

# ELECTRONIC TECHNICIAN / DEALER

WORLD'S LARGEST ELECTRONIC TRADE CIRCULATION

SERVICING CB TRANSCEIVERS

USING AUDIO TEST INSTRUMENTS

PARTNERSHIP TO PROFIT



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T-V**

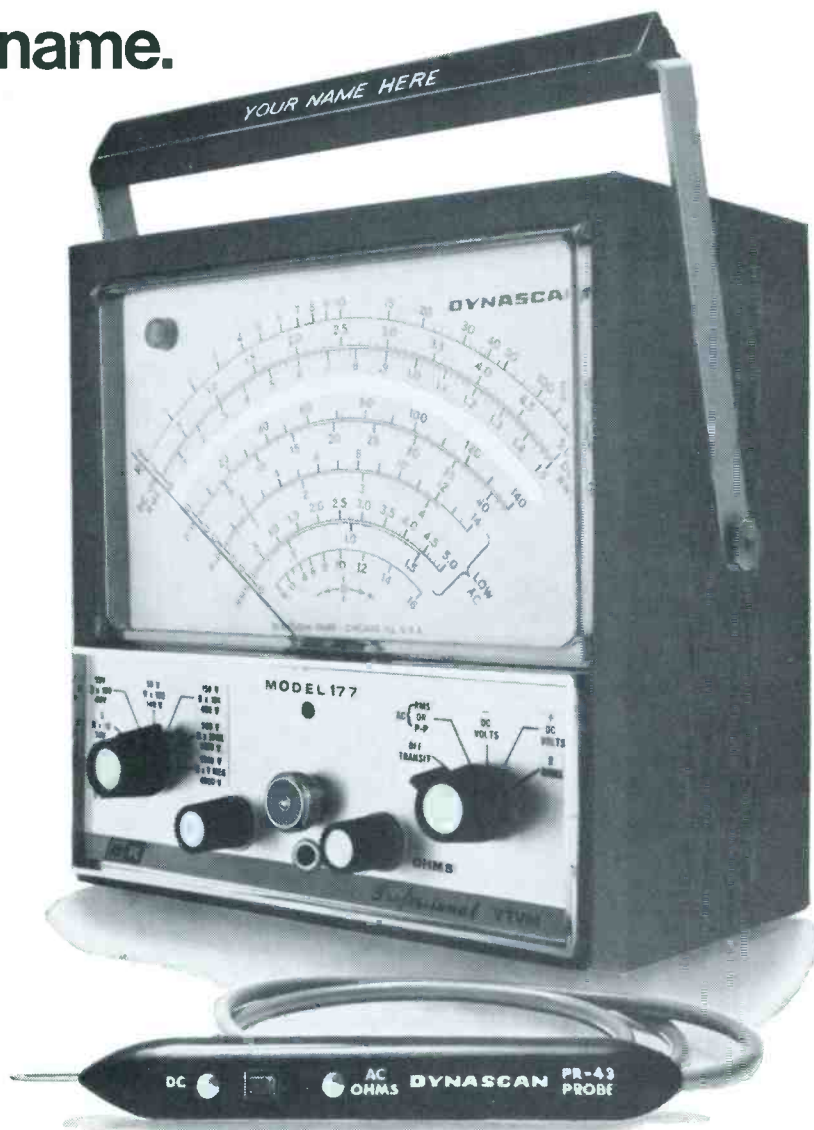
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**COLOR TV SALES & SERVICE STEREO**

APRIL 1968



There's a heckuva lot of VTVM units around.  
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If you're one of the skeptics who think one VTVM is pretty much like another, the B&K 177 "Professional" will change your mind. This one stands out from the crowd.

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EFFECTIVE 8/1/67

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*Nine-seventy-five* buys you a complete tuner overhaul—including parts (except tubes or transistors)—and absolutely no hidden charges. All makes, color or black and white. UV combos only \$15.

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Four conveniently located service centers assure speedy in-and-out service. All tuners thoroughly cleaned, inside and out . . . needed repairs made . . . all channels aligned to factory specs, then rushed back to you. They look—and perform—like new.

*"Prefer a replacement? Sarkes Tarzian universal replacements are only \$10.45, customized replacements \$18.25. Universal replacements shipped same day order received. On customized, we must have original tuners for comparison purposes, also TV make, chassis, and model number. Send orders for universal and customized replacements to Indianapolis."*

Part #	Intermediate Frequency	AF Amp Tube	Osc. Mixer Tube	Heater
MFT-1	41.25 mc Sound 45.75 mc Video	6GK5	6LJ8	Parallel 6.3V
MFT-2	41.25 mc Sound 45.75 mc Video	3GK5	5LJ8	Series 450 MA
MFT-3	41.25 mc Sound 45.75 mc Video	2GK5	5CG8	Series 600 MA

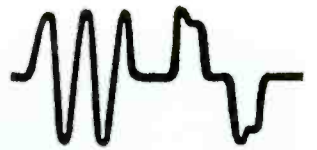
*Genuine Sarkes Tarzian universal replacement tuners with Memory Fine Tuning—UHF Plug in for 82-channel sets—Pre-set fine tuning—13-position detent—Hi gain—Lo noise—Universal mounting*

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 10654 MAGNOLIA BLVD., North Hollywood, California ... TEL: 213-769-2720



## “Trading up” resistors prevents call-backs



Color television sets contain some potential trouble spots for fixed resistors. Sudden overloads or short-outs of a tube, diode or transistor, or leakage in a by-pass capacitor may cause enough current surge in a carbon resistor to cause it to open or to suddenly increase in value. You wind up with a strange set of symptoms that take a lot of point-to-point testing to unscramble.

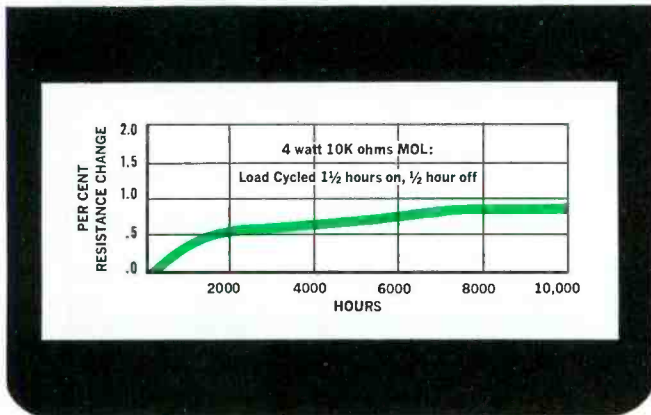
**EXAMPLE:** Suppose a tube or capacitor shorts out. This may cause excessive current drain on the power supply which may affect a resistor in the bleeder network. This resistor may increase in value which would then reduce voltage in subsequent circuits. When this happens, a number of controls must be re-adjusted. By replacing the resistor with a Mallory MOL, the set is brought back to normal operation and the MOL construction virtually precludes this type of difficulty happening in the future.

Granted, resistors don't fail as often as other components. But when it happens, you can take out a simple insurance policy against call-backs by replacing faulty carbon resistors with Mallory MOL's. For just a few pennies more, you're putting a world of extra life and stability in a critical part of the circuit.

In a nutshell, MOL's are metal oxide film resistors with stability comparable to wire-wounds, but far lower in cost. They can stand brief overloads of several times rated wattage without damage. Humidity and vibration don't bother them. They're non-inductive up to 250 mc, so you can use them in rf and if sections without a worry. As for stability, we've run them on load cycle tests up to 10,000 hours and resistance values hold steady within 1%! No wonder every major TV manufacturer is using them.

MOL resistors are usually a bit larger than carbon types, so you may have to bend a few leads to fit them in. They come in 2, 3, 4, 5 and 7 watt sizes (which is more than you'll need in most carbon resistor replacements), in resistance values up to 500K.

Your Mallory distributor stocks MOL's in the values you'll need. And he has an up-to-date cross-reference list which shows you the Mallory part numbers to specify for popular TV sets, by manufacturer and chassis number. See him, or write to Mallory Distributor Products Company, a division of P. R. Mallory & Co. Inc., Indianapolis, Indiana 46206.



Typical stability test data: 10,000-hour load cycling test. Average resistance change is less than 1%!

**DON'T FORGET TO ASK 'EM** — *“What else needs fixing?”*

... for more details circle 124 on postcard

ELECTRONIC TECHNICIAN/DEALER

# ELECTRONIC TECHNICIAN / DEALER

WORLDS LARGEST ELECTRONIC TRADE CIRCULATION

APRIL 1968 • VOL. 87 No. 4

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## COVER

Our cover shows a new sales and service shop recently opened by two TV service-technicians — their story begins on page 58 of this issue.

## TEKFAX • 16 PAGES OF THE LATEST SCHEMATICS • Group 188

ADMIRAL: Color TV Chassis K15

AIRLINE: TV Model GEN-13168A

GENERAL ELECTRIC: TV Chassis AD

MOTOROLA: TV Chassis TS-592

PHILCO-FORD: TV Chassis 18J32

SYLVANIA: Color TV Chassis D09-1, -2, -4

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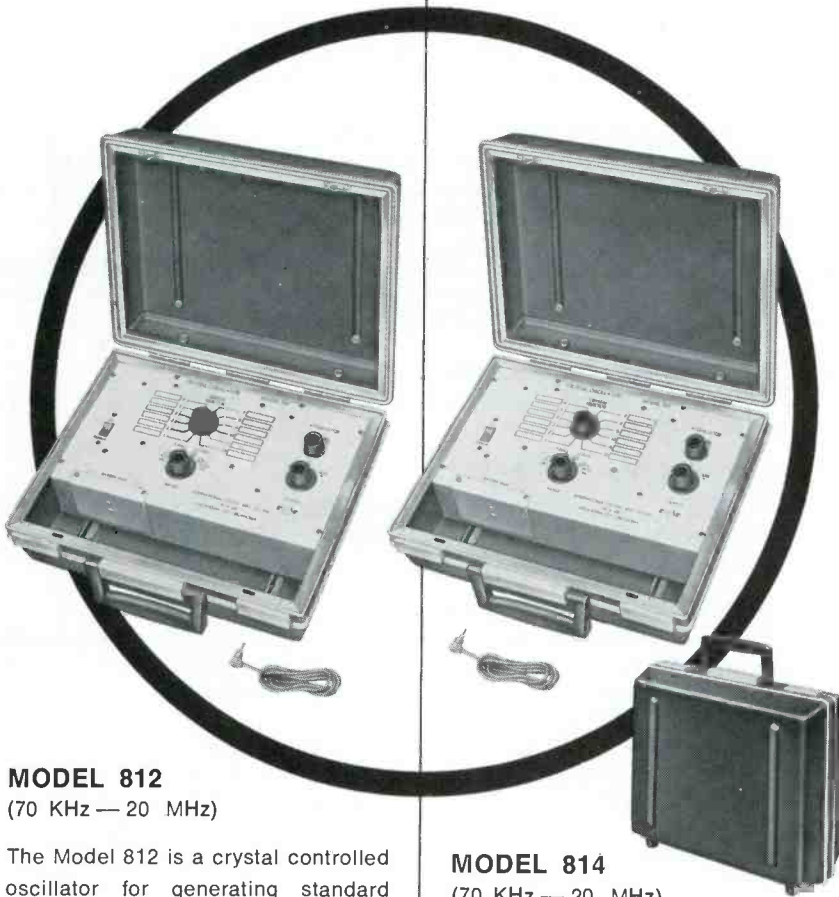
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# 2

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Complete (less crystals) **\$125.00**

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The Model 814 is identical in size to the 812. It does not have individual trimmers for crystals. Tolerance is .01%. Battery operated. Bench mount available.

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*Both the Model 812 and Model 814 have positions for 12 crystals and the entire frequency range is covered in four steps.*

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## EDITOR'S MEMO

### Space-Age 'Imagineering'

Not all young people today spend their time at sit-ins, be-ins, mill-ins or love-ins. Some brilliant young minds at our technical colleges have a new gimmick — outfoxing the telephone company. "The telephone company calls it stealing," according to a WALL STREET JOURNAL article.

