  $\frac{3}{8}$ -inch apart. Bend the end leads to the proper angle and remove the resistor before mounting the coil. Before the coil is soldered to the board, solder one lead of C18 to the coil, four turns from the end connected to the collector of Q5. Note that this lead of C18 does not go through the board, but directly to the coil.

The stationary plates of C20 are connected to the collector of Q5; and the rotating plates to the ground bus on the

board. These two points are marked "CAP" in Fig. 6. Capacitor C25 is soldered directly across C20.

**Operation.** Before turning on the generator, check the battery polarity and voltage. There should be 3.0 V between the positive side of the battery and ground on the board. To check the completed generator, connect it to either a black-and-white or a color TV set. (Because of the very low r-f power output and the dc blocking capacitor C21, the generator cannot damage the

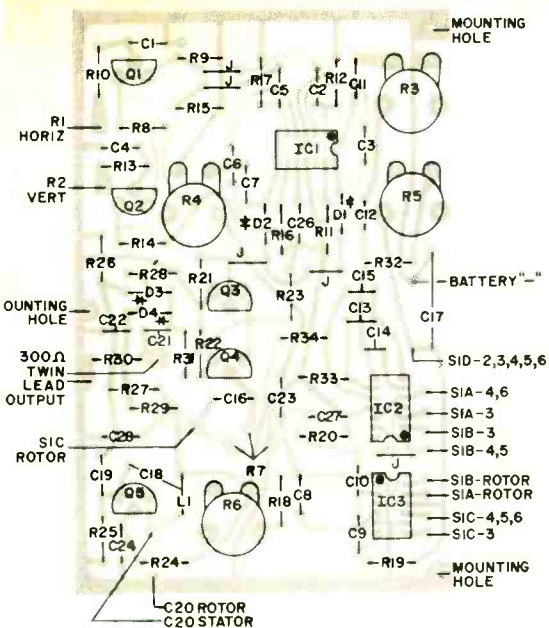


Fig. 6. The actual-size foil pattern (at left) and component installation (above).

TV set, even if the generator is not properly adjusted.)

Before getting into the operation of the generator, let's summarize the front panel controls and their functions. First, there is the MODE switch (S1). Besides turning the power on and off, it is used to select one of five displays: clear white screen (CLR), dot array (DOT), crosshatch (CH), horizontal lines (HL), and vertical lines (VL). The CHNL control varies the r-f carrier frequency over the range of three vhf channels (18 MHz). The HORIZ control varies the frequency of the horizontal sync oscillator about a nominal 15.750 kHz. The VERT control varies the frequency of the generator's vertical sync oscillator about a nominal 60 Hz. When adjusting either the HORIZ or VERT control, you may find more than one setting which results in sync of the pattern. Use the setting that results in the most stable display.

Make the following preliminary potentiometer adjustments:

1. Set R7 about  $\frac{2}{3}$  up from the grounded end. This potentiometer sets the black level of the composite TV signal.
2. Set R4 fully counterclockwise.
3. Set R3 fully clockwise.
4. Set R5 and R6 to midrange.

5. Disconnect the vhf antenna from the set and attach the generator to the antenna terminals on the set.

6. Turn on the TV set and put it on either channel 2 or 3, whichever is unused in your area. Turn the generator MODE switch to CLR.

7. With the plates of C20 (CHNL control) fully meshed, adjust trimmer C25 until the test signal from the generator appears on the screen with little or no buzzing from the set. This should be a clear raster—a completely white screen. Whether it is or not, continue to the next step.

8. Turn the MODE switch to the HL position. Adjust the VERT control to stop any vertical motion of the test pattern. Adjust the HORIZ control to eliminate any diagonal lines or "tearing" of the pattern. You should now see horizontal lines.

9. Touch up the adjustment of the CHNL control to eliminate any noise and to provide the clearest display. You may now prefer to decrease the TV's brightness control and increase the contrast to get white horizontal lines on a black background.

10. Trimpots R4 and R6 are used to set the stability and number of horizontal lines, respectively, though there will be some interaction between them. Adjust them for 9 or 10 horizontal lines and the best stability. Use the VERT and HORIZ controls to maintain vertical and horizontal sync as necessary.

11. Turn the MODE switch to the VL position. If vertical lines do not appear, touch up the HORIZ control.

12. Trimpots R3 and R5 are used to set the stability and number of vertical lines. Adjust them for 9 or 10 vertical lines and the best stability.

13. Turning the MODE switch to the CH position should now produce a 9 by 9 or 10 by 10 crosshatch pattern. Touch up the adjustment of the CHNL, HORIZ, and VERT controls as necessary. Trimpot R7 may be reset slightly to provide the best balance between sync stability and pattern contrast.

14. Turning the MODE switch to DOT or CLR should produce a 9 by 9 (or 10 by 10) array of dots or a clear raster, respectively.

Always turn the MODE switch off when not using the generator.

Once the potentiometers on the board and C25 have been set, the cabinet can be closed. Mark the positions of the HORIZ and VERT dials where sync was obtained for future use. ♦

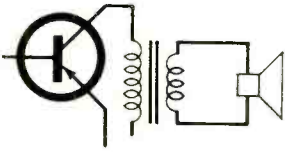
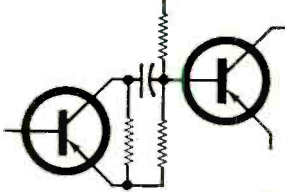
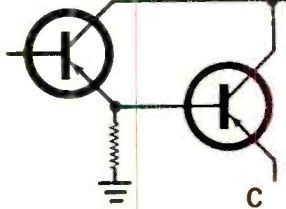
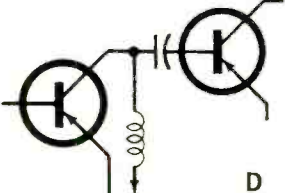
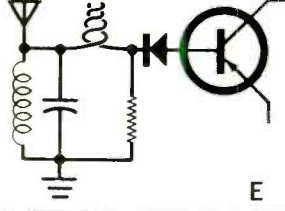
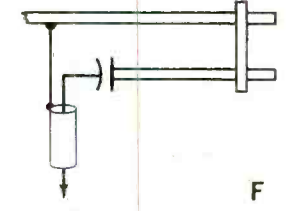
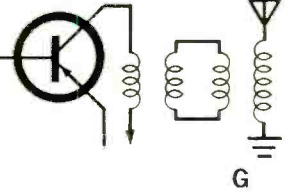
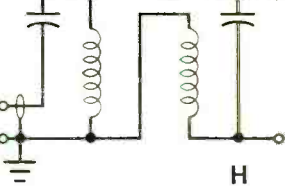
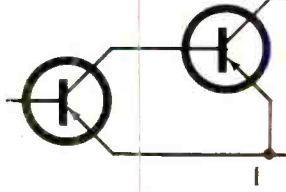
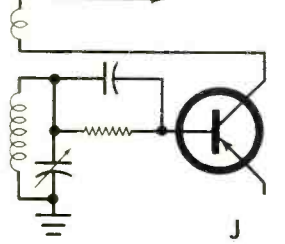


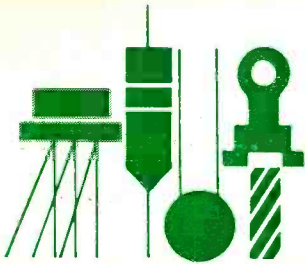
# ELECTRONIC COUPLING QUIZ

BY ROBERT P. BALIN

**M**ANY TYPES of coupling circuits are employed in electronics to meet matching requirements in feedback networks and between amplifier stages. Others are used between amplifiers and speakers, transmission lines, or antennas. Test your knowledge of coupling circuits and devices by matching those shown in A-J with their names numbered 1 to 10 at the right. The answers are below.

1. Balun
2. Direct coupling
3. Emitter coupling
4. Gamma coupling
5. Gimmick, or capacitive, coupling
6. Impedance coupling
7. Link coupling
8. RC coupling
9. "Tickler," or inductive, coupling
10. Transformer coupling

 <p>A</p>	 <p>B</p>	 <p>C</p>																				
 <p>D</p>	 <p>E</p>	 <p>F</p>																				
 <p>G</p>	 <p>H</p>	 <p>I</p>																				
 <p>J</p>	<p><b>ANSWERS TO COUPLING QUIZ</b></p> <table style="margin: auto;"> <tr> <td>A</td> <td>10</td> </tr> <tr> <td>B</td> <td>8</td> </tr> <tr> <td>C</td> <td>3</td> </tr> <tr> <td>D</td> <td>6</td> </tr> <tr> <td>E</td> <td>5</td> </tr> <tr> <td>F</td> <td>4</td> </tr> <tr> <td>G</td> <td>7</td> </tr> <tr> <td>H</td> <td>1</td> </tr> <tr> <td>I</td> <td>2</td> </tr> <tr> <td>J</td> <td>9</td> </tr> </table>		A	10	B	8	C	3	D	6	E	5	F	4	G	7	H	1	I	2	J	9
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# Solid-State Scene

By Walter G. Jung

**T**HIS MONTH we will take a look at a number of diverse devices which can be applied to a variety of uses. The first is a series of digital-to-analog (D/A) converters, elements which may not be familiar to all, so some explanation may be in order.

Among those who practice the art of electronics, there are two distinct camps: the "analog" and the "digital." Generally, circuit designs fall in one of these two domains. In their natural forms, these domains cannot communicate with one another—they require an interpreter. This role is played by the D/A converter, a device or circuit which bridges the communications gap between the two worlds of digital and analog. A D/A converter is neither an analog nor a digital circuit, but a hybrid of the two. It takes in digital information on one side and delivers the analog equivalent at the other side.

For the purposes of illustration, a simple D/A converter which uses an R-2R ladder (a typical technique, as will be seen) is shown in Fig. 1A. Switches S1-S3 represent 3 bits of digital control, each capable of an ON (1) or OFF (0) state. Current  $I$  is applied to the R-2R ladder, which is constructed so that, at each junction, the current divides in half. At the top it splits into  $I/2$  to S1 and  $I/2$  to R. Going down the ladder,  $I/2$  further splits into  $I/4$  to S2 and  $I/4$  to the next R. Finally,  $I/4$  splits into  $I/8$  to S3 and  $I/8$  through  $2R$  to ground. Although only 3 bits are shown, the R-2R ladder can be extended further as required.

Since this is a current ladder, the switches must be followed by very low resistances—either ground or low  $R_L$ .

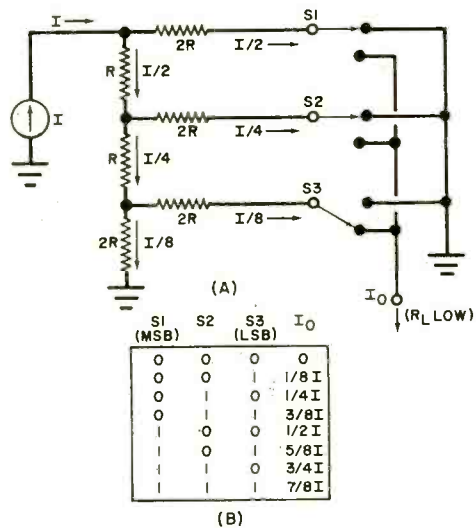


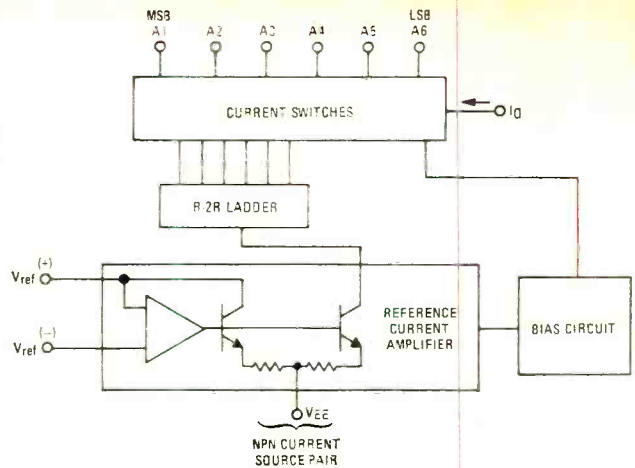
Fig. 1. Functional diagram of a D/A converter using R-2R current ladder.

If this D/A's truth table is followed through as shown in Fig. 1B, it can be seen that the smallest increment is  $I/8$ , which is determined by  $I/2^3$  where 3 equals the number of bits. In general, the smallest increment of output change is  $I/2^N$ , where  $N$  is the number of bits. The full-scale (highest) output current is  $I - I/2^N$ , since one increment of current is wasted in the shunt to ground at the ladder's end.

**Transistor Digital Switches.** The description above, while simplistic, is the basic concept used in a family of monolithic IC D/A converters now being supplied by Motorola Semiconductor. These devices are of two basic designs: 6-bit (MC1506L/

## D/A Converters

**Fig. 2. Basic block diagram of a 6-bit multiplying D/A converter. The 8-bit converter is the same but has 2 more ladder steps.**



MC1406L) and 8-bit (MC1508L/MC1408L). The MC1500 series is for operation at a temperature range of  $-55$  to  $+125^{\circ}\text{C}$ , while the MC1400 series is for  $0$  to  $+75^{\circ}\text{C}$ . In the 8-bit models, there are further part number suffixes which indicate the accuracy. For instance MC1408L-8, MC1408L-7 and MC1408L-6 have accuracies of 8, 7 and 6 bits, respectively.

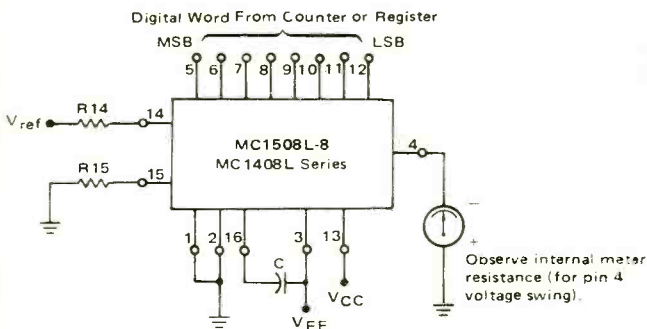
These chips use transistors to perform the switching functions and the current switched can be externally programmed. This introduces another term to this particular breed of D/A—multiplication. With the current being variable (either by dc or ac signals), this type of circuit multiplies the analog current by the digital number represented by the states of the logic switches. In this manner, the input can be a dc or ac signal, controlled by digital logic signals.

A basic block diagram applicable to any of these new devices is shown in Fig. 2. Although 6 bits are shown in Fig. 2, the 8-bit version is similar, with the ladder and switches increased by 2 bits.

The list of possible applications that Motorola suggests for these devices is indeed impressive: programmable gain/attenuation, audio digitizing, programmable power supplies, analog/digital multiplication and division, digital addition and subtraction, programmed pulse and signal generation, and many more. As an example, Fig. 3 is a digitally driven analog panel meter which can be used to read out the status of a digital system in analog form. To calibrate,  $R14$  is trimmed for full-scale deflection with all "ones" as a digital input. The variable full-scale output current provided allows different meters to be used (up to 2 mA max). The comprehensive data sheets for these devices list a number of other possible applications.

The MC1506/1406 devices come in 14-pin dual inline packages, while the MC1508/1408 models are in 16-pin versions. Prices begin with \$5.90 each for the MC1406L.

The D/A converter is an important circuit building block; and now that monolithic circuitry has made it available at low cost, it will no doubt find many new uses



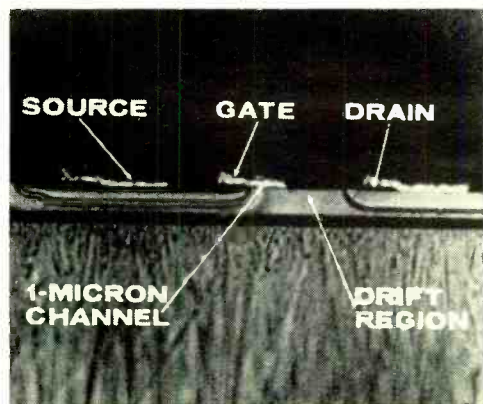
**Fig. 3. Digitally driven panel meter readout using D/A units.**



in your electronic projects. We expect this device to gain acceptance as a standard circuit building block—comparable to the op amp and logic gate in the experimenter's kit of electronic devices.

**New UHF/VHF Performance.** The significant development made by Signetics in FET technology, the D-MOST (double diffused MOS transistor), is now available in several forms which provide new performance horizons in the uhf and low-microwave region. Since the D-MOST process is simple and inexpensive, it can be expected that devices using this technology will be very popular.

Four devices are currently available: SD200 and SD201 are single gate devices, the latter having protection diodes; SD300 and SD301 are dual gates (allowing gain control) and the latter has protection diodes.



**Photomicrograph of a cross section of a typical DMOS transistor. Diffusion technique is simple and inexpensive.**

The unique thing about these devices is to be found in their specifications. For instance, an SD200 has a transconductance of 15 millimhos and a feedback capacitance of 0.13 pF; and it operates at voltages as high as 30 V. At 1 GHz, it has a gain of 10 dB while its noise figure is 4.5 dB. The dual-gate SD300 has a transconductance of 10 millimhos, with a feedback capacitance of only 0.02 pF. It can achieve 13 dB of gain at 1 GHz with a noise figure of 6 dB.

While the figures above apply to the present devices, which come in TO-46 4-lead packages, they don't provide the whole story on D-MOST capability. Signetics has also indicated that these transistors will soon be available in strip-line form (a true microwave package), which allows perform-

ance figures similar to those above to be realized at 2 GHz! Initial pricing (expected to be lower with volume production) for the devices in single quantities is: SD200 and SD201, \$7.00; SD300, \$5.00; SD301, \$6.00.

**Front-End Improvement.** Several FET developments from Texas Instruments also offer improved performance—in this case, in the vhf region. Recently announced are the 3N211, 3N212, and 3N213 n-channel depletion-mode dual-gate MOS transistors. These devices all have high gain, low noise, and low feedback capacitance. They are designed primarily for TV r-f and i-f use at frequencies up to 200 MHz. A look at some of the performance figures is indicative of what these devices might do for that TV or FM front end you'd like to perk up.

As an r-f amplifier, the 3N211 can achieve (typically) 28 dB of gain up to 200 MHz, with a noise figure of 2 to 3 dB. The dual gate construction allows simplified voltage controlled gain (agc), while the low feedback capacitance of 0.05 pF eliminates the need for neutralization. The 3N212 is similar to the 3N211, but is better suited for mixer applications. It has low cross modulation and a low noise figure. In a 200-to-45-MHz mixer, it can achieve a conversion gain of 24 dB. The 3N313 is intended to be used as an i-f amplifier so it has a higher breakdown voltage to suit this application.

All three of these devices achieve their high performance figures by virtue of a transconductance figure which is truly remarkable: 25 to 30 millimhos! They also have built-in gate protection diodes for transient clipping to eliminate handling precautions. As an aid in the use of these devices, TI has prepared Bulletin CA-173, which discusses their use in TV tuner and i-f circuits.

The 3N211 and 3N212 cost \$1.30, while the 3N213 is \$1.35, each.

**For Further Information.** Write: Motorola Semiconductor Products Technical Information Center Box 20924 Phoenix, AZ 85036 Signetics Corporation 811 E. Arques Ave. Sunnyvale, CA 94086 Texas Instruments Inquiry Answering Service Box 5012, M/S 308 Dallas, TX 75222



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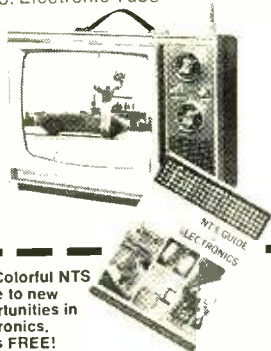
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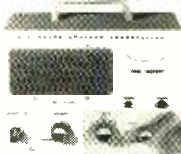
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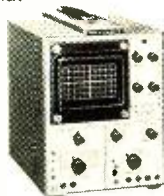
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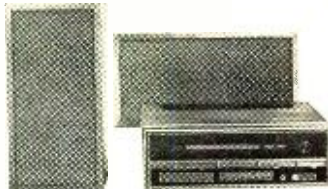
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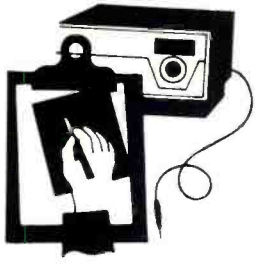
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# Product Test Reports

## MARANTZ MODEL 500 POWER AMPLIFIER (A Hirsch-Houck Labs Report)



**M**ANY of the newer multi-driver, low-efficiency speaker systems are capable of astonishing lifelike reproduction—when sufficient clean audio power is available to drive them. Although the majority of hi-fi enthusiasts will undoubtedly continue to be satisfied with amplifiers rated at up to 60 watts/channel, several times that level can easily be handled by the better speakers without damage to the cones or producing significant distortion. In fact, the reproduction of a solo piano at a natural volume level, using high-quality acoustic-suspension speaker systems, can easily require amplifier peak powers of several hundred watts.

Marantz has recently introduced a “super power” basic stereo amplifier that will drive just about any speaker systems you care to mention. The power ratings of their Model 500 amplifier, all based on continuous power output with both channels driven (between 20 and 20,000 Hz) are: 500 watts/channel into 4 ohms, 250 watts/channel into 8 ohms, and 125 watts/channel into 16 ohms. The rated harmonic and IM distortion at these power levels is less than 0.1 percent.

Although the Model 500 is a “basic” amplifier, it employs 58 transistors and 14 diodes, many of which are used in its extensive protective circuitry. The output transistors are current-limited and feature instant overload recovery. In addition, relay circuits

provide time delayed turn-on, eliminating transient “thumps” and “pops” (that could be fatal to many speaker systems at these power levels), while also protecting both amplifier and speakers against excessive subsonic (less than 8 Hz) drive levels. The amplifier is designed for continuous operation at high power levels. It is cooled by a combination of massive heat sinks and internal forced-air cooling.

Each channel has its own front-panel gain control, output meter, and power limiter switch. This last can be set for maximum outputs of 100, 60, or 20 percent of the rated power; it simultaneously changes the output meter range. The input and output connectors are located behind a removable section of the front panel and are duplicated on the rear apron.

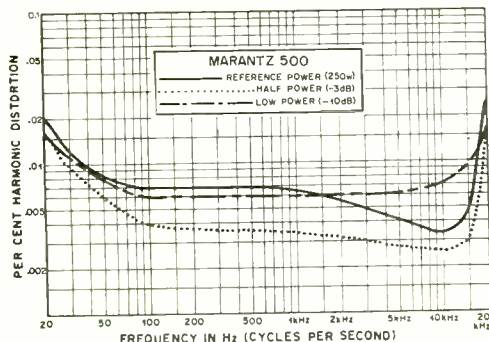
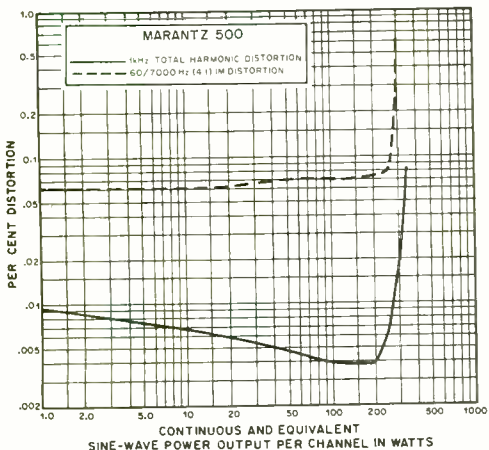
The amplifier measures 17½ in. wide by 16 in. deep by 7 in. high and weighs 78 pounds. At full power, it draws 2000 watts from a 117-volt ac line. (Under normal operating conditions, the power drain is a small fraction of this figure.)

The retail price of the Marantz Model 500 power amplifier is \$1200.

**Laboratory Measurements.** We measured the clipping power into 8-ohm loads to be 310 watts/channel at 1000 Hz. Into 16 ohms, it was 205 watts/channel. We could not measure the maximum power into 4 ohms since the output fuses blew before the clipping level was reached. However, it was well over the rated 500 watts/channel. An input signal of 0.42 volt drove the amplifier to 10 watts output, while about 1.75 volts was needed to drive it to full power. Hum and noise were inaudible, measuring 77 dB below 10 watts, or 91 dB below rated output power.

The distortion was relatively independent

of frequency and power level. At either full or half power, it was less than 0.02 percent from 20 Hz to 20,000 Hz and was typically less than 0.007 at most frequencies. At one-tenth power, a healthy 25 watts, the distortion was 0.006 percent over most of the audio frequency range. With a 1000-Hz input, the harmonic distortion dropped smoothly from less than 0.01 percent at 1 watt to 0.004 percent between 100 and 200 watts. It rose to 0.006 percent at the rated 250 watts/channel and was about 0.08 percent between 300 and 350 watts. The IM distortion was virtually constant over a wide



power range; from 8 mW to over 250 W, it measured between 0.05 and 0.08 percent.

On the three selectable power ranges, the steady-state output corresponding to a 0-dB meter reading was 24.5, 75, and 125 watts, respectively. The clipping power outputs were 75, 215, and 310 watts—a reserve of only 3-4 dB over the average levels. If the meters read consistently higher than about -6 dB, the next higher range should be used to prevent peak clipping.

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the gain controls at maximum, was within  $\pm 0.1$  dB from 10 Hz to 20,000 Hz, falling to  $-1$  dB at 70,000 Hz and  $-3$  dB at 135,000 Hz. At a  $-6$ -dB volume setting (the worst case for internal capacitive loading of the gain potentiometers), the output fell to  $-0.7$  dB at 20,000 Hz and  $-3$  dB at 40,000 Hz.

**User Comments.** The measured performance of the Model 500 amplifier literally speaks for itself. No amplifier we have seen is any better—few can even compare to it. The excitement and “open” quality it exhibits in reproduced music, made possible by a virtually unlimited and undistorted power reserve, must be heard to be appreciated. The amplifier certainly justifies its designers’ expectations in full measure.

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### DUAL MODEL 1229 AUTOMATIC TURNTABLE (A Hirsch-Houck Labs Report)



**T**HE HIGHEST priced automatic turntable in the Dual line is now the Model 1229, replacing the former Model 1219. When a product has reached the stage of refinement attained by the 1219, it is difficult to make major improvements; but small operating refinements are always possible, such as what has been done with the new Model 1229.

Like the former model, the 1229 has a massive 7-pound aluminum platter driven by a synchronous continuous-pole motor. Each of the three speeds (33 $\frac{1}{3}$ , 45, and 78 rpm) can be adjusted over a nominal range of  $\pm 3$  percent by a knob that is concentric with the speed selector lever. The 8 $\frac{1}{2}$ -in. low-mass tubular aluminum tonearm is pivoted on low-friction gimbals, and the entire arm moves up and down to provide the optimum vertical tracking angle when playing either a single record or a stack of up to six discs. The cueing lever gently raises and lowers the pickup with damped control in both directions.

In the 1229, the vernier speed adjustment

Any amplifier of this power rating *must* have forced-air cooling for prolonged operation at greater than home listening levels. Generally, the user is expected to supply the fan and install it (hopefully) in such a manner as to provide proper cooling. Marantz has done the engineering of the cooling system as part of the amplifier design, a fact that should be appreciated by anyone investing so much money in an amplifier that could be extensively damaged by an incorrect installation. The fan, though quiet, can be heard during standby periods when the amplifier is located in the listening area. We measured its acoustic output at 43-45 dB (ANSI “A” weighting) at a distance of 3 ft.—not a troublesome level under normal listening conditions.

has been made more useful by the provision of stroboscope markings underneath the platter. These are illuminated by a neon lamp and can be viewed through a window in the motorboard while the system is in operation. The 1219 had cartridge tracking force calibration markings of from 0 to 5.5 grams and a corresponding range on the scales of the separate anti-skating force control. Since cartridges requiring the higher tracking forces would not be compatible (in quality) with such a refined tone arm and turntable. Dual has reduced the range of force in the 1229 to 0-3 grams. Recognizing the importance of accurate force settings with highly compliant cartridges tracking at 1 gram or less, they have also provided calibration marks at 0.1-gram intervals between 0.2 and 1.5 grams and at 0.25-gram intervals between 1.5 and 3 grams.

The calibrations of the antiskating force dial have been altered to match those of the tracking force dial. Finally, the counterweight, formerly adjustable in click-stop intervals of 0.01 gram, now rotates smoothly for arm balancing.

The retail price of the Model 1229 automatic turntable, minus optional base and dust cover, is \$200.

**Laboratory Measurements.** The tracking force calibrations proved to be extremely accurate, exhibiting an error of less than 0.1 gram. Unlike practically every other automatic record player we have tested, the



1229's tonearm exerts the same force at the top of a stack of records as it does with a single disc. (Most arms exhibit a change of several tenths of a gram.)

The arm tracking error was essentially zero over most of the record surface (between radii of 3 in. and 5 in.), a negligible  $0.25^\circ/\text{in.}$  at a 6-in. radius and a very acceptable  $0.6^\circ/\text{in.}$  at the inner radius of  $2\frac{1}{2}$  in. The antiskating compensation was nearly optimum, although we found that, by setting it about 0.5 gram higher than the tracking force, we obtained a slightly better correction.

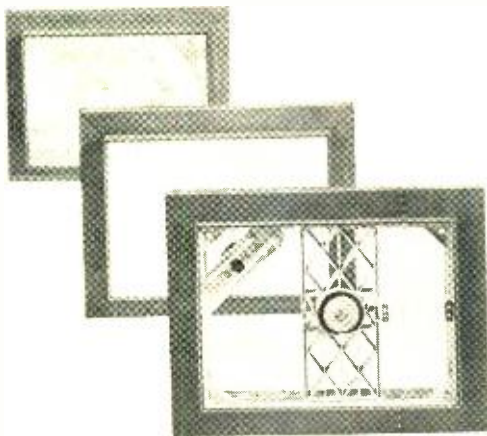
Wow and flutter were each 0.05 percent at  $33\frac{1}{3}$  rpm and were even lower at 45 rpm. At 78 rpm, the wow was 0.025 percent and the flutter was 0.055 percent. The unweighted lateral rumble was  $-38$  dB. With CBS RRL weighting (more indicative of the audibility of the different rum-

ble frequency components), it was  $-56$  dB. These are among the lowest rumble figures we have measured on any type of turntable. The speed adjustment covered a range of  $+2.8$  percent and  $-3.4$  percent about the correct speed. In automatic operation, the change cycle required a relatively short 12 seconds.

**User Comments.** After years of using and testing Dual automatic turntables, we are no longer surprised by their superb performance. We have come to expect it, and the Model 1229 carries on the tradition. With wow, flutter, and rumble levels already below those present on most records and an arm as nearly ideal as is possible with its dimensions, the Dual 1229 automatic turntable is, for all practical purposes, the equal of any combination of record playing components known to us.

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### FISHER MODEL PL-6 SOUND PANEL SPEAKER (A Hirsch-Houck Labs Report)



**S**ELDOM is it claimed that a simple "box" loudspeaker is an attractive piece of furniture. Even the compact "bookshelf" speaker system can sometimes be difficult to fit into a given room's decor. The problem is more severe in a quadraphonic setup where four speaker systems are required—a situation that has deterred many people from converting to 4-channel stereo.

Fisher Radio is now marketing a new loudspeaker that is specifically directed toward solving the speaker-versus-decor dilemma. Externally, their Model PL-6 Sound Panel resembles a picture, framed in mahogany, and measuring  $29\frac{1}{4}$  in. by  $23\frac{3}{4}$

in. by  $2\frac{7}{8}$  in. Covering the driver elements is a fabric "grille" that is available in a choice of four abstract and four rustic scenes. The overall effect is that of a painting or lithograph. And because the Sound Panel weighs only 21 pounds, it can easily be wall hung. Alternatively, it can be built into a room divider or custom cabinet or used as a free-standing floor speaker system on the wood feet supplied with each unit.

Most "thin-profile" speakers in the past have consisted of arrays of small cone drivers housed in a shallow enclosure. The PL-6, on the other hand, has a large polystyrene radiating surface that measures roughly 22 in. by 17 in. Most of this area is the "woofer," driven at its center by a 1-in. voice coil in the field of a 2.64-pound ferrite magnet. The voice coil is coupled to the diaphragm through a compliant cement, the one driving the other by what Fisher terms "hammering" action.

In one corner of the PL-6 is a separate high-frequency driver whose voice coil and magnet are the same size as those used for the woofer. This "tweeter" drives a smaller section of the flat diaphragm, the diaphragm being elastically decoupled from the main area that makes up the woofer surface. The thickness of the polystyrene diaphragm tapers from maximum at the center to very thin around the edges. The tweeter voice coil is driven through a capac-

itor that isolates it from the low-frequency signals, but the acoustic crossover is essentially due to the mechanical design of the structure.

Nominally rated at 8 ohms, the speaker system is much more efficient than acoustic-suspension speakers and can be driven to loud listening levels by amplifiers rated at from 5 watts to 10 watts output. It can handle maximum power inputs of 25 watts continuous or 50 watts of program material.

Fisher claims omnidirectional performance from the PL-6. A portion of the rear of the speaker is open behind each driver so that in a free-standing installation, the radiation pattern is roughly the figure-eight shape of a dipole source. Although there is no radiation at 90° to the speaker plane, the reflection of the rear radiation from the walls gives the PL-6 better overall dispersion than most conventional speaker systems. Of course, hanging the PL-6 on a wall eliminates most of the rear radiation and results in a more usual polar response with a reduction in bass output.

The retail price of the Fisher Model PL-6 Sound Panel speaker system is \$138.