With the editor's permission, the following is a paraphrased portion of the article titled: "Telephone Operators: Ingenious Young Men Outfox Phone Firms," which appeared in a recent issue of the WALL STREET JOURNAL. ET/D readers may enjoy it.

Take a small group of young, persuasive engineers who know the workings of a computer and the language of telephone operators, and they will tell you they are interested in proving that "the system" can be beaten.

The techniques the free phoners use are elaborate. In one city, a young engineer fed all the telephone numbers from four local exchanges into a computer. The result — a list of all the phone numbers that weren't listed. He then dialed all those numbers until he found out which ones would get him into open long-distance lines — lines which, incidentally, were leased by various corporations. Then he used these lines for toll-free calls.

At another meeting of minds, a few Harvard and MIT boys got together and devised some methods for making long-distance calls anywhere in the world. The methods ranged from using the tape-recorded sounds of a telephone being dialed — which was used to activate the telephone company's call-placing equipment — to a scheme designed to foil "Ma Bell's" billing computer. They upset their own applegart though when they found out how to get into the Defense Dept. lines and began calling SAC Air Force bases. (In return for telling AT&T how they did it, it is reported that the men were not prosecuted.)

Out on the East Coast, another student built an electronic gadget that allowed his friends to call him free!

One young man, now a research engineer at an Ivy League college, compares the telephone tactics to scientific experimentation. As he puts it, "The most enjoyable thing was when we predicted from our previous work that certain number codes do something and then we saw it happen — which is after all, the pleasure in all scientific experiments."

# Join "THE TROUBLESHOOTERS"

who get paid top salaries for keeping today's electronic world running

Suddenly the whole world is going electronic! And behind the microwave towers, push-button phones, computers, mobile radio, television equipment, guided missiles, etc., stand THE TROUBLESHOOTERS—the men urgently needed to inspect, install, and service these modern miracles. They enjoy their work, and get well paid for it. Here's how you can join their privileged ranks—without having to quit your job or go to college to get the necessary training.

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

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

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

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

### Think With Your Head, Not Your Hands

As one of The Troubleshooters, you'll have to be ready to tackle a wide variety of electronic problems. You may not be able to dismantle what you're working on—you must be able to take it apart "in your head." You'll have to know enough electronics to understand the engineering specs, read the wiring diagrams, and calculate how the circuits should test at any given point.

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

For over 30 years, the Cleveland Institute of Electronics has specialized in teaching electronics at home. We've developed special techniques that make learning easy, even if you've had trouble studying before. Our AUTO-PROGRAMMED™ lessons build your knowledge as easily and solidly as you'd build a brick wall—one brick at a time. And our instruction is personal. Your teacher not only grades your work, he analyzes it to make sure you are thinking correctly. And

he returns it the same day received, while everything is fresh in your mind.

### Always Up-To-Date

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

In addition, there is complete material on the latest troubleshooting techniques including Tandem System, Localizing through Bracketing, Equal Likelihood and Half-Split Division, and In-circuit Transistor Checking. There are special lessons on servicing two-way mobile radio equipment, a lucrative field in which many of our students have set up their own businesses.

### Your FCC License—or Your Money Back!

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

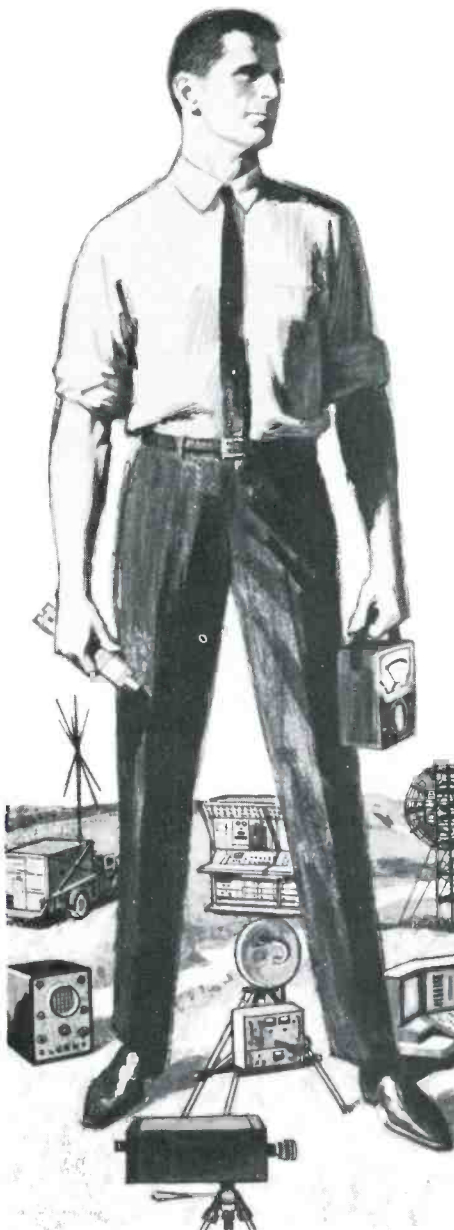
And no wonder. The licensing exam is so tough that two out of three non-CIE men who take it fail. But our training is so effective that 9 out of 10 CIE graduates pass. That's why we can offer this famous warranty with confidence: If you complete a license preparation course, you get your FCC License—or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

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Want to know more? Send for our 40-page catalog describing our courses and the latest opportunities in electronics. We'll also send a special book on how to get a Government FCC License. Both are free—just mail coupon below.

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ET-39

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# LETTERS TO THE EDITOR

## WOW — Quality Color Transmission at Last

In your Editor's Memo titled "Color TV vs the Customer," (ET/D December 1967) you seem to infer that the average color receiver is the standard of the industry. Perhaps you have never tried matching two supposedly identical color TV sets. With luck and patience a close match can be expected, but it doesn't last long. Heaven

help the color TV broadcasters if they have to rely on home receivers to set up color cameras.

Our color monitors cost twice as much as the best color TV, and they have no RF or IF sections! The difference is in the precision circuitry and stability. This precision monitoring equipment might not be necessary if it were not for an agency called the FCC. They take a very dim view of nonstandard television transmissions.

If TV manufacturers were required to meet half the standards of broadcasting, the color TV industry would be set back five years. If the set owner didn't adjust his contrast and chroma

controls too high, a richly saturated scene would not bloom. If tuners were not prone to drift, there would be no need for AFC.

Our visual carrier is accurate to within  $\pm 1\text{kHz}$ , far better than any TV tuner made. I realize that it is not possible to match crystal accuracy with a VFO but don't blame that on the broadcast station.

You might be able to correct the green fleshtone problem if you gave the broadcasters your help instead of general criticism. When such a problem is evident, call the station and report what program was affected and what program information was involved in the color shift. Most stations will welcome a call if a viewer does not receive a satisfactory picture. But, the broadcaster can only control the quality of the signal until it is transmitted.

DAVID G. STORBERG  
KSTP-TV

Minneapolis, Minn.

• As Mr. Storberg points out, the FCC takes a very dim view of nonstandard television broadcasts—and so do we, as they affect the service technician who has to train the customer in the "art of compensation for inconsistency." We submit that color TV receivers should not be considered standards, but what is a standard? What difference the cost of color monitors and expensive cameras in broadcast stations if the levels between these "standards" are not standard? Remember, too, there is sometimes a big gap between the transmitter and the antenna. Mr. Storberg concludes that they can only control the quality of the signal until it is transmitted. Wonderful — that's all we ask. — Ed.

## Musi-Pak Tapes?

We have sold several Musi-Pak tape players, Model 300 and are unable to find a source of additional tapes for this unit. Perhaps an ET/D reader can tell us where these tapes may be purchased.

FRANK SCHMIDT  
Middleburg, N. J.

## Bouquets and Brickbats

Congratulations, you hit the nail right on the head with your editorial "Color TV vs the Customer" in your Editor's Memo, December 1967. It is becoming more and more apparent that in order to see a good color picture you have to go to the movies. Something should be done — and fast.

Something should also be done concerning the conditions that Heinz Neuman told about in his letter to the editor in the same issue where he

# NO MORE GUESSWORK!



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You don't need three guesses to tell if a tube is bad — or why. With the new Sencore MU140 Continental, you **know**. Right now. And you simply can't go wrong. Because it's a complete tube analyzer for 4-way testing — true mutual conductance (using exclusive 5000 hertz square wave), full cathode emission, 100 megohm grid leakage, and internal shorts. Tests all tubes, including foreign — over 3000 in all. Obsolete-proof, too — with "new socket" panel, and controls so standard the switch numbers correspond to the pin numbers in any tube manual.

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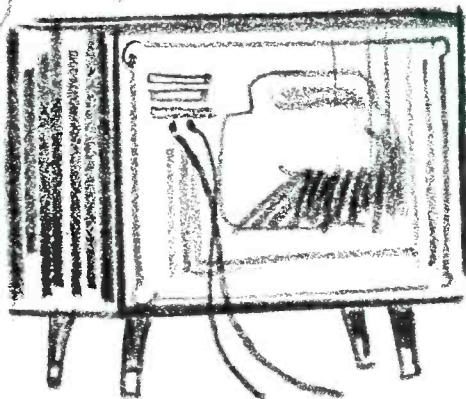
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DEAR ANT GRACE.

OUR TV BROKE. UNKLE JOE  
TRIED TO FIX IT. THEY TOOK  
UNKLE JOE TO THE HOSPITAL  
AN THE TV WAS WORZER.  
DADDY CALLED THE TV MAN  
WHO FIXED IT. WE ARE  
GLADDER THE TV WORKZ  
SO GOOD AZ NEW. BUT  
NOT UNKLE JOE. HE WILL BE  
HOME ZOON BUT THE DR. SAYD  
KEEP HIZ HANDZ OUT OF  
THE TV.

LOVE BOBBY.



See your Sprague Distributor for window-size blow-ups of this message. Or, send 10¢ to Sprague Products Co., 65 Marshall St., North Adams, Mass. 01247 to cover handling and mailing costs. Please ask for poster RP-36.

**Call in your neighborhood TV technician when your set first starts acting up... you'll please the family ...and SAVE money in the long run!**

THIS MESSAGE WAS PREPARED BY SPRAGUE PRODUCTS COMPANY,  
DISTRIBUTORS' SUPPLY SUBSIDIARY OF SPRAGUE ELECTRIC COMPANY, NORTH ADAMS, MASSACHUSETTS FOR . . .

**YOUR INDEPENDENT TV-RADIO SERVICE DEALER**

**DON'T FORGET TO ASK YOUR CUSTOMERS "WHAT ELSE NEEDS FIXING?"**

65-7107

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## non-drift tuner cleaner



specifically formulated by GC for color TV tuners

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Always insist on GC... you'll get more for your money, everytime!

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has everything in **CHEMICALS**



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For quiet TV tuner operation.  
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**DC-29 Silicone**  
heat sink compound  
Cat. No. 8109 ...  
1-Oz. Tube  
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**EPOXY GLUE**  
"Super Grip" ... NASA Approved  
Cat. No. 347  
... 2-Tube Kit  
Suggested Net \$2.50



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## LETTERS TO THE EDITOR

pointed out the difficulty of repairing some of the fiascoes that most of the manufacturers are foisting on the public. It seems that the only people happy with most of the new sets are the stockholders — the customer's goodwill is a thing of the past. It's a cinch that somebody has to pay for the extra time it takes to repair some of the weird circuits used in the new sets that are responsible for big repair bills.

While it is perhaps not fitting that your magazine become a crusading agent for the down-trodden service technician vs the avaricious, money-mad, "space brainwashed" manufacturers, a "bouquet and brickbat" column might be a good idea. If the manufacturers are not more careful, they just might find out that "solid-state" could become "rigor mortis."

MURRAY WITTNER

Long Beach, N. Y.

### Missing Manual

I recently acquired an Oak Ridge CRT tester, Model 106. Unfortunately I did not receive a manual with it and I am unable to use it. Can you supply me with the address of the Oak Ridge Products Co. (Div. of Video Television) so that I can contact them for instructions.

THOMAS H. SEEGER

Hampton, Va.

• We tried to locate this one, but to no avail. If an ET/D reader can send some information on this unit, we will see that Mr. Seeger gets it—Ed.

### Sweep Motor

I enjoy ET/D very much and I usually turn to "Letters to the Editor" first. I hope an ET/D reader can help me. I have a Simpson FM signal generator, Model 479, which is in dire need of a new sweep motor. The factory can not supply the motor. The part number is 22-302-118. I would be interested in obtaining one, either new or used.

CHAS. G. CROSS

Parkersburg, W. Va.

### Schematic Wanted

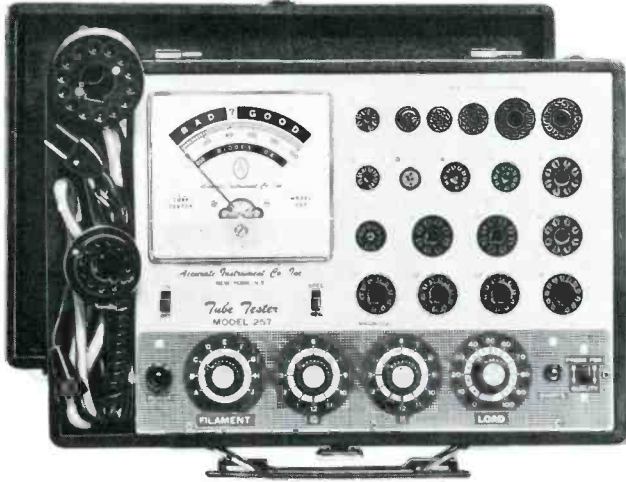
I thoroughly enjoy ELECTRONIC TECHNICIAN/DEALER. I am hoping an ET/D reader may be able to tell me where I can obtain a schematic for a Tele-Mate Model MOD500 CB transceiver.

FRED ARMSTRONG

Reno, Nev.

ELECTRONIC TECHNICIAN/DEALER

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**COMPLETE WITH ALL ADAPTERS AND ACCESSORIES, NO "EXTRAS"**

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## E. F. JOHNSON CO.

### FM Two-Way Radio Model 242-502, 503 — Transmitter and Power Adapter Circuit Descriptions

The entirely solid-state Johnson FM transmitter uses nine transistors, two clipping diodes and a varactor diode modulator. The transmitter will deliver a minimum of 5w RF power output to a 50 Ω load. Refer to the schematic while following the transmitter circuit description.

#### Audio

The audio section consists of Q18, the 1st audio amplifier; Q19, the 2nd audio amplifier, and Q20, the modulator.

The incoming signal from the microphone is coupled to the 1st audio amplifier by C92 which also pre-emphasizes the audio. Q18 and Q19 raise the audio to a suitable level for clipping. D10 and D11 because of their "soft knee" characteristics clip and limit modulation with a minimum of distortion. The audio from the clipper goes through a low pass filter, L17, C97, L18 and C98, with a sharp cutoff characteristic beginning just below 3kHz. The modulating stage, Q20, raises the prepared audio signal to a level adequate for modulation, with R107 providing modulation control. Varactor diode, DV1, provides direct frequency modulation and partial frequency temperature compensation. Bias voltage is supplied by the resistor-thermistor network consisting of R124, R125 and RT1. R125 serves also as the fine frequency adjustment.

#### Oscillator

Q21 is the oscillator transistor, serving in a modified colpitts circuit. C105, C106, comprise the frequency and

temperature compensating elements. Major frequency adjustment is provided by selection and adjustment of L20. The actual temperature coefficient values for RT1, C105, C106 are keyed to the characteristics of the particular crystal used (Y3). No oven or crystal heating device is used.

#### Frequency Doubler

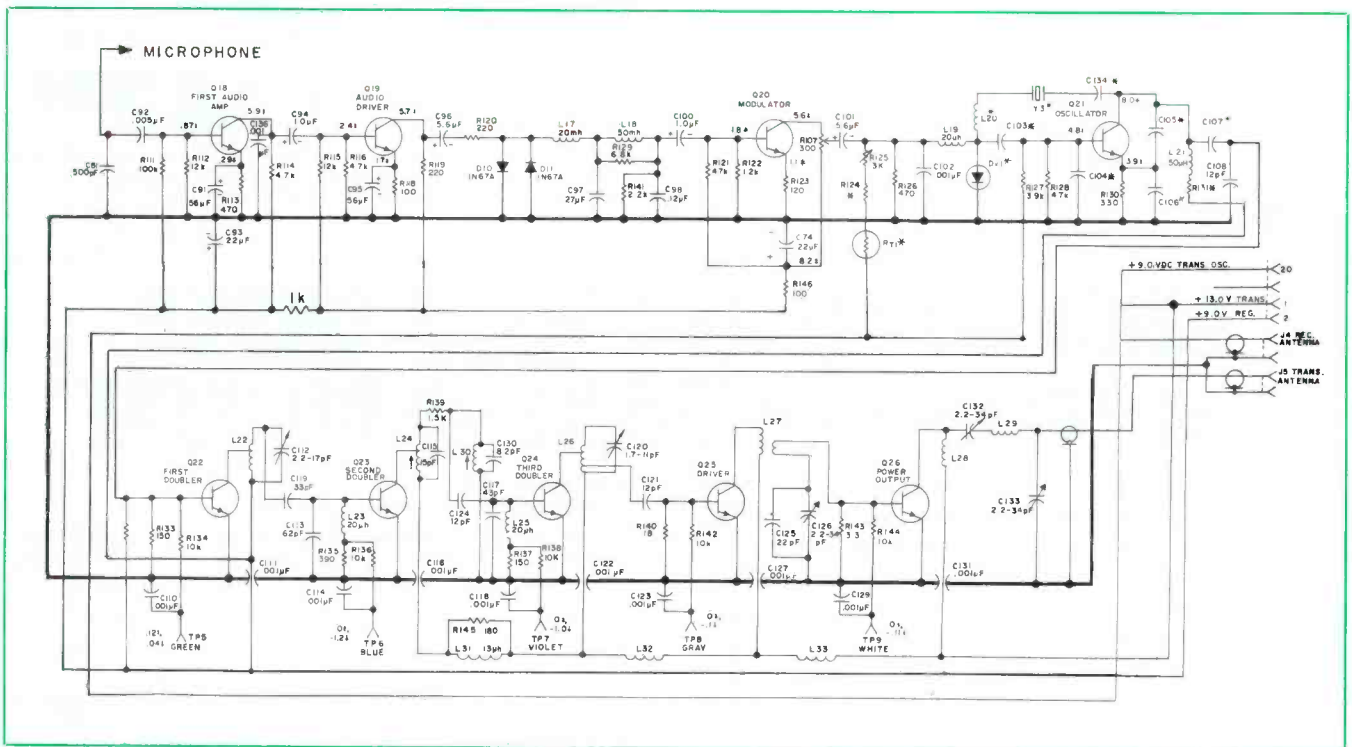
Transistors Q22, Q23 and Q24 function as doublers, multiplying the crystal oscillator output frequency eight times. A double-tuned circuit consisting of L24, C115, L30 and C130 between the 2nd and 3rd doubler reduces the fundamental and 1st doubler products.

#### Driver and Final

Driver Q25 and final Q26 raise the RF power level to between 5 and 8w. A series L network, consisting of C132, L29, C133, provides harmonic attenuation and impedance matching to 50 Ω. The remainder of the filtering necessary is in the power adapter unit, where a series L network "tunes out" the antenna relay and provides "peaking" adjustment for small load variations.

#### Voltage Regulation

To provide consistent performance under changes in supply voltage and temperature, voltage regulation is used in the power adapters. An output of 9v regulated is referenced to a temperature compensated zener diode. This regulated output powers the transmit audio, oscillator, 1st doubler stages and the receiver except for the audio section. A germanium diode is placed in the line to the oscillator to offset ambient temperature effects on the regulating transistor. This insures regulation of better than ±0.05v over the ambient temperature range of -30°C to +60°C.



# The people puller



\*Options with dealer

## RCA's Headliner: first and finest of the 14-inch portable color TVs.

First because it's pulled the most sales of any 14-inch diagonal color set made. Finest because it's got the big features. Like advanced circuitry that won't go haywire. Like true room-to-room portability. And a 102 sq. in. picture that's true to life—and true to the reputation of the pioneer name it bears. Sell the first and finest, the Headliner. It's one reason we say: When you're the first name in home entertainment there's got to be a reason.

# RCA

# introducing the hundred dollar antenna



# plus a not so short story about why Winegard's new SC-1000 is worth every penny...why it's the most powerful 82-channel antenna ever created for civilian use...and how it can change your antenna business.

Every once in a while a new antenna comes along that's more than just "new" and "different looking" and "bigger" and "better" and "more powerful". Once in a while, maybe once in a lifetime, an antenna is created that makes all the "usual claims" and then supports every one of the claims with *performance*. That's our hundred dollar antenna. The SC-1000. The top of our Super Colortron line. The top of any antenna line ever created.

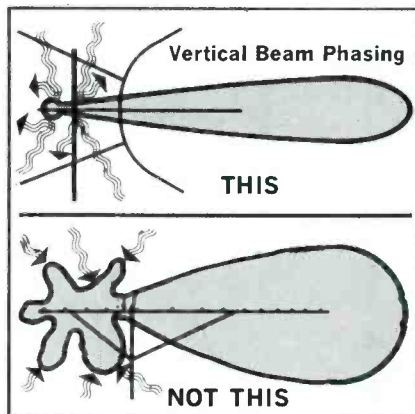
This VHF-UHF-FM super fringe antenna has undergone exhaustive testing and tuning refinements—and proved that it delivers performance worthy of its name, and it's price. Take, for example, an installation in Houston—41-feet above ground, equipped with rotor and 75 ohm downlead (no preamplifier.) The owner\* writes that with the SC-1000 he is now receiving superior reception on stations ranging from 60 miles away (Bryan, Texas) to 200 miles away (Alexandria, La. and Lafayette, La.) Now that's what we call results. And it's why the SC-1000 is already being called "the long distance antenna." Because it pulls in the farthest away, toughest channels—and always better than ever before.

Yes, feature for feature and dollar for dollar (even a hundred dollars) there has never been an antenna like the SC-1000. Let's take a look at the features.

\*Name supplied upon request.

**Exclusive New Compact "Wedge" Design . . . Plus New Vertical Beam Phasing On Each VHF Channel.** Vertical Beam Phasing on all VHF channels means there is no signal pickup from above or below the antenna. It means interference from such sources as airplanes, cars and diathermy machines are shut out. And it means that ghost signals are highly rejected. And that's not all. The VHF capture area is doubled and power gain over a conventional single bay is doubled. The vertical beam is flattened and elongated and spurious vertical lobes are eliminated. All that, and the SC-1000, with its unique "Wedge" design, is

still vastly shorter and more mechanically stable than any other configurations would have to be to come close to the gain of the SC-1000.

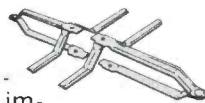


**New "Constant Focus" UHF Screen.** Concentrates all signal on Tetrapole collector element, provides as much signal capture area as an 8-foot parabolic, and at a fraction of a parabolic's size and weight.

**New "Interlaced UHF Resonant Reflectors".** Form a high density magnetic screen with all current fields in phase and working together for a new high in parabolic reflector efficiency.

**Exclusive Patented\* VHF Director System.** Absorbs VHF signal and focuses it onto the collector elements. Helps give the SC-1000 pinpoint directivity to knock-out ghosts, smear and snow. \*U.S. Patent No. 2700105, Canada No. 511984.

**New "Tetrapole" UHF Collector Element.** Has larger signal absorption area than standard UHF dipole. Maintains constant 300 ohm impedance and allows *no loss* coupling between the VHF and UHF operations.



**Exclusive "Impedance Correlators".** Provide perfect 300 ohm VHF impedance match and produce more signal gathering power per inch of antenna—and also contribute to

making the SC-1000 extremely compact.