**Laboratory Measurements.** We tested the PL-6 in a free-standing floor-positioned mode where it was several feet from a wall. Except for a 5-dB peak centered at 450 Hz, the low-frequency output was quite uni-

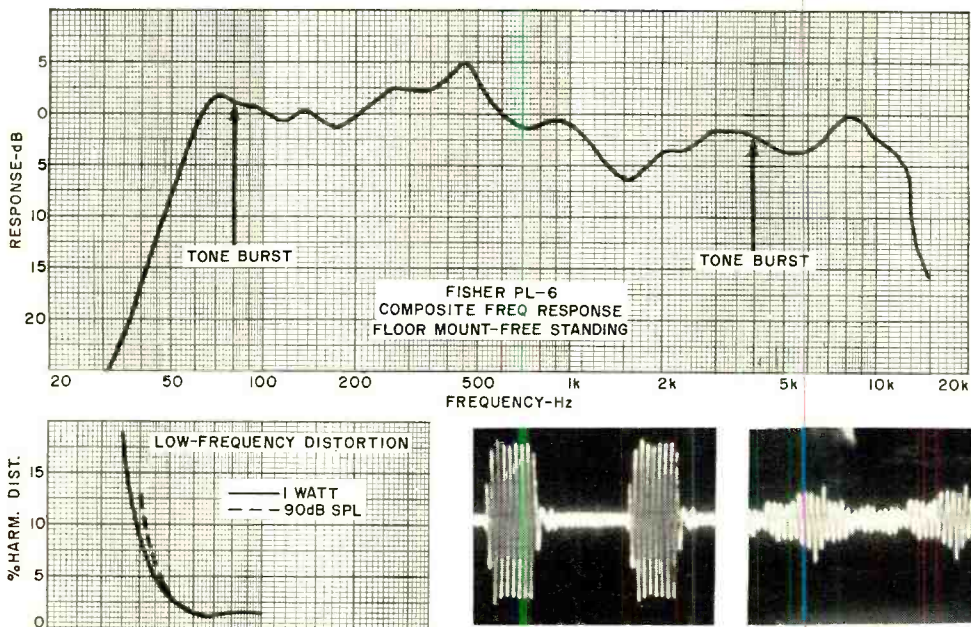
form ( $\pm 2$  dB) from 60 Hz to 1000 Hz. The average level of the higher frequencies was about 3 dB lower, with minor irregularities and overall response of  $\pm 3$  dB from 1000 Hz to 13,000 Hz.

The low-frequency distortion was less than 3 percent down to 50 Hz. It rose to 5 percent at 45 Hz and to 10 percent at 40 Hz. There was little difference in distortion whether we used a constant 1-watt drive level or a constant 90-dB SPL output at a 3-ft distance from the speaker.

The impedance averaged 8 ohms, varying from 7 ohms to 10 ohms over most of the audio range (except for a rise to 30 ohms at the bass resonance of 66 Hz). Unlike most other speaker impedance curves, which are smooth except for one or two major resonance peaks, that of the PL-6 had many small irregularities at low and middle frequencies and a couple at the high end. These suggest the existence of a number of minor resonances, a situation not unexpected in a large flat radiator such as that used in this speaker system.

The tone-burst response was good at low frequencies but was irregular at middle and high frequencies. As claimed, the PL-6 efficiency was high, requiring only 30 mW to drive the output to a 90-dB SPL. This is about 6-12 dB more efficient than most speaker systems we have tested.

**User Comments.** Our first impression on



hearing the PL-6 was of a projected sound in the midrange and a moderate deficiency of highs. To a considerable extent, the response of the system can be "tailored" with tone controls (or even better, by a multi-band equalizer) to have a more balanced character. A moderate treble boost and a little bass cut make a worthwhile improvement.

After only a short listening period, the coloration of the system became much less obvious, to the point where we were able

to ignore it and simply listen to the total effect. It is a very pleasant and listenable speaker system that merely requires some getting used to since it sounds quite different from most comparably priced speaker systems.

The PL-6 has two very big plusses; One is that it is very efficient when compared with conventional speaker systems. The other is its very compact shape and decorator styling—a decided advantage in both 2- and 4-channel systems.

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## REALISTIC MODEL TRC-49 CB TRANSCEIVER



**T**HE NUMBER of CB transceivers with the capability to monitor Channel 9 while normal operation is being conducted on other channels is on the rise. One of the newer rigs providing this feature is the Realistic Model TRC-49 Navaho Pro-Niner. Other than containing a special Channel-9 priority feature, it is normal in all respects.

The Navaho Pro-Niner is a 23-channel, crystal-synthesized transceiver that operates at 5 watts input power to the final amplifier. It contains a noise limiter and blanker with on/off switch, delta tune, and adjustable squelch (operates on both main and Channel-9 receivers). Other features include a meter that indicates S units, relative r-f output, and SWR; public-address facility; function indicator lamps; front-facing speaker; and a detachable dynamic microphone. There is also a jack for an external speaker and another for headphones.

Measuring 12 $\frac{1}{4}$ " wide by 9" deep by 5" high, the transceiver appears to be designed primarily for base station use. However, it has built-in provisions for operation from a 12-volt dc negative-ground source, and mobile mounting hardware is provided with the rig.

The Realistic Model TRC-49 Navaho Pro-Niner CB transceiver's retail price is \$200. For this price, the buyer also receives the microphone, ac and dc power cables, spare fuse, and mounting hardware.

**Main Receiver.** The main receiver, with a tested sensitivity of 0.4  $\mu$ V for 10 dB (S + N)/N (30 percent modulation at 1000 Hz), is a double-conversion one, employing a FET r-f amplifier. The first i-f is nominally 10.6 MHz; the second i-f is at 455 kHz, employing a mechanical filter and transformer-coupled circuits to provide a bandpass of 6 kHz at 6 dB. Adjacent-channel rejection measured 40 dB on the low side and 50 dB on the high side.

The agc, applied to the r-f and mixer stages, maintains an a-f output within 4 dB with an r-f input change of 60 dB (10-10,000  $\mu$ V) and 9 dB at 1-10  $\mu$ V (20 dB). The squelch threshold was adjustable for signals of 0.4-1000  $\mu$ V.

An IC and a push-pull class-B a-f output amplifier delivers 3.25 and 4.5 watts at 1000 Hz with 6 and 10 percent distortion, respectively. This is more power than is usually available in rigs of this type. The PA level can be adjusted with the volume control.

The anl is a conventional series-gate type that follows the detector. The degree of noise limiting is varied by a front panel control. The noise blanker is a bit unusual. Instead of a diode-switched gate for interrupting noise pulses, the gating pulses momentarily shut off the second mixer. The anl and blanker can be simultaneously switched on or off. Their paired performance provided 20 dB attenuation on impulse-noise peaks.

**Channel-9 Receiver.** Also containing a FET r-f amplifier, the Channel-9 receiver had a tested sensitivity of 0.6  $\mu$ V for 10 dB (S + N)/N. Employing single conversion, its i-f is at 455 kHz, where the adjacent-



channel selectivity checked out at 40 dB. Image rejection, as expected with single-conversion at this low i-f, was only 10 dB, compared with 55 dB for the main receiver. However, the likelihood of the appearance of an interfering signal at the 26,555-kHz image frequency is slim.

**Frequency Synthesizer.** The frequency synthesizer uses various combinations of crystal groups as the need requires. The Delta tune varies the frequency of the receiving crystals in a fixed amount of roughly  $\pm 700$  Hz around the center frequency. For the Channel-9 receiver, heterodyning at the mixer is obtained with a separate 26.81-MHz crystal. The transmitting frequency on any channel was within 0.002 percent at 78° F.

**Transmitter.** Signals from the synthesizer go to a transmitter mixer, buffer and driver amplifiers, and the p.a. that has a triple-section output network designed for a 50-ohm load. On line power, the carrier output measured 3.25 watts; using a 13.8-volt dc source, it was 3.5 watts.

Modulation, obtained from the receiver's power amplifier, was excellent, with a clean sine wave up to 100 percent modulation with only 7 percent distortion at 1000 Hz. The positive peaks limited at 100 percent without deteriorating the waveform. But with increased speech levels, the negative peaks "crossed over," making splatter possible. However, observations on a spectrum analyzer indicated that with voice frequencies below 3000 Hz no significant spill-over was observed on the adjacent channel.

Negative carrier shift also was noted, particularly with 117-volt ac power and with loads presenting an SWR greater than 1.1:1, indicating that performance is quite sensitive to the load impedance. It is best

to hold the SWR as near as possible to 1:1. The panel meter can be used for determining the SWR into which the transmitter "looks." Unfortunately, with our test unit, a 50-ohm load with an actual SWR of 1:1 showed up on the meter as 1.5:1, while a load with 2:1 SWR showed up as 1:1. This may have been a peculiarity unique to our test unit.

During transmit, an ON THE AIR indicator and a MODULATION indicator come on, the latter glowing with varying intensity according to the modulation.

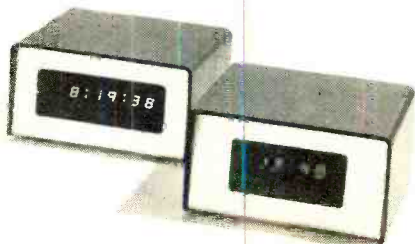
**Channel-9 Operation.** Setting up the Channel-9 priority arrangement is handled by controls grouped at one corner of the front panel. At the OFF position of one control, this feature is disabled. When placed at LIGHT, the system is in operation and a light comes on when a signal appears on Channel 9. When the control is at RECEIVE, a signal on Channel-9 disables the main receiver so that the signal automatically is heard. Then, if it is desired to transmit on Channel 9, without having to shift the synthesizer dial, the TRANSMIT button must be depressed. A third control is an individual squelch for the Channel-9 receiver.

**Other Data.** The receiver section is exceptionally quiet. Even when unsquelched, very little background noise could be heard in the absence of a signal. Both the receiver and the transmitter have a low-frequency roll-off below 750 Hz, amounting to 6 dB at 450 Hz, and dropping faster below this point. With a response at the high end up to 3000 Hz, the result is crisp quality and fine voice intelligibility. On receive, intelligibility is enhanced by the front-facing speaker. The squelch action is exceptionally smooth, with no hard attack or release.

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## MITS 4- AND 6-DIGIT ELECTRONIC CLOCKS

EVER SINCE the advent of digital integrated circuits, the staid old world of timekeeping has been undergoing a major revolution that is threatening to put forever to rest the old mechanical clockwork mechanism. Unless you have been keeping on top of the latest developments in IC technology, you might be surprised to learn that there is on the market a new crop of consumer-type all-electronic clocks that employ a *single* LSI chip to perform all the



functions that, in an earlier day, demanded no less than 14 IC's. The single-chip clock offers the consumer many advantages, not the least of which are compact size, low power drain, and low cost.

MITS, Inc., was among the first of the companies to come out with clocks that capitalize on the new LSI chips. They offer two versions: one has a 6-digit readout system (hours, minutes, and seconds), and the other has a 4-digit readout (hours and minutes). The 6-digit Model DC6 factory-wired clock sells for \$98.50, while the kit version DC6K is \$58.50. The factory-wired 4-digit Model DC4 lists for \$89.50, the kit version DC4K for \$48.50.

The two versions have some common features. Each utilizes extra-large 7-segment LED readouts. While different types of LSI chips are used in each version, both chips feature 50/60-Hz operation and the choice of 12- or 24-hour display formats. (In the 12-hour mode, the leading tens-of-hours zero is blanked, but no leading-zero blanking is used in the 24-hour mode.) Separate double-sided PC boards are used for the readout display and the rest of the electronics (the power transformer mounts on the rear wall of the chassis). Momentary-action pushbutton switches provide a means for FAST and SLOW time setting and a HOLD function for precise time starting.

While different LSI chips are used for the 4- and 6-digit MITS clocks, each is the electronic analog of the basic mechanical clockwork mechanism. Each chip contains a divider chain that delivers a 1-pulse/sec (1-pps) output from either a 50- or a 60-Hz line frequency, depending on whether or not a certain IC pin is connected to ground. In the DC6, the 1-pps output feeds the units-seconds counter, but in the DC4, it pulses the colon between the hours and minutes readouts once a second while a further division takes place to deliver a 1-pulse/min (1-ppm) signal to the units-minutes decade.

Additional circuits on the LSI chips count and decode the 1-pps or 1-ppm "clock" pulses to ultimately provide either a 4- or a 6-digit readout driving signal. Additionally, multiplexing circuits "strobe" the decoder outputs at a flicker-free high frequency, thus saving on outboard circuit complexity. The outputs from the chips are designed for driving low-power readouts, but the LED displays demand more power than these

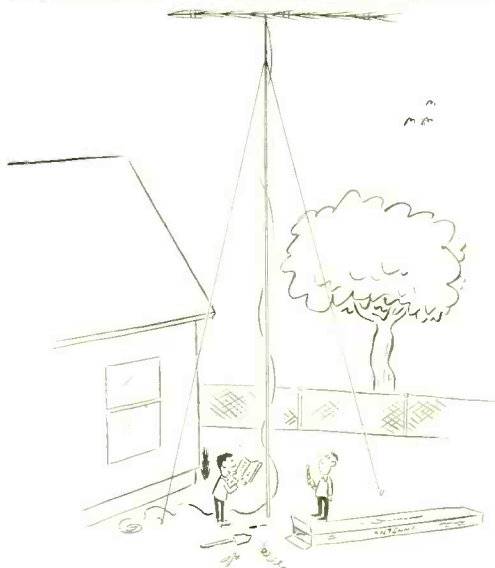
outputs can safely deliver. So, outboard driver transistors are used between the two to provide proper interfacing.

Upon first opening the carton in which our DC6K arrived and laying out the components in preparation for getting to work, we were highly impressed by the quality of the items arrayed. One would expect the LSI chip, LED readouts, and transistors to be of the highest quality available, and this kit contained only 5-percent tolerance resistors where 10- and 20-percenters would clearly have sufficed. Equally impressive was the 1/4"-thick machined aluminum chassis/case assembly. Actually, everything about this kit impressed us to some degree or another.

Assembling the clock is a bit of a let-down for the avid kit builder. It goes together too quickly. For the economy-minded buyer, however, the fast assembly time (our kit went together in a little over three hours), aided by one of the best written and best illustrated assembly manuals, is a strong argument in favor of investing in the kit.

Our DC4 clock arrived factory-wired (a pity; we could have had so much fun assembling it after having whetted our appetites on the DC6K). Yielding to our strong senses of curiosity, we opened the case for a look-see. True to form, its quality was every bit as impressive as the kit we had just assembled.

Circle No. 69 on Reader Service Card



**"We should have read the instructions. Step two was to unfold the antenna."**



# Being an Amateur Pays Off

By John T. Frye, W9EGV, KHD4167

**D**OG-DAY doldrums had finally reached Mac's Service Shop. Customers were so busy enjoying their vacations and all kinds of outdoor activities that they simply ignored malfunctioning radios and TV sets. After all, a tired summer rerun on the TV screen was poor competition for a cookout in the back yard or just chatting quietly in lawn chairs beneath the stars on a balmy summer evening.

As a result, there was not an unrepaired set in the shop nor an unanswered service call on Matilda's pad. Service benches were almost painfully clean and uncluttered; service instruments had been polished and recalibrated; reference books and replacement parts had been carefully and neatly rearranged. Mac and his assistant, Barney, were sitting side by side on the service bench swinging their legs and chatting.

"Mac," Barney said, "I seldom hear you talking about working your ham rig any more. How come?"

"Just don't have the time," Mac explained, loading his pipe. "You have to keep running hard just to stand still in electronics these days. As my wife will quickly and tartly tell you, when I'm home I usually have my nose stuck in a magazine or book. Sometimes I have the ham receiver going while I read, but I seldom flip on the transmitter. I know if I do I'll probably shoot several hours, for hamming is just as fascinating to me as it ever was."

"As long as you've been hamming. I'll bet you've had some weird experiences."

**The FBI-Dillinger Caper.** "That I have. One of the first was what I call the FBI-John Dillinger Caper. You probably know that back in the '30's John Dillinger, Baby Face Nelson, and the Brady Gang—not to be confused with the sweetness-and-light TV show called the Brady Bunch—all operated right through these parts. The

Brady Gang ambushed and killed a state trooper by the name of Minneman and shot up our deputy sheriff, Craig, at the Caley Church just north of town. Dillinger himself is buried only sixty-five miles south of here at the Crown Hill Cemetery at Indianapolis.

"While my rig was only a breadboarded self-excited TNT rig using a pair of '45 receiving tubes and inputting a sizzling thirty-five watts, I was quite active in the traffic CW nets. One day I was sitting out in the lawn swing in the front yard with some girls—wipe that unbelieving grin off your face—when a long black car pulled up and a couple of serious looking men got out. They said they would like to talk to me in private. While I was excusing myself, I noticed something odd about their car: it had a very thick windshield with about a two-inch round hole cut neatly through the glass on the passenger side, a hole, I learned later, for receiving the barrel of a rifle or machine gun.

"As soon as we were inside, one introduced himself as an FBI agent and showed me his identification. He introduced the other man as a law officer from one of the northern counties. Maybe you think I wasn't hastily reviewing my most recent sins as we sat down! They wanted to know if I held the ham call, W9EGV, and if I had handled a radio message in the past three days. I cautiously pleaded guilty on both counts. Then they wanted to know if they could see the message.

"I gulped and said, 'No, not without a court order.' It's not easy to say no to an FBI agent, but I knew showing my message log would be in violation of the Secrecy of Communication portion of the Radio Act. They wanted to see my license, which I showed them, and we sparred around for a few minutes. Finally I said, 'Look, you fellows want to know something. I'm willing to help if I can; so why don't you just ask me?'"





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CIRCLE NO. 23 ON READER SERVICE CARD

"O.K.," the FBI man said, "we have a message with your call as the station of origin, making a date for John Dillinger to meet Baby Face Nelson at a little town to the north of here. On the strength of this, we've had fifty men lying in wait up there for two nights. As you might guess, we checked you out pretty thoroughly before we came, and we think the radiogram is probably a hoax, but we still have to make sure. That's why we'd like to inspect your log."

"In that case, be my guest," I answered, heading for the ham shack. Was I ever glad my log was right up to date! I was dead sure all my transmissions had been monitored around the clock for the past few days. The only message I had handled recently was one I had picked up from Kentucky and had relayed into Chicago that very morning. It was one of those innocuous arrived-safely-will-write-soon type. Satisfied I was not a Dillinger henchman, they asked me not to say anything about the affair. I pointed out that if someone were using my call I wanted to report it to the FCC before he got me into more trouble. They said to go ahead and report the suspected bootlegging of my call and refer the FCC to the FBI for further details. I did, and six months later I got a notice from the FCC that everything had been cleared up to their satisfaction. I never learned any more. The FBI, understandably, is much better at collecting information than at putting it out."

"Wow!" Barney exclaimed. "Got any more wild stories?"

**R-F Burn Treatment.** "Lots of them. Here's one a little more amusing. My sixteen-year-old cousin had a wart on her hand and asked if I could take it off. I had discovered I could tune up the pi-network coupler of my transmitter so that it would develop a very high r-f voltage, enough to leap a quarter of an inch, at the end of a short antenna. I discovered this by burning myself with it on several occasions. I came up with the stupid and dangerous idea that I could burn the wart with this r-f the way a doctor would do with an electric needle. Remember I was only twenty and had no idea of the possible grave consequences.

"She was all for it; so, really hamming it up. I rigged up a wooden-handled ice pick for my 'needle' and got ready to operate. We were both laughing and giggling, and

when the little blue flame leaped to the surface of the wart she let out a bloodcurdling scream. Our voices vibrated the '45 tubes in the transmitter, and at least one of them must have been microphonic. A fellow ham a few blocks away tuned in to my carrier, and he could hear us laughing and giggling and her screaming, and he actually recognized my voice. He came pounding over to see what was going on and to find out how I made my CW transmitter put out a radiotelephone signal. I'm sure he was disappointed all the way around at what he found."

"Did the wart go away?"

"Strangely enough it did, although the r-f only burned a tiny white spot on the top of it. Probably rubbing it with stump water or castor oil or tying a horsehair around it would have achieved the same results."

**The Telephone Company.** "Another time the telephone company called and asked if they could run a loop from one of their long distance lines into my house so that I might decipher some high speed code that mysteriously appeared on that line every afternoon at precisely four o'clock. Naturally I was all for this, and they ran the loop into my ham shack just shortly before Christmas.

"At four o'clock, right on cue, the CW started. It was only about twenty words per minute, and I had no trouble getting it down on paper. Apparently it was concerned with bootlegging—remember this was in the prohibition era—and was placing orders for case lots of whiskey and gin and wine. It only lasted two or three minutes and seemed to be a one-way transmission. The telephone people told me there was no change in resistance on their lines to indicate a direct tap and that they had patrolled every foot of that line without finding anything wrong. They decided the freeloaders were using inductive coupling to put the message on the line and to pick it off, probably by simultaneously raising inductive couplers to the line at remote spots. They thanked me and took the message I had scribbled down for them. Two weeks later they called to say the code had disappeared. I don't think it ever reappeared."

"Ham radio really involved you in some interesting things."

**International Events.** "Yes, and on at least two occasions it gave me a front seat

on events of international interest. On that October morning, 1957, after the Russians put up Sputnik I, I hooked up with a German station. The operator had just come home after working twelve hours at a tracking station, and he was tremendously excited. He gave me almost the precise orbit of the little satellite, told me its operating frequencies, and described when it would be passing over the U.S. Armed with this information, I was able to tune in and record the lonely little beep-beep-beep close to WWV's frequency, and I still prize that recording. It was at least thirty-six hours before the news services published most of this information. I offered my information to our local newspaper, but they were afraid to print it because they had not received it over their news service wires.

"On the morning after the Anchorage, Alaska, earthquake of 1964 I contacted a station operating on emergency power at the hard-hit airport at Anchorage. The operator told me, 'Mac, I'm listening to what your radio stations are saying about the fatalities here, and they are grossly exaggerated. We have some people killed, but not thousands as they are saying. Be-

lieve me, I know what I'm talking about.' Again I relayed this to our local newspapers, but they were afraid to print it.

"When deadly tornadoes raked this state on Palm Sunday, 1965, I sat at the ham rig for thirty-six hours straight because one of the hardest hit areas was just twenty miles south of here. I've also worked in Ohio and Mississippi River floods, in Florida and Gulf Coast hurricanes, in blizzards, ice storms, and forest fires. Many times, unless I was sure I could help, I just listened; but always I felt as though I was *there*, right in the midst of the action, ready to help if needed. As you well know, it is often better for an emergency net to be controlled by a station entirely outside a disaster area. He has reliable power and good landline communications; he is not subjected to the hectic and emotion-charged conditions prevailing in the area; and, quite often, skip conditions enable him to copy clearly weak stations in the disaster area that cannot read each other.

"The point I'm trying to make is that ham radio is a hobby that has all the elements of romance, plus, as a big bonus, a chance to improve your electronics prowess." ♦

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**CIRCLE NO. 5 ON READER SERVICE CARD**



# BUILD AN IC LIGHT MODULATOR

CONTROL UP TO 1 KW OF LAMPS WITH A MINIMUM OF PARTS

BY EDWARD M. YANDEK

**L**IGHT modulators are becoming increasingly popular with college students, hi-fi buffs, electric guitarists, and other musicians. Such devices expand the auditory sensations of music into a pleasing visual experience as well. Usually, however, to buy a good commercial light modulator is fairly expensive; less costly models are generally low on sensitivity and must be used at high listening levels. The single-channel modulator described here is inexpensive, simple to construct, and very sensitive. It should be possible to buy the parts for this modulator (with a 1000-watt controlling capability) for about five dollars.

**Theory of Operation.** The input impedance of the primary of *T1* is in series with *R1* to insure that there is no adverse loading on the audio amplifier. The stepped-up secondary voltage is controlled by sensitivity potentiometer *R2* and applied to the IC input. The key to the sensitivity and simplicity of this circuit is the use of operational amplifier *IC1*, a 741. The gain of this stage is determined by the setting of feedback control *R6*, with respect to *R4*; while the input is protected against overvoltage by diodes *D1* and *D2*. The output of the op amp drives the gate of the triac through *D3*, which prevents the triac input from going negative.

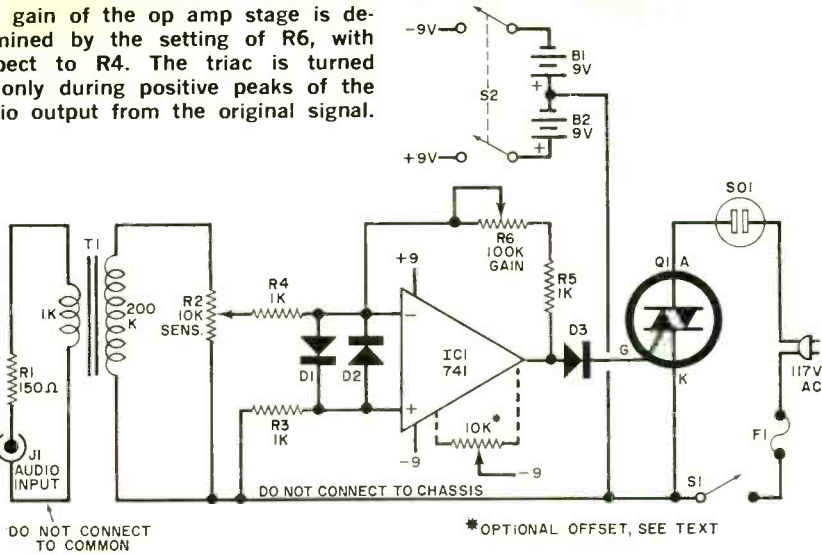
The triac, which operates on both halves of the line power cycles, is connected in series with the lamp load across the power line. Protection is provided by *F1*. Each time the gate of the triac goes positive, the triac fires and remains conducting until the voltage crosses through zero. Then the triac cuts off. The triac, therefore, is turned on only during the positive peaks of the audio.

**Construction.** Parts layout is not critical, and either a PC or perf board can be used. A socket can be used for the IC, and a heat sink is needed for the triac. Select a triac and fuse whose ratings are compatible with the lamp load being used. Keep in mind that the "common" circuit may be at power line voltage level, so *do not* use a chassis ground for this circuit. Terminal strips are used to make power connections. Also be sure that switch *S1* will carry the required current. For low-power operation, a line-isolation transformer is suggested. Both the op amp and the triac are available at low prices from advertisers in this magazine.

Mount the completed assembly in a plastic container with only the audio input jack, the shafts of *R2* and *R6*, and the two switches on the front panel. (*S1* can be part of *R2* or *R6*.) *Do not* connect the shield of *J1* to the common ground in the circuit.

**Adjustment.** Connect a short circuit across input jack *J1* and set gain control *R6* to the center of its travel. Connect a suitable lamp load to *SO1*, and turn on the modulator. The lamp should not glow. If it does, check the wiring of the circuit. If it is OK, then the op amp may require a slight offset to bring its positive-going output below that required to fire the triac. This is accomplished by the use of the optional offset circuit shown in dotted lines in the schematic. With the potentiometer connected between the offset terminals of the op amp and with its rotor connected to  $-9$  volts, the potentiometer can be adjusted until the light goes out. You can also use a low-voltage dc voltmeter (positive connected to the op amp output and negative to the common) to measure

The gain of the op amp stage is determined by the setting of R6, with respect to R4. The triac is turned on only during positive peaks of the audio output from the original signal.



### PARTS LIST

B1, B2—9-volt battery  
 D1-D3—Silicon rectifier diode  
 F1—Fuse and holder  
 IC1—741 op amp  
 J1—Phono jack  
 Q1—Suitable triac  
 R1—150-ohm, 1/2-watt resistor  
 R2—10,000-ohm potentiometer  
 R3-R5—1000-ohm, 1/2-watt resistor

R6—100,000-ohm potentiometer  
 SO1—Power socket  
 S1—Spst switch (may be part of R2 or R6)  
 S2—Dpdt or dpst switch  
 T1—Audio transformer; primary: 1000 ohms;  
 secondary: 200,000 ohms (Lafayette AR-100 or similar)  
 Misc.—Battery holders, terminal strips, mounting hardware, heat sink for Q1, line cord.

the op amp output voltage. It should be less than that required to fire the triac.

**Using the Modulator.** Connect the audio input to J1. (Use two modulators for a stereo system if desired.) Set R2 to minimum and adjust the speaker volume as desired. Turn on the ac power to the modulator; then turn on the op amp battery power. With R6 set at mid-position, slowly

turn up R2 until the lamp begins to pulsate with the audio level.

For increased sensitivity, rotate R6 toward its maximum resistance. If you make the circuit too sensitive, it will be "touchy" so use less feedback and more R2.

Due to the high gain of the op amp, interaction may result if there is an SCR light dimmer on the same ac circuit. Turn such devices off before using light modulator. ♦

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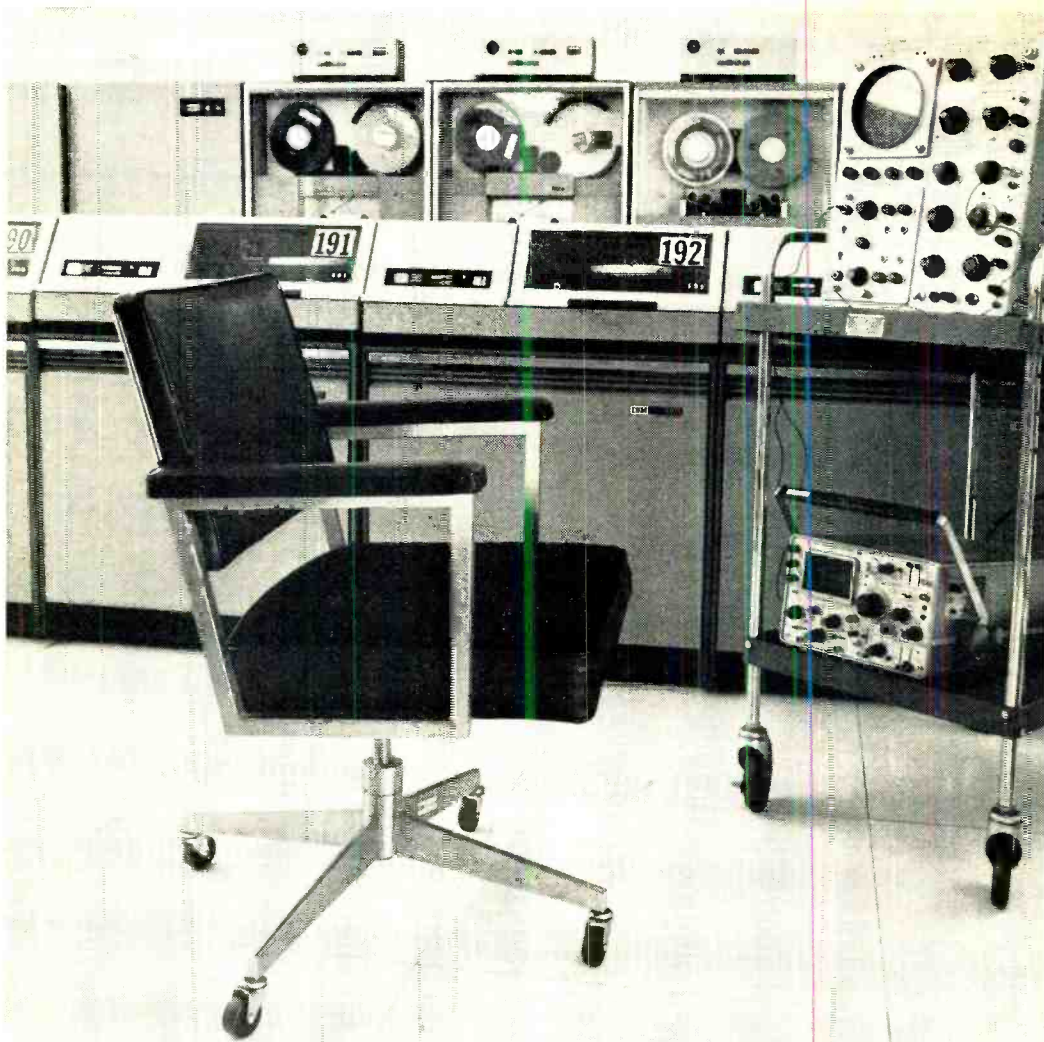
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CIRCLE NO. 3 ON READER SERVICE CARD

# Getting the Most from your Transmitter

SOME HELPFUL HINTS FOR THE HAM OR CB'ER

BY WILLARD R. MOODY, WA3NFU

**T**HE POWER rating of your transmitter is one thing; but the amount of r-f that gets off the antenna is what counts. The rest is actually wasted.

The easiest way, in many cases, to make r-f power measurements, is to connect a calibrated r-f wattmeter to the transmitter output. The commercial r-f power meter is pretty expensive, however, for the occasional user, so it helps to have an inexpensive, easily usable device for making r-f power measurements. Once the output is measured, steps can be taken to improve efficiency.

The circuit shown in Fig. 1 is that of a commercial wattmeter, which is essentially a dc voltmeter connected across an appropriate dummy load whose resistance is the same as that required to terminate the transmitter properly. You can make your own wattmeter using the circuit shown in Fig. 2. The dummy load,  $R_L$ , should be a noninductive resistor of the correct resistance and of sufficient wattage to withstand the expected transmitter power. Since the dummy load must be noninductive (no reactance at r-f), a wirewound resistor won't do.

The complete package should be shielded to reduce r-f radiation to a minimum while tests are being made. The diode rectifier can be any high-frequency type, while the two resistors (one a potentiometer) are used to set the meter scale.

For meter calibration, assume an expected r-f power of 3.5 watts into a 50-ohm

dummy load (antenna). The measured voltage is equal to the square root of the power times the resistance, which, in this case would be 13.2 volts. Other voltage values for other r-f power and/or terminating resistors can be calculated and the meter (voltage calibrated) re-calibrated in watts.

If you have a VTVM which is accurate at low frequencies and fairly accurate at high frequencies, you can measure the power indirectly by measuring the r-f voltage and using the equation  $P = E^2/R$ , where  $E$  is the measured voltage and  $R$  is the terminating resistance. For the example given above,  $P = 13.2^2/50 = 3.5$  watts.

**The R-F Ammeter.** One of the handiest tools to have in making r-f power measurements and trimming up transmitting antennas is the r-f ammeter (usually a thermocouple type). Again assuming a 3.5-watt output into a 50-ohm load, the current is the square root of the power divided by the terminating resistance. The square root of 3.5 divided by 50 is about 0.26 ampere.

To use the r-f ammeter, connect it in series with the required dummy load as shown in Fig. 3. This will enable you to determine just how to tune the transmitter (and antenna network) to maximize the r-f output—the more current, the better. A table, or curve, can be plotted to relate antenna current to r-f power output.