**Exclusive Ellipsoidal Boom.** Strongest boom ever used on a tv antenna. All elements of antenna are special aluminum alloy 40% stronger than used on most antennas.

**Long Distance FM & FM Stereo Reception Bonus.** Comparable to the results you get with a 10 element FM yagi.

**Genuine Gold Anodized Finish.** The only permanent gold finish on any antenna. Sunfast. Protects against corrosion and fading. Lasts years longer.

**Exclusive Built-In Cartridge Housing.** Integral part of the antenna keeps downlead connection weathertight. Accepts Winegard's solid state cartridge preamplifiers, color spectrum filter, etc. A truly great Winegard innovation.



**Exclusive Winegard Gold Bond Performance Guarantee, Plus A New 2-Year Replacement Warranty.**

**The SC-1000 Will Change Your Entire Antenna Business.** We created the SC-1000 simply because there was a glaring need for a modern 82-channel super powerful, super fringe antenna. And performance figures show that it has far surpassed even our most optimistic goals. So whenever you want to get the last ounce of clean, brilliant reception from a new color set—whenever you have a tough reception problem, install the new Winegard SC-1000. You'll have the most satisfied customers in town. And you'll have the best antenna profits in town!

**Find Out For Yourself.** We want you to see for yourself that "the hundred dollar antenna" is everything we say it is, and more. So try one first chance you get. Ask your Winegard distributor for details now. And write for Fact-Finder #261.



## Winegard

ANTENNA SYSTEMS

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# NEW

## GOOD BAD

# Transistor Testing... in or out-of-circuit!

- No guesswork or confusion
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## NEW LECTROTECH TT-250 TRANSISTOR ANALYZER

*One Year Warranty*

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**DIODES AND RECTIFIERS.** Measures reverse leakage and forward conduction directly to determine front-to-back ratio.

**POWER TRANSISTORS.** Simple Good/Bad test instantly determines condition of power transistors. Power Transistor Socket on panel for ease of testing.

**ELECTROLYTIC CAPACITORS.** Measures leakage current of transistor electrolytics at a test voltage of 6 volts.

**PNP OR NPN** determined immediately... no set-up book needed for testing.

**NON-DESTRUCTIVE TESTING.** Regardless of misconnections, you cannot damage transistors or components tested.

### SPECIFICATIONS

- Large easy to read 6" meter • 3 color-coded test leads with self-storing feature • Power and Milliwatt Sockets on panel for ease of out-of-circuit testing • Zener Diode Regulated Power Supply • All steel case • Size: 10½" x 7" x 4" • Wt. 5½ lbs. • 115 volts, 60 cycles.

NET **87<sup>50</sup>**



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**LECTROTECH, INC.**

1221 W. Devon Ave., Chicago, Illinois 60626

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## TECHNICAL DIGEST

### Power Adapter Circuit Description

The Johnson FM power adapters provide transmit and receive switching, dc power for operating the transceiver, and transmit carrier harmonic filtering. The power adapters come in two versions, ac and dc.

### AC Power Adapter

The ac power adapter, model No. 239-200-1 contains a full wave rectifier power supply that furnishes 13.8 and 9.0v of regulated dc for the operation of all transceiver circuits. The dc output of the power supply bridge rectifier, D101 through D104, is connected to the series regulator, Q1, and the emitter follower, Q2. A sample is taken of the output voltage. This is applied to the base of Q3 through R3. The emitter voltage of Q3 is fixed at a constant level of 10v by zener diode, DZ2. The base voltage, which is related to the output voltage, is compared with the emitter voltage. As the output voltage increases, the base voltage increases. This causes an increase in the collector current of Q3. The increase in current through collector resistor R4 causes the voltage at the base of Q2 to drop. This in turn lowers the base voltage of Q1 and finally the output voltage. Any tendency for the output voltage to increase or decrease will be opposed by the action of the regulator. R3 is factory-adjusted to provide an output of 13.5v.

Short circuit protection is provided by a 0.5a fuse in the primary of T1.

Transistor Q4, zener diode DZ1 and associated components form a zener shunt 9v transistor regulator. The output of the regulator is supplied to transmitter and receiver oscillators, all other receiver stages except for the audio section and all transmitter stages up to the 2nd doubler.

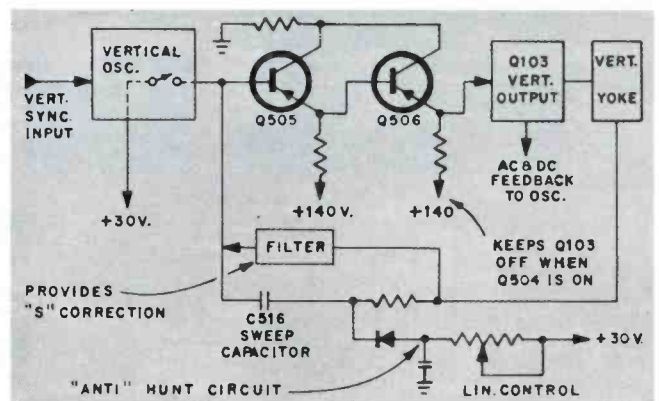
### DC Power Adapter

The dc power adapter, model No. 239-201-1, is identical to the ac power adapter in all functions except that a dc filter is substituted for the ac power supply. A type W51 lamp in the dc power adapter replaces the 39-Ω emitter resistor of the ac power adapter's zener shunt transistor regulator to compensate better for the wide voltage variances of mobile electrical systems.

## RCA VICTOR

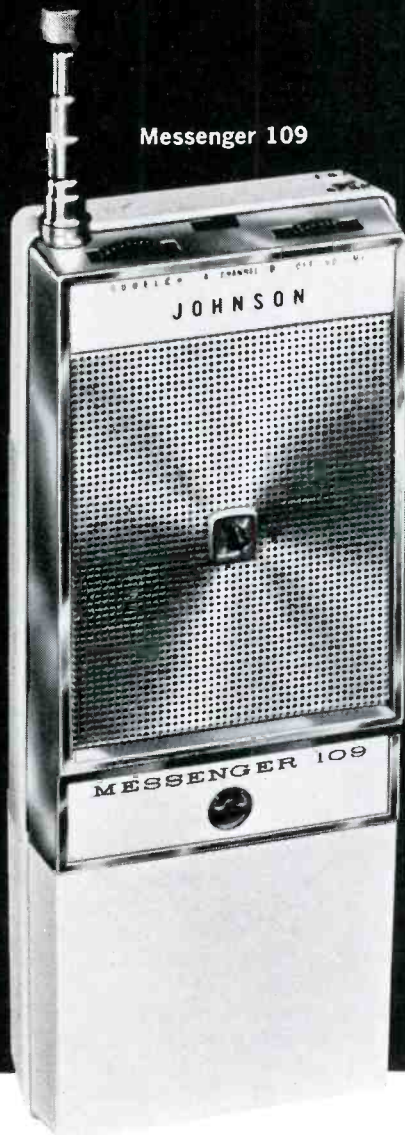
### TV Chassis KCS153 — Vertical Deflection Circuit Descriptions

Transistors now perform all necessary functions of vertical deflection in a transistorized television set since the frequency of operation and the power required in this cir-





# Two new ways to make your



Messenger 109



Messenger 320

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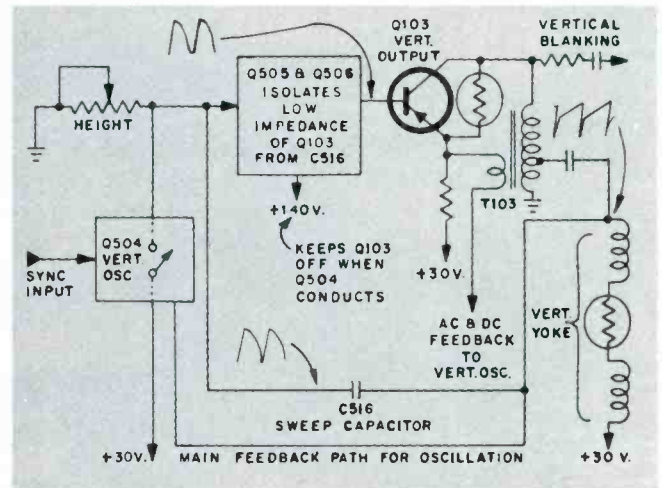
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## TECHNICAL DIGEST

cuit are well within the capabilities of modern transistors. Most circuit refinements in a practical transistor television vertical circuit are concerned with obtaining a high degree of stability and good linearity.

The vertical circuits of the KCS153 chassis consist of a vertical oscillator (synchronized with incoming vertical



sync pulses), a "pre-driver" stage, a "driver" stage and a vertical-output stage.

The oscillator and output transistors work as a feedback system and are grounded-emitter circuits. The pre-driver stages are dc amplifiers which are "emitter-followers," or common-collector, circuits. A very linear rise in current through the vertical-deflection yoke windings is accomplished by this vertical-deflection system.

The vertical oscillator can be considered as a "switch" which is closed at retrace time and open during vertical scan time.

Oscillation is sustained by positive feedback from the yoke to the base circuit of the vertical oscillator.

Off-time, or that time during which the oscillator transistor is open, is controlled by the large time constant in the oscillator base circuit. This corresponds to sweep time. On-time of the oscillator occurs when the voltage on the vertical oscillator base becomes lower than the emitter. This happens quickly and lasts for a very short duration. This is vertical retrace time.

The switching action is employed at the vertical oscillator collector to connect the sweep capacitor quickly to 30v at retrace time and permit a linear decrease in voltage on this capacitor during scan time or while the oscillator transistor is off.

The pre-driver and driver stages perform the function of isolating the vertical-output stage from the sweep-capacitor charging circuit.

The sweep capacitor during retrace time is discharged rapidly because of the 130v flyback pulse. During scan time, the capacitor starts a gradual exponential buildup. This buildup, however, is "linearized" by the feedback from the output transistor, which tends to keep the charging current constant. This produces a very linear voltage rise.

The output transistor then drives an impedance-matching autotransformer to feed the deflection yoke through a dc blocking capacitor.

Other circuit features of the KCS153 vertical circuit

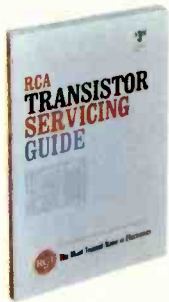
*Continued on page 85*

# Put yourself in the profit picture

All the items shown are available from your local participating RCA Tube Distributor with your purchases of RCA receiving tubes and picture tubes.

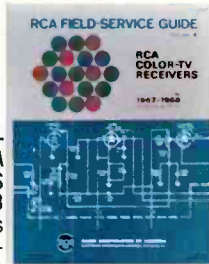


FABULOUS ELECTRIC RAZORS FROM SCHICK (1A1694M) (1A1694L) —For men, the Schick "Traveler". For ladies, the "Lady Petite".



**RCA TRANSISTOR SERVICING GUIDE (1A1673)**—This very important Guide will be indispensable to you in your understanding of transistor theory, amplifier principles and considerations and servicing!

A complete Subscription to RCA Service Notes for 1968 (1A1687)



**THE RCA FIELD SERVICE GUIDE FOR RCA COLOR RECEIVERS FOR 1967 AND 1968 (ERT-201)** — This Guide helps you perform all adjustments on 1967 and 1968 RCA Color TV Receivers that can be performed in the home.



**RCA HOT CHECK LAMP (1A1677)**—Adjust the horizontal output tube current of a color TV set quickly and easily, to prevent premature tube failure and the resulting call back.



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**IMPERIAL NON-STICK TEFLON\* COATED CUTLERY (1A1697) (1A1696) (1A1698)**—A 6" French Chef's knife, a 7½" slicing and carving knife, and a spreader-trimmer blade.

\*TEFLON is a DuPont approved finish



SATIN COLOR TV SERVICE BANNER (1A1686)



INDOOR THERMOMETER (1A1689)



**REFLECTIVE SAFETY BUMPER STRIP (1D1335)**—Offers day and night visibility for a service message on back of truck. 3" x 12".