Obviously, in the preceding calculations,

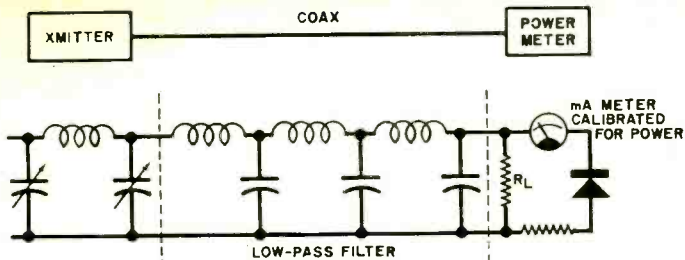


Fig. 1. A commercial power meter is a dc voltmeter measuring drop across a dummy load resistor. (Filter represents coax.)

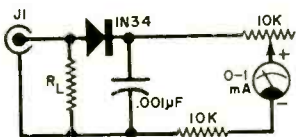


Fig. 2. In the homemade power meter, the potentiometer is adjusted to calibrate the meter.

between light levels to closely approximate the power output.

**Tuning the Antenna.** After testing with a dummy load, it is important to make sure that the maximum power is transferred to the antenna. This entails a proper impedance match for maximum power transfer.

you can use 52 ohms, 72 ohms, 300 ohms or other values in place of the one used in the example. Use the value suggested by the manufacturer for that particular transmitter. In the case of a pi-network output, which can work into a wide variety of antenna loads, use the load value for your antenna. In any case, tune the transmitter and any associated antenna tuning network for maximum power in the dummy load, since this means maximum voltage (for the voltmeter approach) or maximum current (using an ammeter).

If for some reason you do not care to use either approach, load the transmitter with

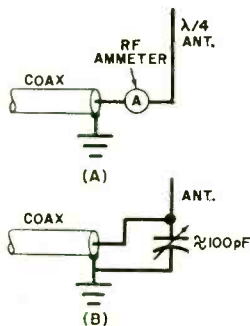


Fig. 4. Ammeter is used to check antenna current (A). A capacitor adjusts the antenna length (B).

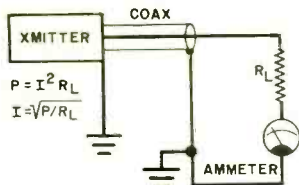


Fig. 3. Use an ammeter to measure the current flow through a dummy load to check the output.

an ordinary light bulb whose wattage is about the same as the expected r-f output of the transmitter and tune for the brightest glow. Using a similar bulb operating at its specified voltage, a comparison can be made

Assume that the transmitter is fed to a quarter-wavelength vertical antenna provided with the proper radials and transmission line. Connect the 50-ohm dummy load at the antenna end of the transmission line (Fig. 4A). Connect the ammeter in series with it (at the base of the antenna) and tune the transmitter for maximum current. After this is done, connect the transmission line to the base of the antenna. The antenna should have a sliding portion for adjusting the length; or it may have a variable capacitor at the base (Fig. 4B) if the vertical is slightly longer than  $\frac{1}{4}$  wavelength. A capacitor value of about 100 pF (at the appropriate voltage rating) can be used



ere. The capacitor is adjusted for maximum antenna current (at the base).

Theoretically, the resistance of a  $\frac{1}{4}$ -wavelength antenna (measured at the base) should be 37.5 ohms. The ratio of 50 to 37.5 gives a measure of the mismatch between the transmission cable and the antenna impedance. This comes out to 1.33:1; and although 1:1 is desirable, anything less than 3:1 is acceptable.

Refinements in impedance matching for a single operating frequency can be made by removing the center lead of the coax from the antenna connection lug (leaving the braid at the ground point) and sliding it up from ground until the meter indicates maximum antenna current. This approach is best done with a field-strength meter located several wavelengths away from the antenna, and with a second person using either a walkie-talkie or telephone calling out the changes in field strength as the antenna is trimmed.

**Transmission Line Tests.** To determine how much power is lost in the transmission line, measure the transmitter power output with the dummy load connected directly to the transmitter antenna terminals. Then measure the power when the dummy load is connected across the far end of the transmission line, with the dummy load mounted very close to the portion of the antenna to which it will be connected. In the case of

a dipole, the dummy load is suspended from the center insulator. For a base-fed antenna, the dummy load is placed near the base connection points. The difference in measured power between the two tests will show just how much power is being lost in the transmission system.

(In using the above technique, neither the dummy load nor transmission line is connected to the antenna itself.)

If you are making measurements on a dipole antenna, then, by inserting the r-f ammeter in each leg of the transmission line, you can trim each side of the antenna for maximum current. These measurements can be made at a low r-f level to avoid r-f burns or transmitter damage in the event of accidental shorts. With a power of 1 watt and a center impedance of 70 ohms, the current at the center of the dipole would be 0.12 A. This is based on the premise that the antenna center impedance is almost 70 ohms but can vary due to height above ground and other conditions. It is preferable to use a balun so that the transmission line will not be unbalanced at the antenna feed-point. An SWR bridge and/or a field intensity meter can be used to make the measurements much easier.

It should be noted that every facet of r-f measurements cannot be covered in this brief article; but the role of the r-f ammeter deserves this attention since current is a fundamental parameter. ♦

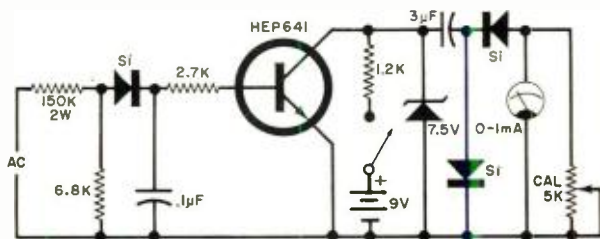
## YOUR OWN FREQUENCY DEVIATION METER

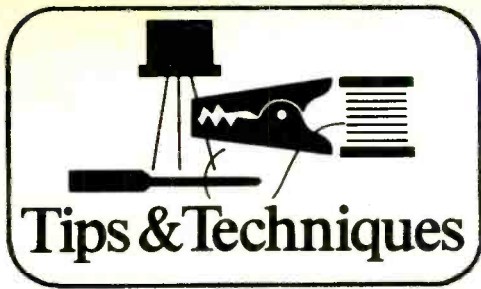
ONE OF THE major problems with 117-volt alternators driven by gasoline engines is that the nominal 60-Hz output frequency may change drastically with engine speed or loading.

Conventional frequency deviation meters are expensive and are not used often enough to warrant their price. These are the vibrating reed types of meters.

If you have a well-stocked spare parts box and are handy with a soldering iron, you can easily put the circuit shown below to good use. Construction can be made on either perf board or a small PC board can be easily designed.

Calibration is simple. Using the commercial 60-Hz power line (which is usually accurate enough for calibration) as the ac input, adjust the calibration potentiometer for a meter indication of 0.6—which will correspond to 60 Hz. You can measure between 1 and 100 Hz.

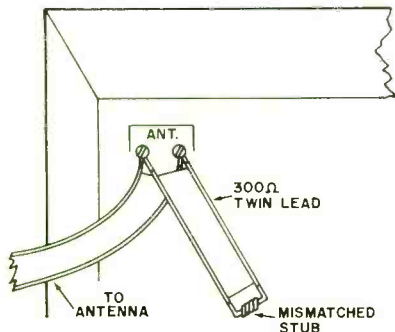




# Tips & Techniques

## TWIN-LEAD CHASES AWAY TV GHOSTS

Rattled by TV "ghosts"? Here's a way to tackle the problem with the aid of a 36" length of 300-ohm twin-lead and a razor blade. Tune the receiver to the channel on which the problem



is most severe. Strip away the insulation from one end of the twin-lead and connect the freed wires to the antenna terminals, without removing the antenna. Now, using the razor blade to cut through the insulation and short together the wires of the twin-lead, work from the free end toward the antenna terminals until the ghosts disappear or are reduced to a minimum. Then clip away the excess twin-lead and twist together the conductors.

—T.R. Roberts

## NAIL CLIPPERS MAKE BETTER CUTTERS WHEN WORKING ON PC ASSEMBLIES

A heavy-duty toenail clipper becomes a handy tool on your workbench if you do a lot of printed circuit board work. Wires and component leads protruding through the foil side of the boards should be trimmed away as close as possible to the foil pattern after soldering. Diagonal cutters are generally inadequate for the job, but the flat cutting blades of a toenail clipper let you trim as close as you want. And if you use #22 insulated hookup wire, you can even cut notches (just large enough to sever the insulation without nicking the wire) in the cutting edges to make a handy wire stripper.

Cut only copper wires and leads with the clipper; anything harder will turn the blades' edges.

—R.A. Dormer

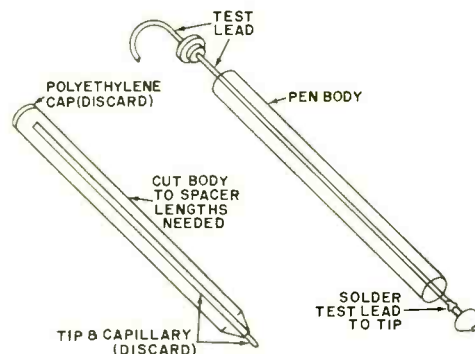
## RIGID POLYSTYRENE FOAM MAKES HANDY KIT-BUILDING AID

Rigid polystyrene foam—available from many hobby shops and florists in block form—is a great boon to the kit builder who wants to keep track of his components. Small parts like resistors, diodes, capacitors, etc., can be "plugged into" the foam blocks where they will be ready for instant identification and use.

—Peter R. Stone

## "BIC" PENS MAKE DANDY TEST PROBES AND PLASTIC SPACERS

Most of us throw away our Bic ball-point pens when the ink runs out; but this is a mistake. By saving the clear-plastic (hexagonal-barrel type) pens, you will always have a supply of no-cost plastic spacers and test probes. To make the spacers, remove and discard the filler assembly

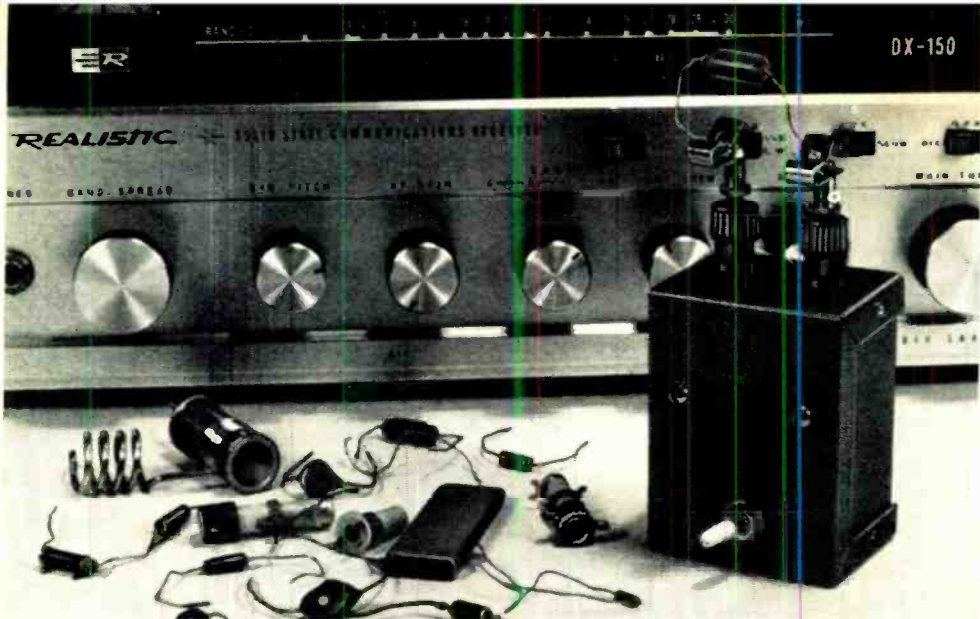


and polyethylene cap and cut the barrel to the lengths needed. To make the probe, save everything but the cap that fits over the point and the plastic capillary fastened to the point. Soak the point in acetone or lighter fluid to remove ink. Drill a hole large enough for the probe cable through the small end cap, solder the wire to the pen point, and reassemble the pen.

—L. H. Wells

### TIPS WANTED

Do you have a "tip" or "technique" that might help your fellow readers? It may be worth money to you. Send it in (about 100 words, with a rough drawing and/or clear photograph, if needed) and you'll receive payment if accepted. Amount depends on originality and practicality. Material not accepted will be returned if accompanied by a stamped, self-addressed envelope. Send material to: Tips and Techniques Editor, POPULAR ELECTRONICS including Electronics World, 1 Park Ave., New York, NY 10016.



# QUICKIE INDUCTANCE CHECKER

Two-transistor circuit measures r-f inductance using a conventional shortwave receiver.

BY J. A. ROLF, K5JOK

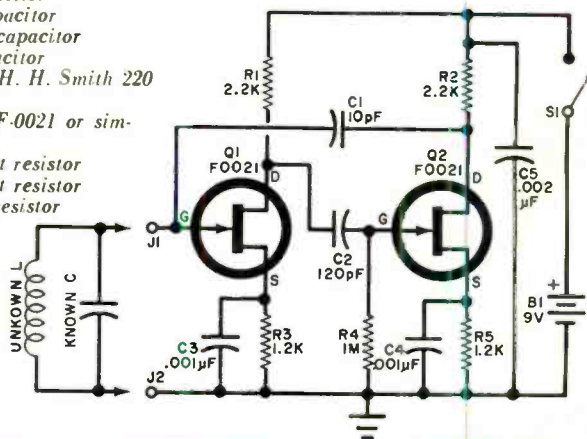
**H**AVE YOU ever bought one of the bargain packs of r-f chokes and coils and then wondered what you had? Or, have you tried to wind coils for a project and weren't sure whether you had the right value of inductance? If so, you're typical of many experimenters and you will find this "quickie" inductance checker very handy. It will measure (with the aid of a shortwave re-

ceiver r-f inductance from 0.3  $\mu$ H to 7 mH. The inductance checker is a two-terminal oscillator with low input capacitance. When an unknown inductance and known capacitance are connected in parallel across the two terminals, the circuit oscillates at the resonant frequency. Once this frequency is determined by a shortwave receiver, it is a simple matter to find the unknown value

## PARTS LIST

- B1—9-volt transistor battery
- C1—10-pF, 5% silver mica capacitor
- C2—120-pF, 5% silver mica capacitor
- C3,C4—0.001- $\mu$ F disc ceramic capacitor
- C5—0.002- $\mu$ F disc ceramic capacitor
- J1,J2—Five-way binding post (H. H. Smith 220 or similar)
- Q1,Q2—JFET (Motorola HEFP-0021 or similar)
- R1,R2—2200-ohm, 10%, 1/4-watt resistor
- R3,R5—1200-ohm, 10%, 1/4-watt resistor
- R4—1-megohm, 10%, 1/4-watt resistor
- S1—Spst switch
- Misc.—Enclosure, (see text), battery clip, perf or PC board, mounting hardware etc.

Fig. 1. Frequency of FET oscillator is determined by the unknown L and known C.





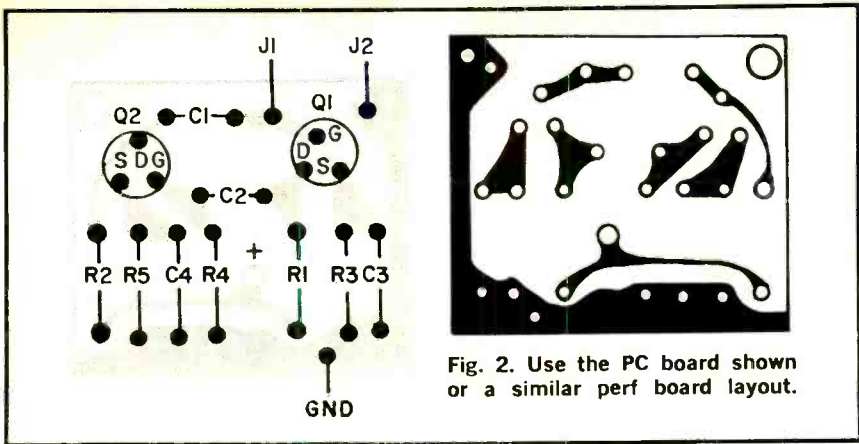


Fig. 2. Use the PC board shown or a similar perf board layout.

of inductance, either by calculation ( $L=1/4\pi^2f^2C$ ) or by using a resonance chart.

The schematic of the circuit is shown in Fig. 1. Two JFET's are used in a simple feedback configuration that provides a two-terminal resonant circuit with high input impedance and low shunt capacitance. The oscillator will operate from below 600 kHz to above 30 MHz, and with only two standard capacitors (10 pF and 100 pF), a resonant frequency within the range of most SW receivers can be obtained with inductances from 0.3  $\mu$ H to 7 mH.

**Construction.** The simplicity of the circuit allows compact construction in a small (2 $\frac{1}{4}$ " by 2 $\frac{1}{8}$ " by 1 $\frac{3}{8}$ ") Minibox (Bud CU-2100A). A small perf or PC board, mounted in the bottom of the box, is used to hold all components except the on/off switch, batteries and terminals. Component layout for the PC board is shown in Fig. 2.

The construction is not critical, though it is important to keep all leads as short as possible. The perf or PC board is positioned in

the box so that the lug of J1 connects directly to the proper board terminal. Note that J2 does not have to be insulated from the box.

**Operation.** Any known capacitor between 10 pF and 100 pF can be used with an unknown inductance, though 10- and 100-pF silver mica capacitors make the arithmetic easy. Connect the unknown inductance and known capacitor across the terminals and turn on the power switch. Tune the SW receiver until the oscillator is heard. It puts out a healthy signal which can easily be identified by placing your hand near the tuned circuit and listening for frequency change.