VINYL COUNTER CHANGE MAT (1A1684)



**PORTA-FILES FROM HAMILTON SKOTCH (1A1699) (1A1700)**—The Porta-File

is a great way to organize your important records and valuable papers. Porta-File and Kabinette combination is even better.



Available through your local participating RCA Tube Distributor with your purchases of RCA Receiving Tubes and Picture Tubes. See him today!  
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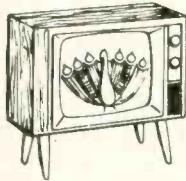
**WINDOW DISPLAY ON RCA RECEIVING TUBES AND PICTURE TUBES (1A1685)**—33½" high; 19¼" wide; 6" deep.



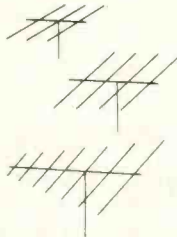
# FS134 UHF-VHF-FM Solid State Field Strength Meter



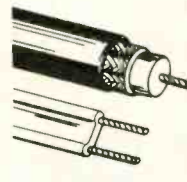
CHECK DISTRIBUTION SYSTEMS



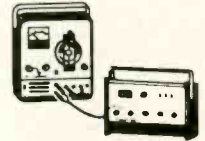
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Get in on the lucrative business in distribution systems, UHF, FM, and VHF antenna jobs with the all new FS134 completely solid state portable field strength meter. Calibrated in true microvolts on all bands:  $\pm 3\text{DB}$  on VHF-FM/ $\pm 6\text{DB}$  on UHF.

**FS134 Field Strength Meter**—The FS134 uses Jerrold coax connectors so you can correct problems on existing systems, as well as install, balance, and check new distribution systems. Built-in attenuators of 0, 20, and 40 db (X1, X10, and X100) enable you to measure signal strength from the amplifier to the last tap-off in the system. The FS134 is portable and requires no AC cord; you can take it to the top of the tower to orient the VHF TV, UHF TV, and FM antennas for best signal with minimum interaction between them. Highly sensitive: 30 Microvolts  $\pm 3\text{DB}$  on VHF-FM and 30 Microvolts  $\pm 6\text{DB}$  UHF. Separate built-in UHF tuner for greater accuracy in critical antenna work and translator checking. 4" 2% meter calibrated in microvolts and db. Uses industrial standard for 0 db, often called 0 DBJ or DBM.

Now check db loss in various cables and lines, compare different antennas and amplifiers for db gain, field intensity surveys, and show a critical customer why he needs a new antenna for his FM stereo or color TV set. The audio amplifier and speaker let you monitor the TV or FM sound signal and aid in tracking down noise. Besides the Jerrold connector for 75 ohm cable, the FS134 has a built-in balun to match 300 ohm twin-lead; no messy adaptors. The FS134 is powered by easy to get "C" cells or optional rechargeable battery supply (part #39G15), installed in minutes as cheater cord receptacle is already riveted to panel. 10" x 9" x 5", 9 lbs.

**\$199<sup>50</sup>**

**39G15 Rechargeable battery supply (less battery) ..... \$9.95**



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ELECTRONIC TECHNICIAN/DEALER

# CHASING COLOR TROUBLES WITH A SCOPE

Dust off your scope and make it pay for its keep

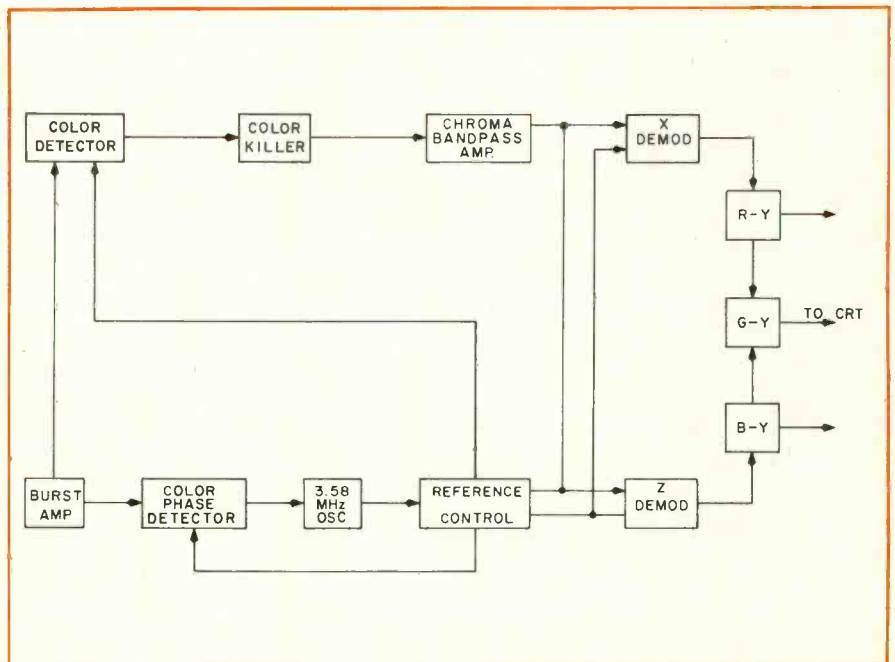


Fig. 1 — Block diagram of the basic sections of a color TV receiver.

■ If you learn how it's done, you can locate color troubles fast with a scope. First, we must isolate the trouble to the color section of the receiver. Then, check for a clean snow-free B/W picture.

If the B/W picture is good, we have possibly learned that the problem does not exist in the antenna, lead-in, tuner, RF, IF or video stages. If in doubt, feed a signal from a bar/dot generator to the grid of the 1st video amplifier stage. This will determine whether

or not the fault is in the front end of the receiver or in the color section.

Connect the bar/dot generator to the set's antenna terminals. Adjust the TINT control to the rotation center point and advance the color GAIN control.

Set the channel selector knob to the same channel as the bar/dot generator. It is wise to work with low frequency channels—2, 3, or 4.

The RCA WR64B bar/dot generator, for example, is preset to channel 3 and the color receiver

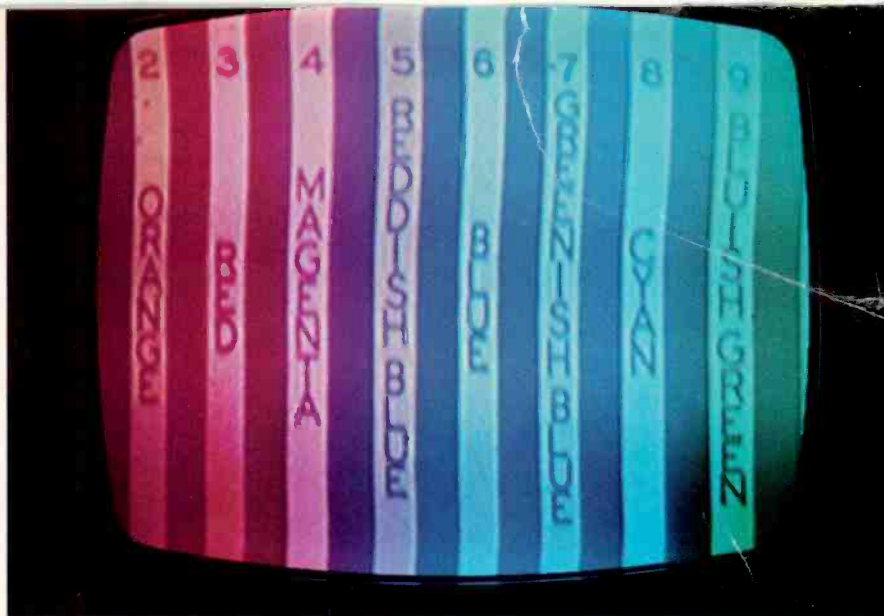


Fig. 2 — Color bars from a bar/dot generator can help you chase the lost or missing colors.

must be switched to this same channel. Keep the color gain low. In case of a weak telecast color picture, it is possible to get a strong color pattern from the bar/dot generator. The color generator output level should be adjusted to match the strongest, or average, telecast signal.

Adjust the fine tuning control to obtain a good color bar pattern on the CRT screen (see Fig. 2).

Be sure the color killer control is properly adjusted. Many times a customer will complain of weak or "breathing" color pictures and the fault lies in improper color-killer control adjustment. This is especially true in weak color signal areas. When weak or no color symptoms arise, adjust the color killer control to maximum before attempting to isolate the trouble. You will notice excessive color fringing around the features and excessive color snow if the color section is performing properly.

### Color Isolation

With the defective color screen before us, let's see what color or colors are missing. Analyze just what is lacking in the color picture. Isolate the possible color symptoms down to a given color stage or stages, and then scope that section.

Perhaps first it would be best to see what each color does and what to look for. See the block diagram of the color section in Fig. 1.

A burst amplifier stage simply amplifies the burst signal. It is keyed into conduction with a horizontal pulse. In this stage, check for out-of-phase color, off frequency color, no color lock or a loss of color.

The color killer stage is designed to eliminate color snow on a B/W picture. Check the color killer stage for loss of color and drifting color.

The chroma amplifier is a color bypass amplifier and will separate the color signal — sending it to the grid of the demodulator tubes. Check here for a loss of color, weak color, no color or loss of color detail (see Fig. 3).

A color phase detection stage improves the phase and frequency of the 3.58MHz oscillator. Also, a correction voltage is applied to the reactance stage. Look for missing, misplaced or out-of-lock color.

The 3.58MHz oscillator stage is a crystal-controlled reference oscillator and is stabilized by the reactance tube. Check this stage for no color, weak color, color drift and intermittent color. Suspect the 3.58MHz crystal and substitute with a new one.

The demodulator stages must be capable of detecting both amplitude and phase of the color signal. These "X" and "Z" demodulator stages are coupled to the R-Y, B-Y and G-Y amplifiers. Look in these stages for loss of color, misplaced color or loss of one color.

In the R-Y, B-Y and G-Y amplifier sections, check for a loss of one or possibly two colors and a poor B/W gray scale. Watch for a change in the B/W picture after the receiver has warmed up. B/W gray scale may change from a B/W picture to a tinted picture.

When the B/W gray scale will not adjust properly, also suspect a defective CRT. Check the CRT with a good tester. The emission of one color gun may be low enough to upset the B/W picture. Check the CRT for intermittent purity and poor gun convergence.

### Applying the Scope

Your wide-band scope, together with a low capacitance probe, can

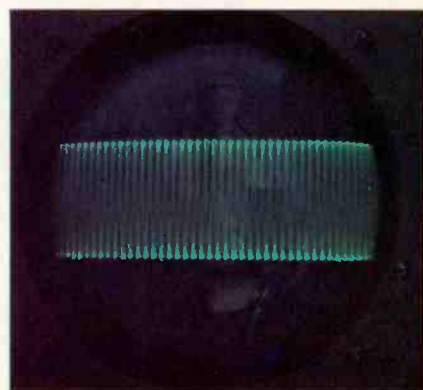


Fig. 5 — Waveform taken from the secondary of the 3.58MHz oscillator transformer in an RCA CTC22 chassis.



Fig. 3—A typical screen of a color set indicating loss or weak color. Even with the color killer wide open, all color tubes substituted, color signals were still weak.



Fig. 4—Color picture with only a green tint showing. Notice the extremely green fringing at the left side. Nine times out of ten, this condition is caused by the 3.58MHz reference oscillator failing.

be used to quickly locate many color TV circuit faults. After all suspected color tubes have been substituted, bring the scope into play. Set the scope's horizontal sweep frequency near 5MHz.

After the color bar/dot generator has been connected to the receiver's antenna terminals and tuned in, proceed to locate the color trouble. For instance, we may get a picture as shown in Fig. 4. Here we have little color except a few streaks of green. When the color contrast control is advanced, more green comes into the picture. Don't jump to conclusions — but go direct to the G-Y amplifier stage or the green screen control. From previous experience this picture tells us that the local ref-

erence 3.58MHz oscillator stage is not functioning properly.

To prove the point, check the waveform. Place the scope probe tip to the top winding of the oscillator transformer secondary. Compare this waveform with those found on the receiver wiring schematic (see Fig. 5).