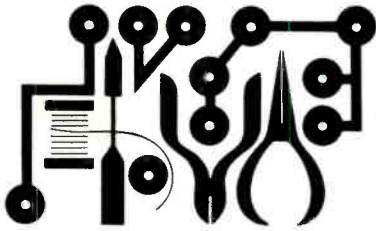
A 10-pF capacitor will resonate at 30 MHz with a 3- $\mu$ H inductance and at 600 kHz with a 7-mH inductance. With a 100-pF capacitor, resonance will occur at 30 MHz with 0.3  $\mu$ H and at 600 kHz with 700  $\mu$ H.

To facilitate connections, two banana plugs fitted with clips can be used, though care should be taken to keep leads as short as possible to minimize stray capacitance. To establish the range of an inductor with a variable capacitor, connect the variable capacitor and coil across the terminals and tune from minimum to maximum capacitance.

In fact, you can fashion a separate interconnecting box containing a calibrated variable capacitor and inductance to make a simple but useful r-f signal generator. A small transistor-receiver capacitor and a suitable loopstick coil can be used for a 500-to-1500-kHz generator. The harmonics between 500 and 1500 kHz can be heard well above 30 MHz.  $\blacklozenge$

Prototype photo shows general layout.



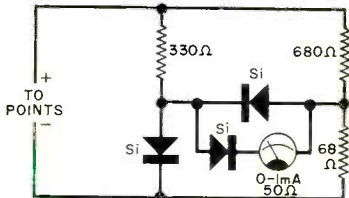


# Hobby Scene

## Check Engine Points

**Q.** *Is there some way I can check the closed resistance of the points in my car engine? My ohmmeter doesn't go that low.*

**A.** You can use the circuit shown here to measure the small voltage drop across the points. If you assume that the first 10% of the meter range (very low voltage drop) indicates a good set of points, then indications above this mean poor closed contact resistance. This dynamic testing circuit senses only the low-voltage drop and ignores the points' open time. If the meter remains in the lower 10%, all is well. If the meter "wanders" about, you may have troubles. Use between 500 and 1000 rpm of the engine.

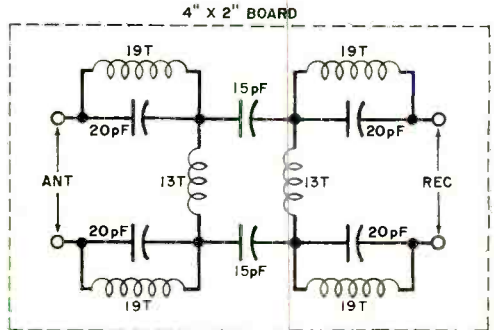


## CB vs TV Antenna

**Q.** *My CB rig is an excellent unit and has all the best features, including TVI filtering. Because the CB antenna shares the same small roof as our TV antenna, when I use the CB, TV reception is destroyed. Is there some way that I can use the CB yet allow my family to watch TV at the same time?*

**A.** Try the filter circuit shown below. It is connected between the TV set and the antenna, preferably as close to the tuner as possible. The parts are arranged physically as shown and all components are cemented to a small piece of perf board. All coils use #24 enamelled wire. The 19-turn coils are wound on 7/16" by 3/16" by 11/16" wood or plastic forms with spacing of one wire diameter. The 13 turn coils are wound on

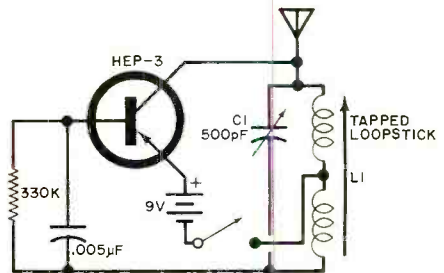
10-megohm, 1-watt resistors (or 3/4" diameter wood dowel), also with one-wire diameter spacing.

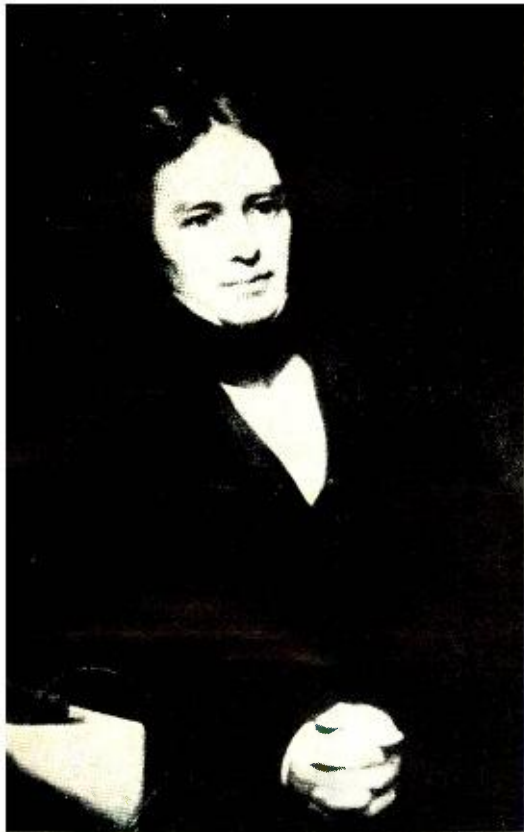


## Copying Morse Code

**Q.** *I have been an SWL for several years, and now want to try my hand at copying some of the Morse code stations I hear. Since I don't want to meddle with my SW receiver, is there an external beat frequency oscillator I could use?*

**A.** The circuit shown below is a simple r-f oscillator operating at 455 kHz (the usual i-f of most SW receivers). To set it up, couple the output of the bfo to the antenna terminal of your set, tune in a station, and adjust *C1* or *L1* for the most pleasing tone. In fact, *C1* can be a made a front-panel bfo adjust. Build the circuit in a small metal box, with a short length of insulated wire for the antenna.





# FARADAY AND ELECTROSTATIC LINES OF FORCE

*By David L. Heiserman*

**A**S A BOY in the early 1800's, Michael Faraday hardly looked the part of someone destined to grow up to become one of the world's most productive scientific geniuses. The son of a poor London blacksmith, Faraday spent much of his boyhood standing in welfare lines waiting for food. Out of sheer desperation, his family permitted him to drop out of school at age 13 to earn his own way as an errand boy in a bookstore. For young Michael, leaving school was no great loss since he had no fondness for school.

Faraday soon found that he had a liking for books, especially the ones about popularized science. Fortunately, his employer was an understanding man who allowed the boy to read between errands and janitorial duties.

One day a customer gave Faraday a ticket to a lecture that was to be given by the eminent British scientist, Sir Humphrey Davy. Owing to his reading, Faraday understood most of what Davy said at the lecture. He also managed to take down an incredibly complete and accurate set of lecture notes. A few days later, he copied the notes into a booklet and mailed them to

Davy, along with a request for any kind of a job in the scientist's laboratory. Davy was impressed and flattered and offered Faraday a job as bottle washer in his chemistry lab.

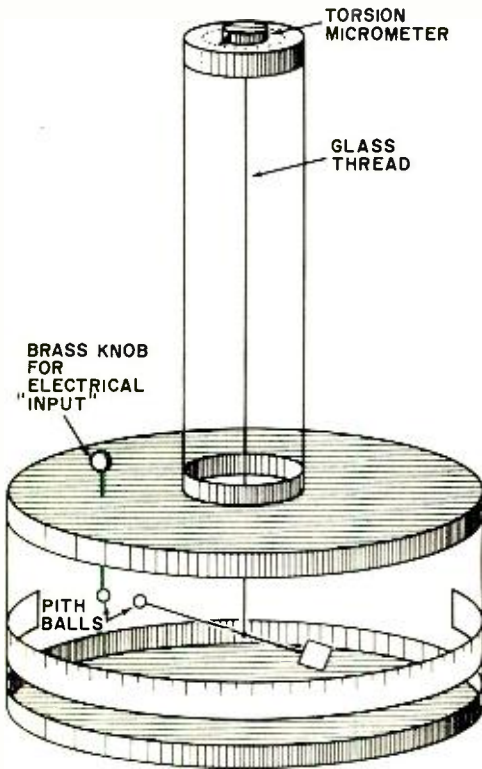
**The Scientist Emerges.** Faraday's abilities and enthusiasm soon prompted Davy to promote him to research assistant. After that, Faraday's list of accomplishments makes most success stories seem uneventful. By the time he was 30, he had worked his way up to being one of Europe's most popular experimenters and lecturers. Almost entirely self-taught, Faraday conducted his own experiments in chemistry and electricity with a genius and precision that surpassed that of most scientists of his time. He had no liking for mathematics, but he made up for the deficiency by drawing elaborate analogies between everyday situations and his abstract theories.

In 1831, Faraday began his famous series of experiments that eventually led to his discovery of electromagnetic induction and the invention of the first electric motors and generators. It was only his lack of mathematical sophistication that prevented



Faraday from becoming the discoverer of radio. Clerk Maxwell, a more mathematically minded investigator, later used Faraday's principles to formulate the basic equations for electromagnetic waves.

Ever in search of new knowledge, Faraday by 1836 returned to the electrolysis experiments he had once shared with Davy. By placing sheets of metallic foil on opposite faces of a block of ice, he demonstrated that no current could flow through the ice until it melted. To the contrary; the ice seemed to gather and store an electrical



**The Coulomb Torsion Balance.** The instrument is initially calibrated by turning the torsion micrometer so that it reads zero when the two pith balls just touch. Placing an electrical charge onto the pith balls makes the suspended ball rotate away from the fixed one. Faraday rotated the torsion micrometer until the charged pith balls were exactly 20° apart, then he recorded the number of degrees and minutes he turned the micrometer knob. By knowing the torsion constant of the glass thread, it was possible to calculate the amount of force and, hence, the amount of the electrical charge that was on the balls.

charge. But once the ice melted, current began to flow and decompose the water into its fundamental elements of oxygen and hydrogen. While this experiment was popular among professional and amateur experimenters of the time, Faraday saw some important features in it that others had overlooked.

The idea that current-carrying conductors produce a magnetic field had served him quite well in his work with induction; so, he proposed the existence of another kind of field—an electric field—to explain the storage quality of ice and all other kinds of nonconductors. In his laboratory notes dated December 23, 1836, Faraday describes a new kind of apparatus for studying the relationships between different types of insulating materials and their “inductive capacity.”

Faraday built devices made of two hollow airtight brass spheres. One of the spheres was small enough to fit inside the other, leaving ½ inch of space all around for inserting different types of insulating gases or solids. He suspended the smaller sphere inside the larger by means of a glass tube. A wire running through the glass tube provided electrical connection to the inner sphere.

The outer sphere was mounted on a stand equipped with a valve that let him evacuate the space between the spheres or fill the space with different kinds of gases. He also fashioned a mold for forming solid materials that would perfectly fit into the space.

With this apparatus, Faraday was able to construct a “spherical” capacitor whose plates he could separate with any type of dielectric material of his choosing. His main idea was to compare the “inductive capacities” (a term now known as “dielectric constant”) of different insulating materials by charging the spheres with a static potential and measuring the amount of charge they acquired.

To measure the stored charges, Faraday used a sensitive torsion balance invented by Coulomb. This apparatus consisted of a thin lacquered straw about the size of a toothpick suspended at right angles from a length of fine glass thread. Minute forces applied in the proper direction to one end of the straw made the straw twist about the thread. By measuring the angle of the twist, an experimenter could calculate the actual amount of applied force.

To make the torsion balance sensitive to electrostatic charges, Faraday attached a small pith ball to one end of the straw. He attached a piece of paper to the opposite end to serve as a damper for the mechanical oscillations and act as a counterweight. Another pith ball, fixed to the frame of the balance, carried test charges to the space around the ball on the straw. Charging the fixed pith ball made the movable one rotate through an arc Faraday measured by means of a piece of paper scribed with units of arc in degrees and minutes.

In his experiments, Faraday would place a dielectric material between the spheres, charge them with a static voltage, and measure the amount of charge with the torsion balance. He also kept track of how fast the charges leaked off the spheres, discovering that different materials took on different amounts of charge. Spheres separated by glass, for example, took on larger charges and held them longer than did spheres separated by air or hydrogen. This confirmed his suspicion that different insulating materials have different "specific inductive capacities."

What is more important, these experiments backed up his theory of electrostatic lines of force and cleared up a longstanding problem concerning charged insulators. Other researchers believed that the metallic plates and not the dielectric between them held the stored charges. By demonstrating that electrostatic lines of force within the dielectric—not the plates—held the stored charge, Faraday cleared up a prevalent misconception.

**The Perfectionist.** Since Faraday did not like to bother with mathematics, he was content to explain his findings in terms of pictures which showed lines of force more concentrated in some materials than in others. His data was so accurate and complete that other scientists incorporated his notion of "specific inductive capacity" into formal equations that stand to this day.

Faraday's notes indicate that he often mistrusted the readings he obtained from the torsion balance. To convince himself, and many critics as well, that the amount of charge stored within different types of materials was really different, he frequently used two identical sets of hollow spheres. He would charge one set, measure the charge with the torsion balance, and then touch the charged set of spheres to an un-



**A Faraday Sphere.** Faraday used this piece of equipment to determine the "specific inductive capacity" (which we now call the dielectric constant) of different types of insulating materials.

charged set. Whenever the two sets contained the same type of dielectric, they divided the original charge equally. But when one set of spheres contained a better dielectric than the other, the set with the better dielectric took on a large percentage of the original charge.

The scientific community accepted Faraday's theories and experimental results with enthusiasm. As a result of his work with dielectric lines of force and dielectric materials, the 1891 International Electrical Congress voted to name the electrical unit of capacitance, the "Farad," in honor of Michael Faraday. ♦



# Test Equipment Scene

By Leslie Solomon, Technical Editor

**A**FTER a hard day's work at the test bench—checking, adjusting, replacing—we usually feel that the gear we've been working on is just as good as (if not better than) it was when it left the factory. The other day, for example, we had just finished the alignment of a color TV receiver and everything, but everything, was right on the money. This was, undoubtedly, the best color set ever.

Then we took the set to its normal home, converged it, set the controls, and turned it on. A critical viewing of the picture left us with a nagging feeling. Something about the picture was wrong. We just couldn't put into words what it was; and then, bingo, the little light bulb over the head came on.

For years, we TV types have memorized the magic number: 525. This is the number of horizontal scanning lines per frame transmitted in the USA. This works out to 262½ lines for each interlaced field because that is the way the signal is transmitted. The key word here is *interlaced*. After looking at this set, and many others, both color and monochrome, we have come to the conclusion that interlace may be in the dictionary but it's forgotten about when it comes to TV.

Most TV sets are adjusted so that their sweeps (horizontal and vertical) are as stable as possible for the best viewable picture. In the majority of cases, the most stable setting for the vertical sweep is in a condition known as "line pairing." This is where the scanning lines forming one field lie directly behind the scanning lines of the other

field. This, of course, is quite different from interlacing. In many receivers, if you try to set the vertical sweep to produce a clean interlace, the instant you let go of the vertical speed control, the line pairing reappears. To make matters worse, it often seems that the best interlace occurs at the point where the vertical sync is on the verge of "rolling."

What does this mean? You guessed it. The best that many TV receivers can reproduce is 262½ lines—or less. What does the "or less" mean? Well, it takes a discrete amount of time for the electron beam to whip from the bottom of the raster to the top—at the demand of the vertical sync pulse. During this interval, horizontal sync pulses are transmitted to keep the receiver horizontal oscillator in step while the retrace transition is taking place. A number of horizontal lines is lost during the retrace, and most of these appear as a black bar between the frames. (Roll the vertical down a bit on your receiver and you will see this.) There is no specified number of lines lost since the FCC standard calls for between 13 and 21 lines per field in this interval. Most stations, especially networks, use these "invisible" lines to transmit the VITS (vertical interval test signal) which appears as various arrangements of white dots and dashes in the black horizontal stripe. These dots and dashes represent a great variety of test signals, including chroma, but this is not our concern at the moment.

If you start to add things up, you come to the conclusion that the 525 lines you carefully memorized, turns out to be 262½ lines (due to pairing), minus approximately 21 lines (due to retrace), leaving a total of 241½ lines that most TV receivers are producing.

The answer appears to lie in the manner in which the vertical integrator is triggered. The longer vertical pulses keep "piling" up a charge on a capacitor, until the level is

## Untestable Factors



high enough to trigger the associated vertical oscillator. Due to the borderline triggering conditions of many vertical oscillators, there is a hazy triggering point, with the result that maximum stability occurs when the lines are pairing.

The previous information does not mean you should be overly critical of your TV set; but it points up one area where test equipment does not help and shows what can happen when you keep your eyes (physically and mentally) open.

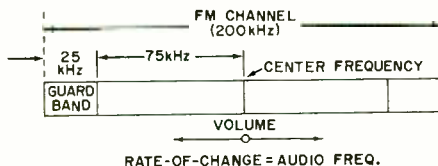
**Stereo Problems.** In the same vein as the TV discussion above, let's consider the alignment of a stereo-FM receiver. In this case, everything was checked and put in apple-pie order; but there was a complaint later that some stations, that came in nicely when transmitting mono, dropped in signal strength when they went to stereo. This, of course, is aggravating when the set owner expects good stereo from that particular station. What are the factors involved here?