Many color circuit diagrams have the correct waveforms on the schematic. Some are located several pages back — making color signal tracing a little more difficult. To solve this problem, simply clip the waveforms out and paste them in the proper places on the schematic. Of course, once you become thoroughly acquainted with these color waveforms, the aforementioned system

is not necessary. You'll memorize them.

Check the 3.58MHz waveform for correct shape and amplitude. A weak 3.58MHz crystal will result in a weak color picture or color will drift in and out. Substitute a new crystal. Sometimes it may be necessary to try a couple of different crystals in the reference oscillator circuit. After locating the color trouble with the scope, in the 3.58-MHz stage, a VTVM negative grid reading will indicate the oscillator stage is functioning. A low negative grid voltage will point out a defective or weak crystal.

#### Complete Loss of Color

The causes for no color are fairly

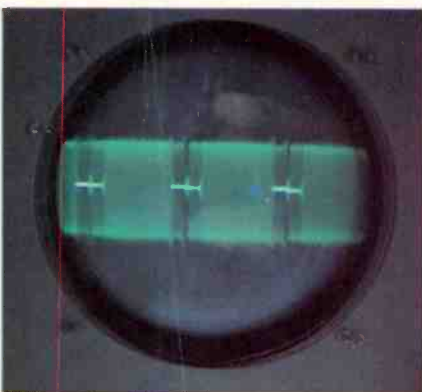


Fig. 6 — Waveform at the secondary side of the chroma bandpass transformer.



Fig. 7— Red was missing from this color picture because of a leaking coupling capacitor from the "X" demodulator plate to the R-Y amplifier grid.

waveform of the color killer stage. Then go to the grid of the burst amplifier tube.

Most color receiver schematics list the color waveforms of various stages. Know what each waveform represents and where located. Use a systematic method of checking out the color stages and you will speed the color servicing process. By quickly checking the waveforms at the grid of the burst amplifier, chroma bandpass transformer, the

For further improvement, if necessary, check the 3.58MHz oscillator waveform, burst amplifier and reactance stages.

### Actual Cases

**Weak color.** An RCA CTC25XA chassis had drifting color. It was in and out. All suspected color tubes were substituted but the fading condition continued. A scope waveform of the 3.58MHz oscillator stage showed lower-than-normal

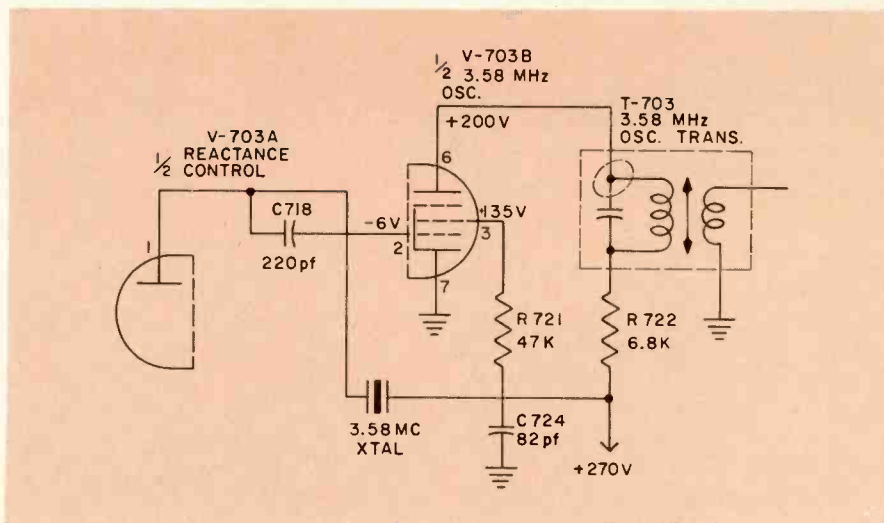


Fig. 8 — The primary side of T703 went open on this RCA CTC25 chassis.

easy to locate. But locating the causes for weak or intermittent color is more difficult.

Connect the color bar/dot generator to the receiver antenna terminals. Since all suspected color tubes have been substituted, make sure the color killer setting is at maximum. Go directly to the 3.58MHz oscillator stage with the scope probe. Check the waveform and its amplitude at the secondary of the oscillator transformer.

If everything is OK here, proceed to the grids of the two demodulator tubes. When both color and reference signals are present, the trouble is in the circuit that is common to both demodulators. In case the color chrominance signal is absent, but the 3.58MHz reference signal is present, check the bandpass amplifier for loss of color signal.

Touch the scope probe tip to the ungrounded side of the chroma bandpass transformer secondary. You should see a waveform as shown in Fig. 6. If not, check the

3.58MHz oscillator transformers, demodulator grids, the R-Y, B-Y and G-Y amplifiers, most color problems are quickly located.

### Loss of Color Sync

When color is out of lock, or sync, color stripes will show diagonally across the screen or a rainbow pattern will appear. This will be true also when color bars are fed to the receiver antenna terminals. Color bars will appear horizontally on a regular color telecast — which indicates the color is out of sync. On very weak color signals, readjusting the fine tuning control may lock the color in. Color lock will frequently jump out also with shifts in advertisements or with critical fine tuning adjustments.

Touching up the reactance tube plate coil adjustment may be all that is necessary to lock in the color. Simply ground the reactance control tube grid and adjust the reactance plate coil until the picture moves slowly one way or stands still.

amplitude. We then suspected the 3.58MHz crystal.

Before replacing the crystal, however, a voltage check was made at V703B's grid — the 3.58MHz oscillator tube. The potential was  $-4v$ . The schematic showed it as  $-6v$ . After the crystal was replaced, we measured  $-9v$ .

**No color.** A CTC22 RCA color portable came into the shop having no color. The CRT showed green streaks in the picture. Adjusting the color CONTRAST and TINT controls had no effect on the picture. A quick scope check indicated the 3.58MHz reference oscillator was dead.

In checking the oscillator stage with a VTVM we found a shorted CR703 voltage-doubler diode in the 5GH8 grid circuit. Replacing the diode restored color to the small screen portable.

We ran into the same symptoms in another similar chassis.

A scope check pin-pointed a dead 3.58MHz stage. The suspected crystal was replaced. Now we had



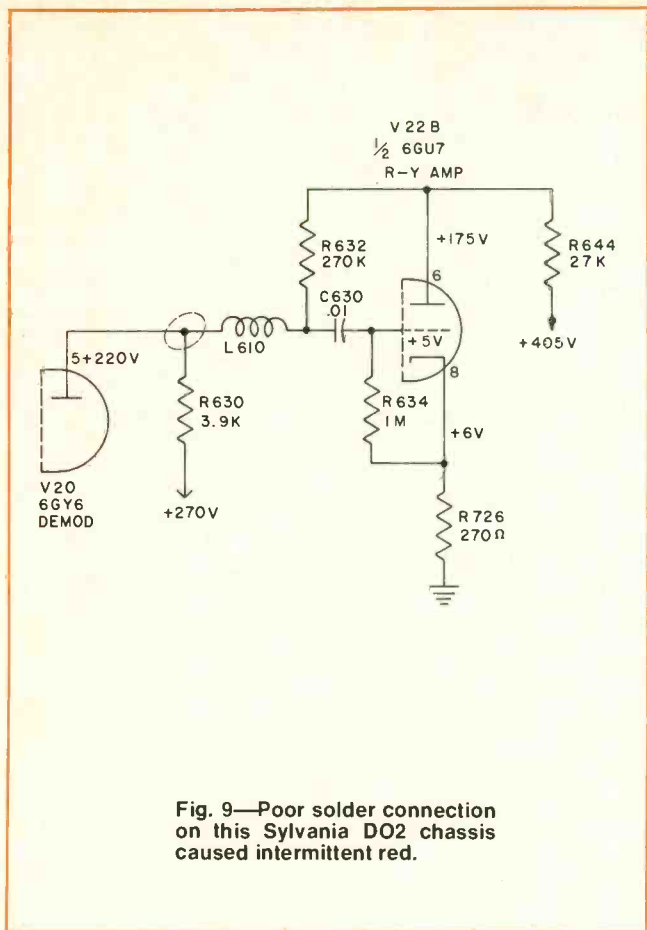


Fig. 9—Poor solder connection on this Sylvania DO2 chassis caused intermittent red.

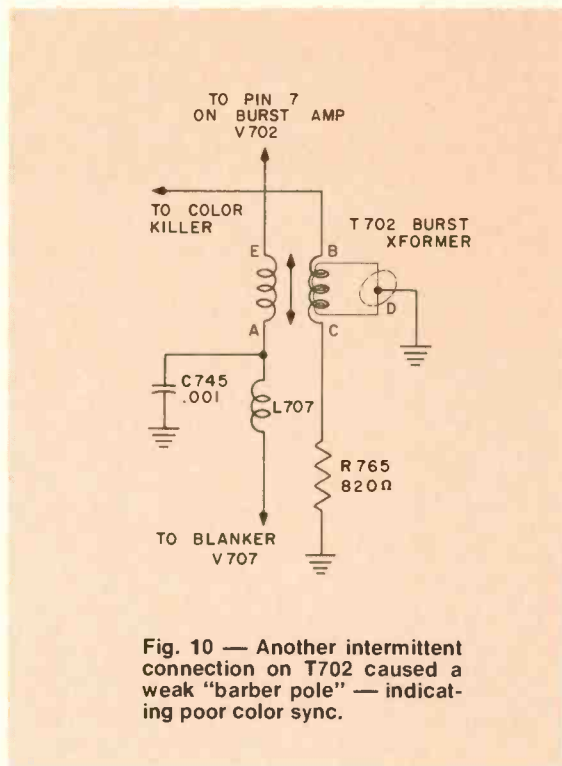


Fig. 10 — Another intermittent connection on T702 caused a weak "barber pole" — indicating poor color sync.

some color but it would drift in and out. We suspected other color stages.

After wasting precious time with other waveform and voltage checks, we ended up where we had started. Instead of checking out the oscillator stage waveform after the new crystal was installed, we second-guessed the trouble. Another new crystal was installed — once again proving that new components can also be defective and should always be checked out *first* after installation.

**Missing color.** The red color was missing from another color set. A scope check showed the red signal was on the grid of the "X" demodulator tube. But no color showed at the R-Y amplifier grid. The suspected trouble was L707 or C733.

A VTVM check indicated a 10K leakage in C733. The grid voltage at pin 9 had gone positive. And it operates normally with a negative voltage (see Fig. 7).

**Intermittent color.** This nearly new CTC25 chassis had intermittent color. The set would operate

sometimes for several hours and then the color would disappear. Then again, when cold, color would be missing and within a few minutes it would "pop" in.

The symptom was a tinted green and blue screen. The B/W picture was tinted blue. When the color disappeared altogether, adjustment of the color CONTRAST and TINT controls had no effect on the picture.

After the set operated several hours on the service bench, the color disappeared. A scope check of the 6GH8 oscillator tube revealed no reference waveform. A quick voltage check was made on pin 6 and the color reappeared. After several attempts to measure the oscillator tube plate voltage between intermittent conditions, we finally caught pin 6 with no voltage on it. Now, either the 6GH8 tube was shorted or the winding of T703 had opened. A few checks revealed that the primary winding of T703 would intermittently open and then make contact inside the metal can (see Fig. 8).

**Intermittent red.** When the color section of this Sylvania DO2 became intermittent, the symptoms on the screen were predominately green and blue. The red color was missing. But a quick scope check at the 6GY6 "X" demodulator grid showed a perfect waveform. But red was missing from the plate of the tube. "Poking" around the PC board at L610, the color would go out or it would return to normal. A poor soldered joint was discovered at L610 and R630 — feeding to element 6 of the "X" demodulator tube (see Fig. 9).