First, you must understand a little about FM modulation. As you know, the signal from an FM transmitter is of constant amplitude, while the modulation from the program source (records, tape, or live) varies the rate-of-change of the carrier's swing about its assigned channel frequency in the FM band. The higher the modulation frequency, the faster the rate of change; and conversely, the lower the modulation frequency, the slower the rate of change.

How, then, is the volume determined? The answer to this is that the amplitude of the received signal is a direct function of the amount of frequency swing to each side of the assigned carrier frequency. A soft (in volume) passage means a small deviation in frequency, while a loud passage produces a wide swing. If you stop and think about the familiar "S" curve of a ratio detector or discriminator, you will note that the two peaks of the linearly sloped curve are at

some frequency above and below the actual i-f frequency. At exactly the i-f frequency, there is no output; and this is one reason why an FM receiver finds it difficult to demodulate an AM signal.

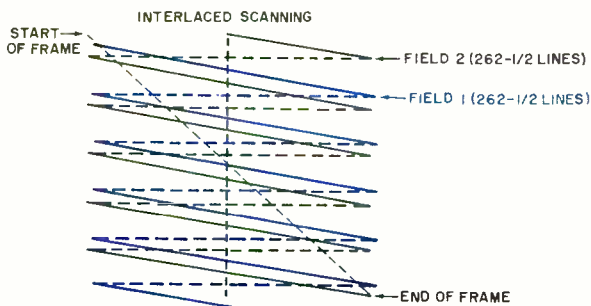
As the deviated FM signal rides up or down the slope toward the peaks, the recovered audio level becomes a function of how far the carrier is deviated toward the peaks. Now you can see that a wide deviation means high audio levels.



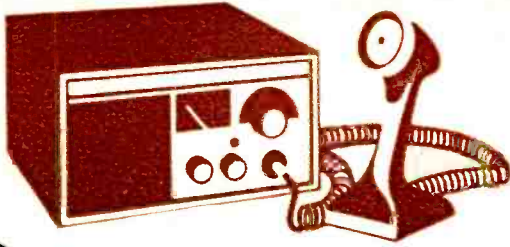
**Swing of FM channel is reduced (lowering volume) to carry stereo and SCA sidebands.**

To enable a monophonic FM transmitter to accept another signal—the stereo L-R in this case—the new signal must be inserted in such a way as to leave the base signal (L+R) intact in the interests of mono-stereo compatibility. To do this within the assigned channel space, the deviation of the main carrier must be reduced to leave spectrum space for the added signal. This, of course, means that the deviation level of the main signal is lowered; and this accounts for the reduced volume of the received main carrier. The L-R signal (38 kHz), the pilot carrier (19 kHz), and the SCA signal (if used), plus the necessary guard bands occupy the remainder of the space between the edges of the main (L+R) signal and the limits of the assigned channel.

What does all this mean to the service technician? He has to take a little more care in getting the maximum sensitivity and reducing front-end noise; and he has to consider higher gain antennas when this type of complaint is received. ♦



**A TV frame consists of two interlaced fields, each consisting of 262 1/2 lines as shown here. With the proper interlace, the "weave" of the raster is tight and a smooth picture is displayed. If there is any pairing (one field directly behind the other), the scanning lines in the raster are visible.**



# CB Scene

By Matt P. Spinello, KHC2060

IT IS rather doubtful that the Federal Communications Commission will order a 12', colorfully decorated cake in the shape of a super-selective, SSB transceiver, from which a mini-clad model rockets upward on a given signal, walkie-talkie in hand, in celebration of CB radio's 15th birthday this month. Nor are FCC Commissioners likely to don funny hats in the nation's Capitol and rattle noise-makers in honor of the anniversary. It is felt however, that there are a number of Commissioners on board the Citizens Band wagon rooting for its survival and growth ("CB Scene," July 1973) and willing to work with CB'ers to solve the problems that exist on 11 meters.

CB veterans of the late 50's and early 60's will recall that, to get on the air inexpensively at the out-set, a licensee had two choices: a Benton Harbor lunch box (title given the first Heathkit CB rig), or a brown bag of parts procured from the local electronics distributor with a schematic diagram. Both designs were tube models. Base station antennas were flimsy compared to today's highly selective and improved versions; and mobile antennas were bulky. An awkward 102" whip might tear off your rear fender if you hit a low tree branch.

If a CB'er had the bucks, as early as 1960, he could purchase the first transistorized walkie-talkie manufactured, from Globe Electronics, Council Bluffs, Iowa, for \$250. The transceiver was pocket-sized,

was limited to 100 mW of power and had a very limited range. About the same time, the RME4303 walkie-talkie, housed in a long, rectangular metal box, in military khaki, made its bid for the marketplace from Radio Manufacturing Engineers, Washington, Illinois. The 4303 was a reliable unit with a single-channel, crystal-controlled transmit stage and a fully tuneable receiver for all 23 channels.

The BC603, an army tank-type receiver, was popular with early CB'ers. It sold as surplus from \$6 to \$12; you made your own power supply. Although compact in size, it was referred to on the air as "IHE" (instant hernia equipment). The unit weighed about as much as a brick-filled footlocker.

Out of transistorization grew miniaturization, and from the gadgetry, gimmickry and major improvements made along the way evolved today's CB nation which a new licensee can join by choosing from a selection of over 200 models of equipment, priced from under \$50 for a complete mobile system to as high as \$800 for the ultimate in base station operation. There is no fair comparison between the two eras. Today's industry offers much more stable, rugged, pint-sized productions than most dreamed possible 15 years ago. The CB'er of the 70's can select the system that will serve his needs well.

**Monitour Report.** CB Scene's Monitour (monitoring tour; May issue, page 97) continues this month with visits to five more U. S. cities. Monitour reports are the result of in-person, on-site monitoring of the CB channels by your editor, with statistics gathered from a minimum of 50 calls in each area.

*Chicago, Illinois.* Surprisingly, while most channels were "hyperactive", Chicago was not plagued by the percentage of code names more commonly in use in New York

## CB Has a Birthday

and Kalamazoo as reported after our initial tour. But the legality or necessity of most conversations may have been debatable depending upon who sat as judge.

Heaviest activity, with overlapping carriers, was encountered on channels 4, 7, 11, 15, 17, 21 and 23. Someone using walkie-talkies (inaudible to us) was asked to leave channel 9, the national emergency channel. They apparently complied and channel 9 stood silent for the next hour. Then, for the next 45 minutes the area REACT monitor handled four assistance calls for directions, one for an overheated vehicle and relayed the report of an accident on the John F. Kennedy Expressway to the Chicago Police.

*Denver, Colorado.* Back to name-calling! The first transmission intercepted came across like a 5,000 watt p.a. system at an outdoor rock festival with "Dog Man" in Florida calling Denver. He undoubtedly was barking up the wrong tree; no one answered! Luckily for Denver, the dog faded into oblivion within two minutes.

A number of business firms are using CB radio in the Denver area on channels 2, 4 and 6. Chit-chatters like "Rice Wagon", "Window Washer", "Model-T", "Rubber-lips", "Crawfish", "Red Baron" and "Wiggle-worm", confine their illegal activity to channels 18, 19 and 20.

During a discussion with Herb Banister, local CB'er and super television technical director, we learned that activity is extremely high in Denver, and that CB radio is a must when tromping through wooded regions or unfamiliar ground up in the mountains. Many rescues of lost persons and those crippled by skiing accidents have been credited to the effective use of 5-watt walkie-talkies. Herb felt that legal activity "almost" broke even with illegal code names and chit-chat.

*Las Vegas, Nevada.* Not everyone in Las Vegas is at the gambling tables. There are a number of individuals without call signs running amuck on 11 meters. Channel 9 (giving the area some hope) remained silent. Heavy skip interfered on most channels, mainly interrupting illegal chit-chat. Channels 4, 11, 13, 20, 22 and 23 were jammed. Contributors to the congestion included "Mama Hillbilly", "Tinkerbelle", "Brown Eyes", "Lone Gopher", "Beachcomber" and "Six Pack".

A Mississippi skip station attempting to reach Las Vegas was covered by a local operator making a stab at California and

Oregon stations at the same time. One lonely channel 11 mobile after five minutes of frustration, finally cut through illegal garble, skip and a transmitter being tuned on the air to let his wife know he would be home in ten minutes.

Perhaps the FCC should give the West Coast field monitoring team a few silver dollars and an extended weekend in Las Vegas; CB operation there parallels the gambling timeclock: it continues 24 hours daily.

*Rockford, Illinois.* Home of Olympics gold medal winner Judy Lynn who does not use CB radio; also the home of famed Dixieland band leader Dave Remington who at one time used CB on the road, keeping in touch with his band via walkie-talkies in 3 or 4 automobiles. Dave is known for his quick wit and sometimes biting humor. His response when asked whether he still relied on CB to communicate with his troops: "Naw, the German shepherd ate one of the walkie-talkies, so we gave it up. But I still use the antenna to direct the band!"

On the serious side, Rockford has on-air problems common to every other major metropolitan city, but seems to be making an attempt at working them out. REACT controls channel 9 and the local team reportedly was highly commended for its volunteer work during the floods that hit the area in April. They handled communications, administered first aid and commandeered boats around the clock to evacuate families from their homes.

Channels 4, 5, 7, 9, 11, 12, 15, 19 and 23 were mostly occupied during our visit. The temptation to make contact with skip stations prevailed, but was generally unsuccessful. A code-namer assisted an Ohio motorist, then clearly identified himself with his code name, legal name, call sign, address, phone number and directions to his home.

**What's New?** So what's new with you, your club or emergency team? If you haven't registered with "CB Scene," now's the time before the snow flies. Chances are we'll drop by in a Winnebago Motorhome to eavesdrop on your next club meeting. As long as you're writing, why not include one of those photos of some of your club members shown actively engaged in public service activity. Our readers want to know what you're up to.

I'll CB'ing you!







## New Products

### LAFAYETTE 4-CHANNEL STEREO HEADPHONES

The Model F-4400 4-channel stereo headphones from Lafayette Radio Electronics feature a unique patented "baffle plate" that increases acoustic front-to-rear separation. The



phones consist of four separate  $2\frac{1}{4}$ " drivers, each in its own acoustically isolated air-tight sealed chamber. Special circuitry is built in and switchable for deriving 4-dimensional sound from 2-channel stereo program sources as well as delivering 4-channel sound from quadraphonic amplifiers and receivers. The adjustable headband and ear cushions are foam filled and covered with vinyl leatherette.

Circle No. 70 on Reader Service Card

### PACE SCANNING MONITOR RECEIVER

A programmable two-band uhf/vhf scanning monitor receiver—the Scan 216—covering 140-174 MHz and 450-470 MHz simultaneously is available from Pace Communications. It features a switching network that can be programmed for monitoring any combination of eight channels in the vhf or nhf bands. The Scan 216 is designed for both mobile and home use and, consequently, includes circuitry for powering from 12-volt dc as well as 117-volt ac sources. An exclusive feature is the use of a unique IC and FET transistor complement to provide the versatility of broad band adjustments while maintaining good selectivity and sensitivity.

Circle No. 71 on Reader Service Card

### RCA "MINI-STATE" TV ANTENNA SYSTEM

RCA has developed a truly miniaturized solid-state uhf/vhf TV antenna that can be installed in places unsuited for conventional outdoor antennas. The Mini-State antenna is highly directional and develops uniform response across the TV band. A unique preamplifier with interference filters has been designed into the antenna array to assure optimum transfer of signals to the TV receiver. The antenna array is mounted on a circular platform that can be electrically rotated 360° with the aid of the supplied remote control unit. (The antenna is also available without the rotator as the Model 5MS330.)

Circle No. 72 on Reader Service Card

### LEADER BATTERY-OPERATED VOM

A rugged multimeter with full protection against polarity reversal and overload is being offered by Leader Instruments Corp. as their Model LT-70. The VOM will read as low as 0.25 volt full-scale and 250  $\mu$ A on normal readings for measurements of small solid-state dc voltages and currents. LI scales are also included for measuring back currents as low as 75  $\mu$ A to check diode and transistor quality. Sensitivity is 20,000 ohm/volt on dc and 8000 ohms/volt on ac. The LT-70 will read as high as 40 megohms, 2.5 A ac and dc, 1000 V dc and 250 V ac, and -20 dB to +22 dB on the 10-V range and +20 dB to +36 dB on the 50-V range.

Circle No. 73 on Reader Service Card

### SANSUI STEREO AMPLIFIER

A professional-quality, state-of-the-art amplifier, the Model AU-7500, has been introduced by Sansui Electronics Corp. It features three



separate tone controls (bass, midrange, and treble) for accurate playback equalization; direct-coupled amplifiers, and two microphone, two stereo phono (with switchable impedance), tuner, and auxiliary inputs. Stereo outputs and inputs are provided for two tape decks, with a DIN socket wired in parallel for one of the decks. There are also inputs and outputs for a 4-channel adapter. The amplifier also has jump-erred preamp and main amplifier sections to permit the separate use of each section.

Circle No. 74 on Reader Service Card

### RADIATION TECHNOLOGY FASTENER SYSTEM

All manner of fasteners—including screws, rivets, plugs, etc.—can be made quickly from a new plastic developed by Radiation Technol-

ogy, Inc. The company's RAD Repair System consists of a number of nuclear-irradiated polyethylene rods with a "memory." The rods which come in various diameters, shrink to half their length and double in diameter with the application of heat. As the rod expands, it fills any void (up to its memory size) in which it is placed. If the void is a blank hole, a rivet or plug will be formed as the free ends expand. If the void is a nut, the interior thread pattern will be impressed on the rod as it cools; then the other end can be heated and a screwdriver blade pressed into the hot plastic to form the screw head. Prototype project builders will welcome this new product.

Circle No. 75 on Reader Service Card

### ACE AUDIO STEREO PREAMPLIFIER

The Ace Audio Company's "Basic Stereo Preamp" is a simplified control center designed without tone or balance controls. It can be used



alone for a true flat response of  $\pm 0.1$  dB from 20 Hz to 20,000 Hz, or with a graphic equalizer for complete tone control. Features include two slide-type volume controls; power, tapemonitor, input selector, and stereo/mono switches; and four accessory outlets, three of which are switched. The preamp is characterized by low-distortion performance and straight-through operation.

Circle No. 76 on Reader Service Card

### JFD TV/FM BOOSTER-COUPLER BLISTER PACKS

JFD Electronics Corp. is offering blister-packaged TV/FM signal booster-couplers. The packaging system has a two-fold purpose. First, it maintains the booster-coupler in factory-fresh condition. Secondly, on the front of the package there is a description of the purpose and benefits of using the coupler, while the back of the package provides complete instructions for installation by the buyer. Four models are currently blister packaged: PC4382BP for vhf/uhf TV and FM (one 300-ohm input, four 300-ohm outputs); PC4782BP, vhf/uhf/FM (one 75- or 300-ohm input/four 75-ohm outputs); PC4312BP, vhf/FM (one 300-ohm input/four 300-ohm outputs); and PC4712BP, vhf/FM (one 300- or 75-ohm input/four 75-ohm outputs).

Circle No. 77 on Reader Service Card

### ARCHERKIT 10" SPEAKER SYSTEM KIT

Hi-fi enthusiasts can assemble their own speaker systems with the Archerkit 10" speaker system from Radio Shack. The only tools needed for assembly are a screwdriver, pliers, and a soldering iron. The three-way speaker

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system consists of a ¾"-thick bass-reflex type enclosure, 10" woofer, 6" cone-type midrange driver, ¾" tweeter, and an electrical crossover network. Impedance of the system is 8 ohms, while frequency range is 40-18,000 Hz. Power-handling capacity is 40 watts peak. Included in the kit is walnut finishing oil. Enclosure dimensions are 9" deep, 14" wide, and 22" high.

Circle No. 78 on Reader Service Card

### HEATHKIT ENGINE ANALYZER

Now do-it-yourselfers can achieve professional-grade results on a budget by assembling Heath's Model CM-1050 engine analyzer. This instrument tests conventional, magneto, transistor,



and most capacitive-discharge ignition systems, regardless of voltage or grounding. It works with any 3-, 4-, 6-, or 8-cylinder engine, permitting rapid servicing of storage battery, generator or alternator, voltage regulator, starter, distributor, points, condenser, coil, accessories, and all electrical wiring. The instrument is battery-powered for complete portability. It comes with tune-up specifications book for all American-made cars and light trucks.

Circle No. 79 on Reader Service Card

### UNIVERSITY PAGING/OUTDOOR SPEAKERS

Two new paging speakers, the Models FID-8 and FID-T, have been added to the University Sound product line. The first is a reflex horn speaker with standard 8-ohm impedance, while the latter is similar but features a built-in 70/25-volt transformer and six screwdriver-selectable wattage taps. The horns are round and exponentially flared to prevent undesirable reflections within the horn. They are made from non-resonant, virtually shatterproof material and are designed to withstand severe environmental conditions, making the FID-8 ideal for use in outdoor environments such as on patios and around pools for listening from a conventional hi-fi system. The speakers are rated at 15 watts rms and have frequency ranges of 260-14,500 Hz.