**Weak "barber pole."** A CTC-25XA chassis had an intermittent "barber pole" — indicating poor color lock.

All voltages appeared normal on the 6GH8, burst amplifier tube. An intermittent joint turned up in the secondary of T702, however. This connection would open on the grounded side, within the transformer, throwing the color out of sync (see Fig. 10). ■

Part two of a series

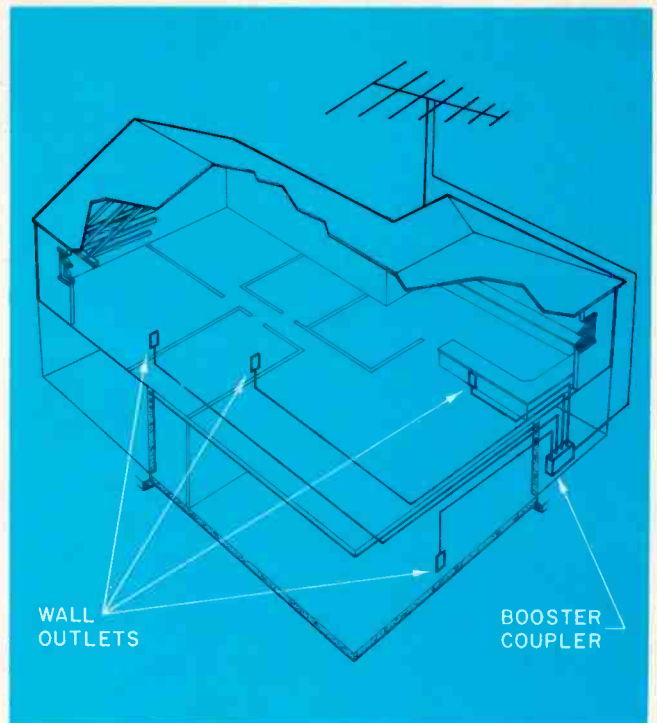


Fig. 1—Simple home MATV system in strong signal area uses a four-set splitter (or booster coupler), four wall outlets and four matching transformers.

## Selling and Installing MATV Systems

Get your share of this fast-expanding business

■ As pointed out in part one of this series (ET/D February 1968), MATV systems are designed backward—we always begin at the distribution system (output) and work our way back to the headend (input). A logical reason exists for this procedure: The needs of the distribution system dictate the headend requirements. You can't actually plan a headend without knowing what kind of distribution system it will serve. So, let's begin with a small distribution system.

### Home Systems

Since you'll probably want to begin by selling and installing home MATV systems (this market has a vast potential), let's discuss these small, relatively easy systems first.

The layout of the distribution system is determined by the layout of the house itself. Suppose, for example, in a strong signal area, you want to provide TV signals to four sets (see Fig. 1). You'll simply use a four-set splitter (or booster/coupler), four wall outlets and four matching transformers. In a small

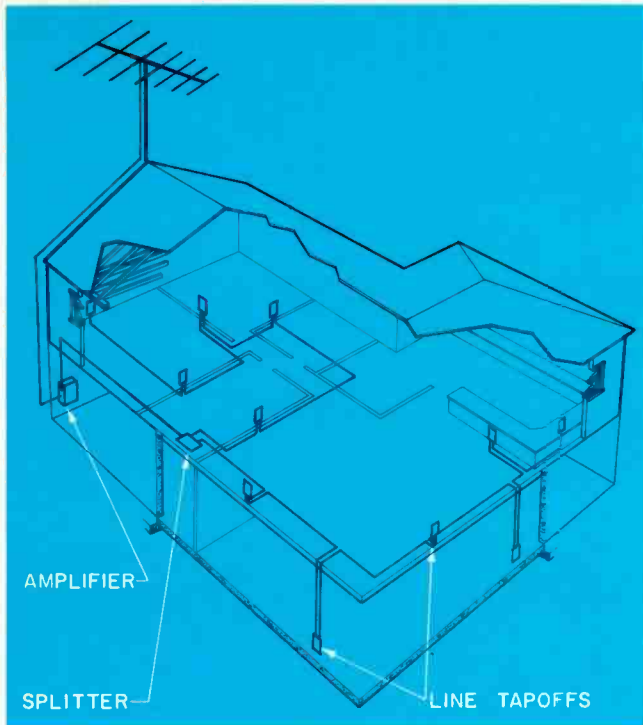


Fig. 2—System using small amplifier, a splitter and line tapoffs.

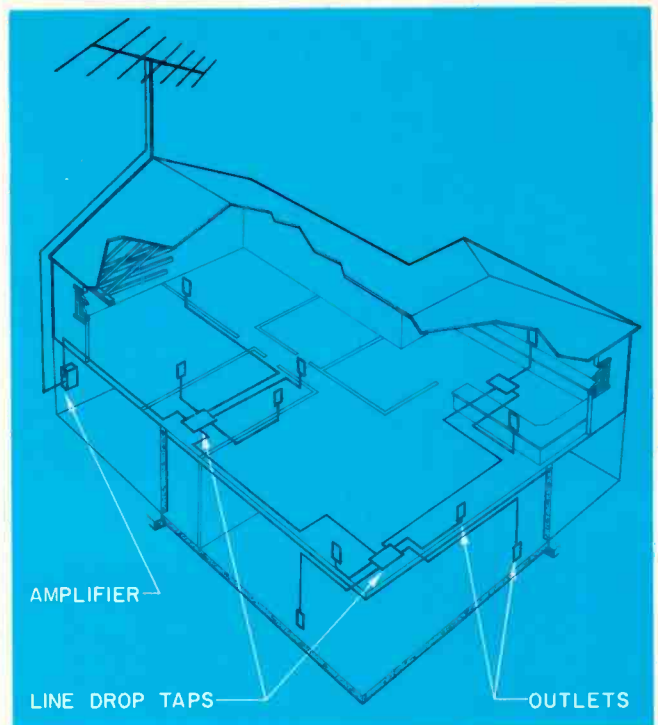


Fig. 3—Another approach to home MATV system. Three line droptaps are used with droptaps in series at locations convenient to the wall outlets.

system like this, the splitter may be combined into a single unit or a booster/coupler may be used with only the necessary addition of four wall outlets. If the signals are very strong it is recommended that 72  $\Omega$  cable be used. If the house is under construction, you can run the cable through the walls, along with the electrical conduit.

In existing houses, you'll have to run the cable through closets, along baseboards—hiding it as best you can. As for outlets, you can select from a wide variety to meet any particular need.

Remember also that antenna preamplifiers are a must for deep-fringe area reception or where one or more weak signals are mixed with strong local stations. Preamplifiers can overcome lead-in loss, establish a better signal-to-noise ratio and boost signals enough to operate up to four TV sets with no additional amplification.

The trouble with a distribution system like that shown in Fig. 1 is its lack of versatility. What if a child becomes sick and the customer wants

to move a portable into the child's bedroom? What if the TV owner wants to watch TV on the patio or enjoy a baseball game while working at a basement workbench? Obviously, more TV outlets are needed. Why not a "wall-to-wall" job, with outlets in every room and area where a TV set might be used? And some rooms would have dual outlets. If you're selling MATV for a home just being built, recommend this type of system. Point out how easy it will be for you to run the cable while the walls are open. Tell your customer you want to provide for all present and future needs.

Another system which provides more outlets for homes is shown in Fig. 2. Here a small amplifier is used, together with a splitter and line tapoffs. These tapoffs are available in surface-mounting boxes for basement walls or locations where it is not possible to run the cable inside the walls. Cable from the distribution amplifier is run from one outlet to the next.

Still another approach is shown in Fig. 3. Here line droptaps are used.

A trunkline is run from the amplifier through the attic or basement and droptaps are connected in series at locations convenient to the wall outlets. Droptaps are available having single, double or four-way outputs to supply any number of remote points where feed-through outlets may be connected.

### Larger Systems

It's a short jump from the professional home MATV system to a distribution system for a small motel. As you can see from Fig. 4, the layout is almost the same electrically, although physically it must conform to the configuration of the motel.

In laying out larger distribution systems, several factors must be considered:

1. Is the building under construction or is it finished? A building under construction, of course, makes the job a lot easier.

2. How will cable or twin-lead be run? The object is to keep cable runs short yet hidden. In existing structures, the cable can be run in air-

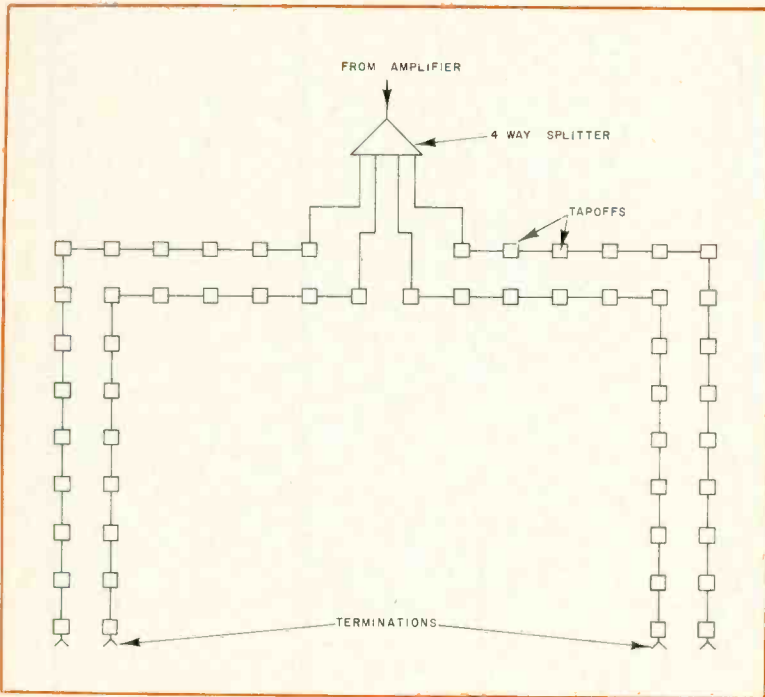


Fig. 4—MATV system for small motel.

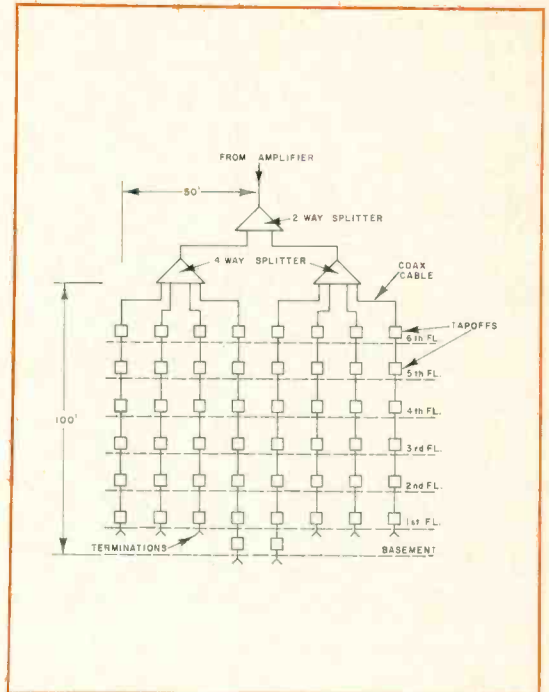


Fig. 5—Small motel or apartment house MATV system using one 2-way and two 4-way splitters.

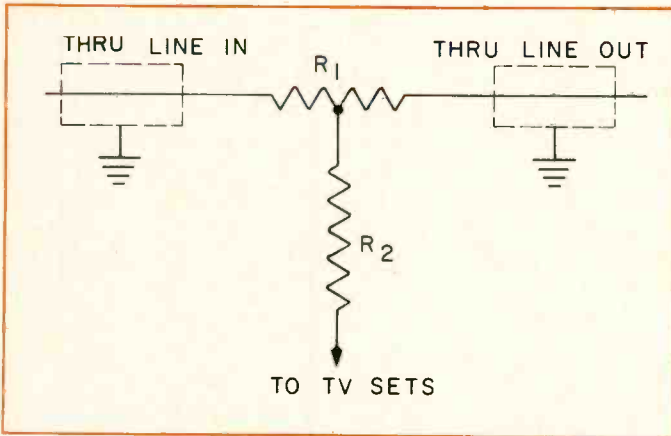


Fig. 7—Through and isolation losses represented in a tap-off.