Circle No. 80 on Reader Service Card

### PIONEER 4-CHANNEL STEREO RECEIVER

The Model QX-949 is the most complete and advanced stereo receiver offered by U.S. Pio-



neer Electronics Corp. A 4-channel unit, it features a CD-4 demodulator as well as RM and SQ matrix decoding circuitry. Hence, this receiver can decode and reproduce all 4-channel sources. Direct-coupled circuits deliver 40 watts rms/channel between 20 Hz and 20,000 Hz into 8-ohm loads. In 2-channel operation, it delivers 60 watts/channel into 8 ohms. The QX-949 can handle three tape decks for tape-to-tape duplication or a noise reduction system, two turntables, and an auxiliary source. Built into the receiver is a 4-channel level indicator that graphically displays on a CRT screen any adjustments made while listening to 4-channel sound.

Circle No. 81 on Reader Service Card

### HEP 7-SEGMENT DIGITAL READOUTS

Motorola's HEP Semiconductor division has just introduced a four-device, seven-segment digital readout kit—designated HEK-5—that retails for less than \$10 per kit. The kit contains "thought starter" projects, a booklet that includes basic information about readouts, their applications, and their capabilities. It also provides complete parts lists and schematics necessary for building specific interest projects, two of which are a digital clock and a digital stop watch. Kits are available from HEP suppliers throughout the country.

Circle No. 82 on Reader Service Card

### TOYO 2/4-CHANNEL SOUND CENTER

The Toyo Radio Co. of America, Inc., integrated Qaudio Model 742 sound center com-



bines a 4/2-channel cartridge player with a 40-watt AM/stereo FM receiver and automatic turntable with tubular pickup arm, Shure M75 cartridge and diamond stylus. The receiver features a built-in 4-channel decoder (matrix and ambience-recovery), a unique Qaudio "joy-stick" sound balance control system, and an illuminated "position scope" that lets the listener balance his four speakers for perfect listening anywhere in the room.

Circle No. 83 on Reader Service Card



## MIT'S POCKET CALCULATOR KIT SERIES

The new 1200 series of mini-calculators from MITS features a keyboard that employs key travel comparable to desk-top models. All three models in the series are battery-powered, and each has provisions for an ac converter. An automatic display cut-off is built in, to save battery life. The calculators perform the usual four arithmetic functions as well as mixed multiplication-division functions. The models available are the six-digit 1206, nine-digit 1209, and 12-digit 1212. All provide true credit balance and have additional indicators for display and calculation overflow. The readout system consists of seven-segment LED units.

Circle No. 84 on Reader Service Card

## REGENCY TWO-METER HAM TRANSCEIVER

The 12-channel Model HR-2B FM transceiver is the newest addition to Regency Electronics' line of 2-meter amateur products. Measuring only 2½" x 5½" x 7½", it is the smallest



multi-channel transmit/receive, high-power, 2-meter system currently available. Output power is 15 watts on any of its 12 crystal-controlled channels in the 144-148-MHz band. The receiver section has a sensitivity rating of 0.35  $\mu$ V, 20 dB of quieting, and 3 watts of audio output power, as well as a noise-compensated squelch system. The transmitter section features individual-channel trimmer capacitors and a built-in VSWR bridge limiter. The HR-2B is designed to operate from a 13.8-volt dc source. It comes with channel-1 (146.94-MHz) transmit and receiver crystals installed.

Circle No. 85 on Reader Service Card

## PEARCE-SIMPSON MARINE SCANNING MONITOR

Designed by boatmen for boatmen, the new Pearce-Simpson Cheyenne 8 marine scanning monitor receiver made by Gladding Corp. adds flexibility to any marine communication system. This ac/dc receiver will monitor any eight vhf channels of the user's choice simultaneously. It scans across the band, pausing to listen only when a signal is present. Position one is a priority channel: the receiver reverts to it any time a signal is present, even if the scanner has stopped to listen to a transmission on another channel. Each crystal position has a bypass switch that permits the user to temporarily cut out any particular channel.

Circle No. 86 on Reader Service Card

# Midwest Hifi

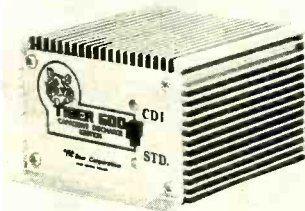
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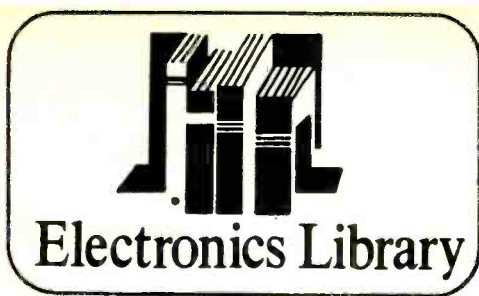
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## COMPUTER GLOSSARY FOR ENGINEERS AND SCIENTISTS

by *W.M. Chow & C.J. Sippl*

The phenomenal growth of computer technology and use compelled the authors to assemble this glossary of terms commonly used by computer specialists. The glossary is specifically aimed at engineers and scientists. Its intent is to provide an up-to-date, pertinent, and useful tool to assist engineers and scientists in breaking down the barriers in communications.

Published by *Funk & Wagnalls*, 666 Fifth Ave., New York, NY 10019. Hard cover. 246 pages. \$6.95.

## ANALYSIS OF ELECTRIC CIRCUITS

by *Frederick F. Driscoll*

This book provides an excellent introduction to the basic principles and practical applications of modern electronic circuit analysis. Its coverage includes: fundamental concepts; waveforms; elements, terminology, and laws; series and parallel circuits; addition of sinusoidal waves and complex numbers; complex impedance and admittance; impedance networks; transient response; tuned circuits; transformers; and harmonics and Fourier analysis. The text's treatment of electronics is thorough and will be particularly welcome to the advanced student.

Published by *Prentice-Hall, Inc.*, Englewood Cliffs, NJ 07632. Hard cover. 458 pages. \$12.95.

## AUTOMOTIVE TEST EQUIPMENT YOU CAN BUILD

by *A. Edward Evenson*

If you service your own car, this book can save you time and money. It is an easy-to-read guide that explains how to build your own professional-level test equipment. The dwell meter, tachometer, points and capacitor tester, ignition tester, dynamic compression tester, volt-amp tester, and alternator tester are all covered in the first seven chapters. Each chapter describes one particular test instrument, covering not only construction and theory of operation but also applications and testing procedures. Supplementary test instruments, such as timing lights, coil testers, battery testers, and oscilloscopes, are covered in the remaining chapters.

Published by *Howard W. Sams & Co., Inc.*, 4300 West 62 St., Indianapolis, IN 46268. Soft cover. 160 pages. \$4.95.

## HANDBOOK OF MODERN ELECTRONIC DATA

by *Matthew Mandl*

As its title implies, this is a reference book—and a rather impressive one at that. It contains basic equations, explanations of circuitry, tables and graphs, solid-state theory, and numerous other informational items, including data on lasers, holograms, antennas, color codes, symbols, vectors, and phase factors. In contrast to a theory textbook where the subject matter sequence is arranged in the order of difficulty, this data book employs topic groupings for convenience in referencing the material.

Published by *Reston Publishing Co., Inc.*, Box 547, Reston, VA 22090. Hard cover. 274 pages. \$13.95.

## ELECTRONIC PRINCIPLES

by *Albert P. Malvino*

Using an approximation approach, the author of this book develops the basic theories of electronics as well as their applications to

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modern industrial practices. The textbook is well suited for a one-term course in community colleges and technical institutes. The necessary prerequisites are ac and dc theory, algebra, and trigonometry. The text presentation is generally devoted to solid-state electronics, with a concluding chapter on vacuum tubes. Related topics in communication electronics, such as modulation and intermodulation and mixing, are also presented.

Published by McGraw-Hill Book Co., 1221 Avenue of the Americas, New York, NY 10020. Hard cover. 748 pages. \$13.95.

## PHYSICAL ELECTRONICS

by J. Seymour

Providing an introduction to the physical principles underlying the operation of present-day electronic devices, this book was written for the second- or third-year undergraduate in electrical engineering and applied physics courses. Topics covered include: electrons in atoms, gases, and crystals; the p-n junction; junction transistors; FET's, and other semiconductor devices; electron emission and vacuum devices; microwave devices and electrical noise; and masers and lasers. Five appendices, a glossary of symbols and abbreviations, and a table of physical constants are included.

Published by Halsted Press, A Division of John Wiley & Sons, Inc., 605 Third Ave., New York, NY 10016. Hard cover. 438 pages. \$10.50.

## DIGITAL ELECTRONICS

by F. Doktor & J. Steinhauer

This book provides a general survey of the entire field of digital techniques, opening with a systematic introduction to all topics of importance to the subject. Theoretical derivations are given where necessary for an understanding of the topic being discussed, and each chapter includes a theoretical basis of the topic together with specimen calculations and discussion of practical problems.

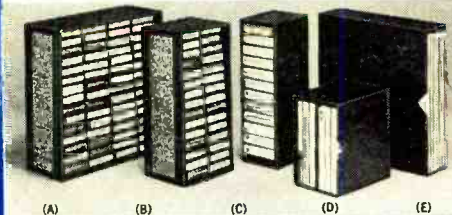
Published by Barnes & Noble Books, 10 East 53 St., New York, NY 10022. Hard cover. 270 pages. \$19.75.

## NICKEL-CADMIUM BATTERY APPLICATION ENGINEERING HANDBOOK

What the tube and transistor manuals have done for their respective fields, this handbook does for the field of nickel-cadmium batteries. It documents in one handy reference book the characteristic data, capabilities, and limitations of nickel-cadmium batteries and provides other information needed for properly applying these batteries to specific requirements.

Published by General Electric Battery Products Section, P.O. Box 114, Gainesville, FL 32601. Soft cover. \$2.50.

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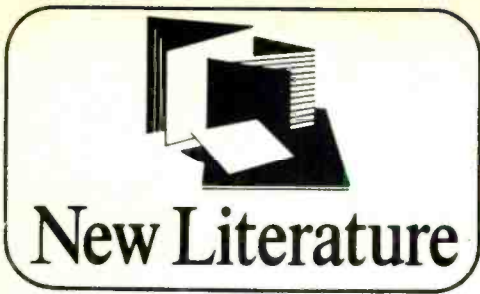
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# New Literature

## LAFAYETTE RADIO 1974 CATALOG

The 1974 edition of the world's largest annual catalog of consumer electronic parts and equipment is now available from Lafayette Radio Electronics. Catalog No. 740 features both 2- and 4-channel hi-fi gear, including amplifiers, tuners, receivers, recorders, etc.; CB and ham radio equipment; test gear; automotive accessories; and over 20,000 other items. Address: Lafayette Radio Electronics, 111 Jericho Tpke., Syosset, NY 11791.

## TDK OFFERS "GUIDE TO CASSETTES"

A 48-page booklet packed with useful information on home tape recording methods and equipment is available from TDK as "The TDK Guide To Cassettes." The pocket-size booklet offers a short course in tape recording terminology and technology for the layman, including an explanation of the various types of tape formats, their relative merits, and applications. Address: TDK Electronics Corp., 2373 48 St., Long Island City, NY 11103.

## RCA RECORDING TAPES BROCHURE

In Audio Recording Tapes Brochure No. IT-1182B, published by RCA, there is a host of useful information about the company's Red Seal brand of cobalt energized cassettes, low-noise 8-track cartridges, and reel-to-reel tapes. The brochure details running times, track and tape widths, base and film coating thicknesses, magnetic characteristics, and recording characteristics. Address: RCA Electronic Components, Harrison, NJ 07029.

## GE "PERMA-CELL" BATTERY BROCHURE

The dollar-saving benefits of using the General Electric Perma-Cell battery system are discussed in the company's GEA-9661 brochure. Detailed are the essential characteristics of the Perma-Cell nickel cadmium batteries, the Model BC-1 battery charger, and how the two pair up to make a "system." Address: General Electric Co., Battery Products Div., P.O. Box 114, Gainesville, FL 32601.

## MIDLAND ELECTRONICS CATALOG

Prominently featured in Catalog No. EP-73 from Midland Electronics is the company's entire line of monitor receivers and base station, mobile, and hand-held CB transceivers and accessories. Other products listed include PA equipment, power supplies and adapters, intercoms, hi-fi equipment, a closed-circuit TV camera, multimeters, etc. Address: Midland Electronics Co., P.O. Box 19032, Kansas City, MO 64141.

## AVANTI ANTENNA CATALOG

The 1973 edition of the Citizens Band Communications Catalog is now available from Avanti. Listed and described are the company's entire line of base and mobile antennas and accessories. The latter includes trunk lid and deck mounts, a co-phasing harness kit, etc. Address: Avanti Research & Development, Inc., 33 West Fullerton Ave., Addison, IL 60101.

## NORTRONICS TAPE HEAD REPLACEMENT GUIDE

The Recorder Care Division of Nortronics Co. had just released Form No. 7297C, a two-color brochure that details the company's line of universal replacement heads for cassette and 8-track cartridge players. The heads are referenced according to manufacturer and machine or head part number, track style, and Nortronics replacement part number. The brochure also provides information about QM-Series recorder care accessories. Address: Nortronics Co., Inc., 8101 Tenth Ave. North, Minneapolis, MN 55427.

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SALE

# Surplus Scene

By Alexander W. Burawa, Associate Editor

## HOW TO BUY SURPLUS COMPUTER BOARDS

**F**OR YEARS, surplus dealers have been offering for sale computer boards at very attractive prices. Computer boards are most often bought by knowledgeable, economy-minded experimenters who want to build up their spare parts inventories. To the experimenter, some boards are worth buying, while others are decidedly useless—at least for electronic purposes. At the risk of offending some dealers, we are going to reveal some of the secrets of buying computer boards that will yield usable parts and define the types of boards that will prove useless for most electronic purposes.

Taking the latter first, let's begin with a few generalizations. Almost without exception, any board that is ultra-thin and where leads are bent close to the component bodies can be considered useless. So can boards loaded with unidentifiable IC's, small black plastic cubes, and little else. Add to this list boards containing one or several LSI chips, usually sold as "computer memories" or such like; by the time you figure out the functions these chips perform and how to put them to use, you'll likely have a long white beard. Charred components or areas of the board, except around power resistors and transistors, are sure signs that the board is useless. Also, avoid any board that is plastic encapsulated; you'll never get the components off the board in one piece.

Now let us enumerate what to look for in boards that will yield usable components. The most useful computer board assemblies that will yield practical components are those crowded with resistors, capacitors, diodes, and transistors. Don't look for anything exotic because exotic things usually have control numbers that you won't be able to decipher. Resistors and capacitors are generally of precision tolerance, but make sure that they are clearly marked. Diodes,

particularly the signal types, generally present no problem; they are usually identified by color banding and, even lacking banding or number identifications, have clearly indicated cathode ends. Transistors need not be identified by EIA (2N and 3N) numbers. If you have a curve tracer and/or transistor checker, you can quickly determine transistor types according to polarization, material, and power-handling capacity. (FET's and UJT's aren't so easy to identify, but these are rather rare.)

There are a few—not many, but a few—boards sold on which are mounted encapsulated reed relays. These are always a worthwhile investment. So are boards on which are mounted multi-turn and precision trimmer potentiometers. (Inductors are hardly ever identified and should not be given serious consideration.)

You will soon discover that not all boards containing "useful" components are worth the investment. Make a quick check for the features outlined in the second paragraph. If a given board passes this test, give it a more careful visual inspection. Give particular emphasis to lead length after components are dismantled. Leads should be long enough to permit the components to be re-mounted on a new printed circuit board or to permit them to be hooked to terminals in point-to-point wired assemblies.

Lead length can be deceptive. So, check carefully and don't assume that the leads are bent over against the board's copper foil pattern. To conserve space in the thickness dimension, most component leads are very short to start with. After the components are installed on the board and their leads are soldered to the copper foil, the leads are often ground almost flush with the copper foil. Take this into account when you're making a value judgement. ♦

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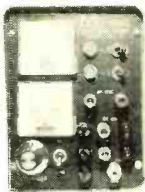


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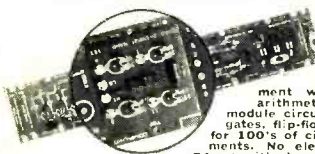
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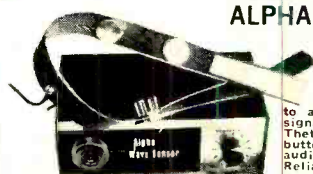


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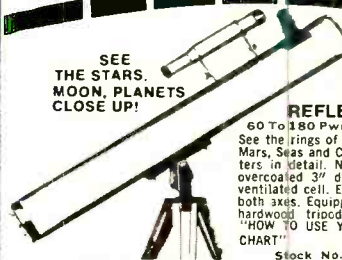
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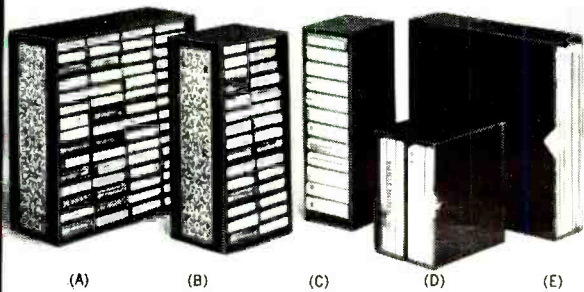
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