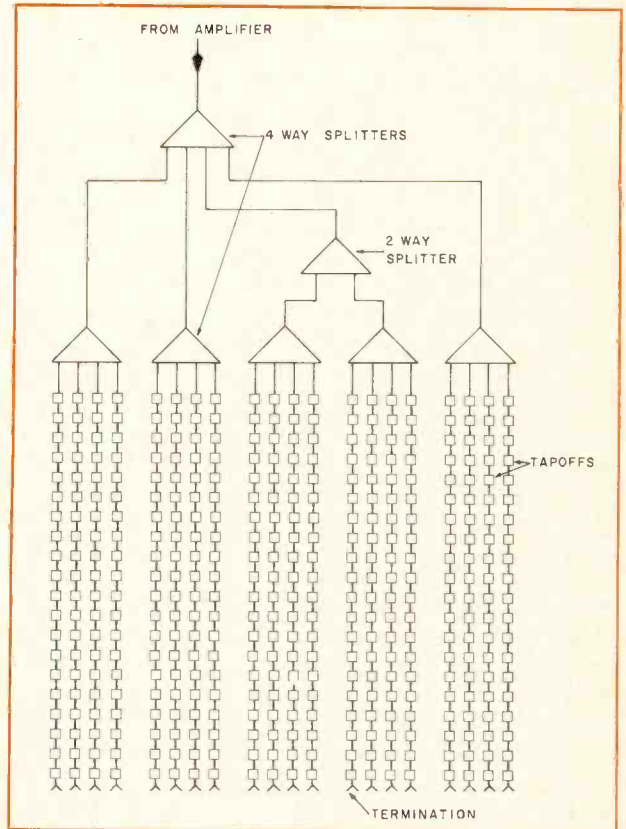


Fig. 6—System for larger motel or apartment house.

shafts, vents, conduit (if provided), along ceilings and baseboards or outdoors. In estimating and quoting the price of an MATV job, be sure you know exactly how the cables are to be run and that the owner of the building agrees to this. Some cable-run methods are much more expensive than others in terms of labor.

3. What type of tapoffs will be used? A wide variety of tapoffs are available. Choose the type that best suits the physical needs of the system you are installing.

4. How strong are incoming signals? Within 15 to 20 miles of a transmitting station, incoming signals are usually quite strong—depending on the receiving site location. It is possible in this case for the short length of twin-lead between a wall outlet and a TV set to pick up signal. This will cause a ghost on the TV screen. In these areas, you should use 75  $\Omega$  tapoffs, plus a separate set-mounted matching transformer. In more distant areas, you'll find that it is cheaper and easier to use a tapoff having a 300  $\Omega$  output.

6. How many trunkline cables will you need? In general, it's better to use two short trunklines than one long one. You get the necessary trunklines by using a splitter, 2-way or 4-way. It pays to use good quality splitters since they provide excellent isolation and relatively low loss. If you use a 4-way splitter to provide only three trunklines, be sure to terminate the unused output. Also, terminate the ends of all trunklines after the last tapoff.

Two typical distribution systems are shown in Fig. 5 and 6. Using the aforementioned criteria and these examples, you should be able to lay out any MATV distribution system.

### Calculating System Losses

During the process of designing a distribution system, you must consider the total losses in the distribution system. This tells you how much signal the headend will have to provide.

Calculating losses is simple—if you're willing to overcome any prej-

udice you may have against decibels. We mentioned decibels briefly in the introductory article of this series. Now, let's explore the subject a little further.

Decibels are used as an easy short-cut. You could calculate distribution system losses by a long series of multiplications and divisions. But db is a lot easier and faster. All you have to do is add and subtract. An example will show how easy it is.

Let's calculate the losses of the system shown in Fig. 5. The losses we're interested in occur between the input of the first 2-way splitter and the output of the basement tapoff. If we get enough signal to this tapoff, we'll get sufficient signal to all other tapoffs in the system. It is not necessary to calculate the losses in the other trunklines. The loss to the farthest tap from the headend is known as the total distribution system loss.

To calculate this loss, we'll need manufacturers' specifications and they are always given in db. Let's begin with the cable or twin-lead used. We always calculate cable losses at the highest frequency the system will carry. If it's an "82 channel" system, covering TV UHF, VHF and FM, then we figure cable losses at the high end of channel 83—890MHz.

But, let's assume our MATV system will carry no UHF stations, and the highest VHF station to be received is channel 13. Suppose the particular cable we plan to use shows a loss of 3.5db per 100 ft at 220MHz—the high end of channel 13. Since the distance between the 2-way splitter and the longest trunkline is about 150ft, the cable loss would be (1.5 x 3.5), or 5.25db. Most 2-way splitters have around 3.5db loss and most 4-way splitters have about 6.5db loss. That leaves the matching transformer loss (necessary in 75  $\Omega$  coax cable installations) of about 0.5db and the tapoff, which requires a little explanation.

A tapoff, as the name implies, actually extracts only a small portion of the signal and passes most of it

on. Two types of losses are associated with tapoffs: the through loss and the isolation loss. These losses are represented as shown in Fig. 7. Resistor R1 represents through loss and R2 represents isolation loss. Typically, isolation loss runs from 12 to 23db and through loss is a fraction of a db. Some systems use tilted tapoffs. That is, the isolation is higher at channel 2 than it is at channel 13. This tends to compensate for uneven cable losses. It may be less complex to use flat tapoffs as employed in this system.

Let's assume that we've chosen taps having 17db isolation and 0.4db through loss. But here's an important point: The signal travels through the through loss of every tapoff in the line, but through the isolation loss of only the tap in question. Hence we multiply the through loss times the number of taps in the line, but add the isolation loss only once.

Now that we have all the elements, let's begin at the 2-way splitter and add all the losses as follows:

Two-way splitter .....	3.5
Four-way splitter .....	6.5
150ft cable .....	5.25
Through loss of 0.4db times 7 tapoffs .....	2.8
Isolation loss .....	17.0
Matching xformer loss .....	0.5
Total distribution system loss .....	35.55db

To give ourselves a little tolerance we can round this off to 36db. This means that a headend amplifier that provides 36db output at channel 13, will provide 0db  $\mu$ v to the last set in the system.

You will recall from the introductory article of this series that 0d  $\mu$ v is *not* zero signal. It is equal to 1k  $\mu$ v (1000 microvolts). This is more than sufficient signal to give a snow-free picture and to drive the AGC system of any properly operating TV receiver.

The next article in this series will cover headends. Antennas, filters, traps and both single channel and broadband amplifiers will be considered—with special emphasis on signal mixing and equalization. ■



Antenna VSWR indicator. Courtesy E. F. Johnson.



Cobra 23 channel base station CB transceiver. Courtesy Dynascan.

**Don't overlook  
citizens band radio  
as a valuable addition  
to your TV-radio  
service-dealer business**



Sonar 23 channel CB transceiver.



Lafayette 525C 23 channel CB transceiver.



Johnson Messenger 350 single-sideband CB transceiver.

## Making a Go

■ In 1957, the FCC first proposed the 27MHz (11 meter) band for citizens band radio. In 1959 these frequencies were officially designated as the Citizen's Band. By July of that year, the FCC had licensed 54,000 CB mobile and base stations. And at the end of December 1967, this figure had risen to over 802,000! No wonder so many TV-radio service-dealers are taking on CB equipment sales and service. Many shops are going one step further by expanding to include both CB and business/industrial radio.

### Sales Know-How

One important thing to learn about selling CB radio is not to oversell. Know the equipment and its capabilities. Don't promise the customer communications ranges of 30 miles when you know that under normal conditions the most he can expect in his locality is 15 miles.

If you are selling a system to a previous user and owner of an older transceiver, it doesn't do any harm to explain equipment design advances which improve performance. It might also be advantageous to explain something about new antenna designs

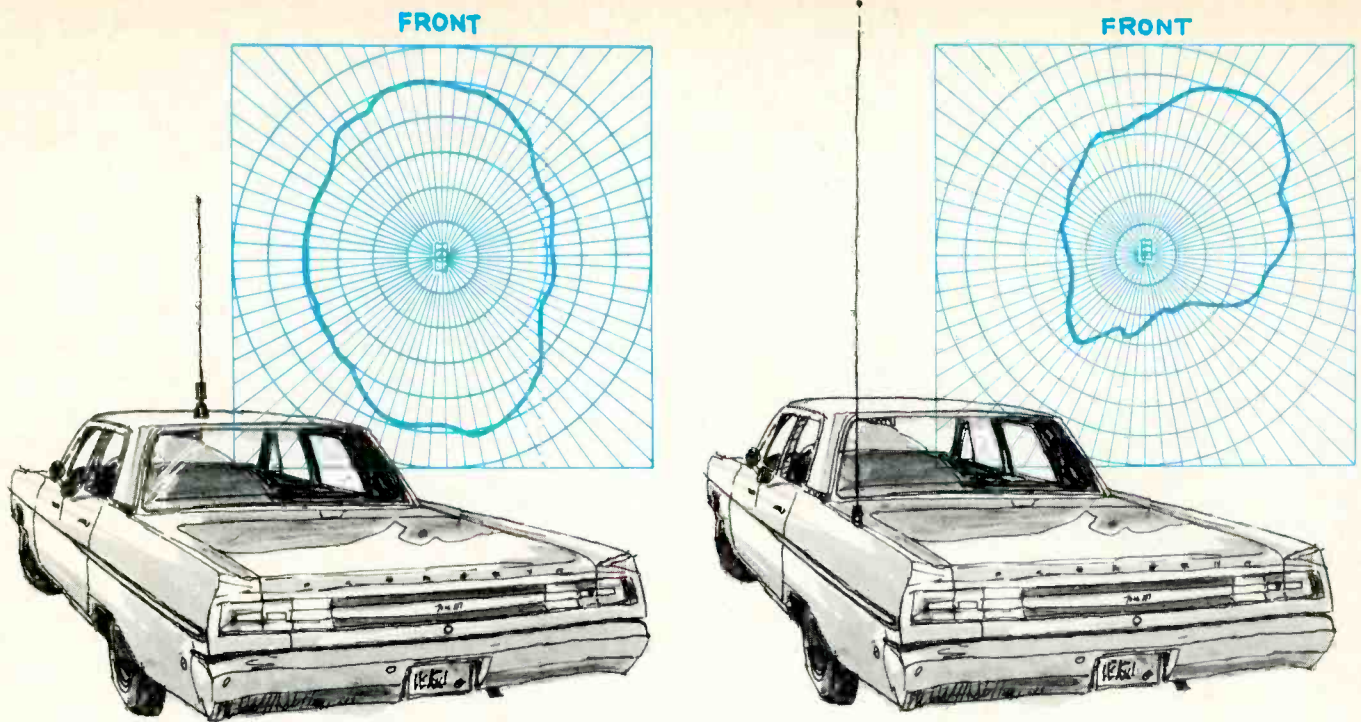


Fig. 1 (left) — Center roof mounting provides maximum omni-directional radiation.  
 (right) — Rear deck mounting provides directional pattern.

## at Two-Way Radio

Part three of an in-depth series

which may possibly increase operating range beyond that of the old antenna. But don't go overboard and make promises based on what "John Doe" claims for a "super-duper sky banger."

Some CB customers are at the mercy of the dealer when it comes to purchasing equipment. The wise dealer will first find out what the customer wants the equipment to do and then give him honest answers as to whether CB radio equipment can do the job or not. A farmer may want to install a transceiver in his house and a mobile in his combine. He may know nothing more about CB radio or how it operates than you would know about planting soy beans. In many cases, a practical demonstration is the best way to educate a new CB customer. You may want to demonstrate a system in operation at a customer's nearby farm. (Make sure you first arrange for an appointment.) If the prospective customer is going to use the 2-way radio equipment in a business where an office girl and perhaps other employees will be required to operate the unit, by all means include them in an operational training session. Customer training is even more important when

the customer is purchasing industrial communications equipment which we will get into in a future article.

### Installing the Transceiver

Generally, 2-way radio installation practices follow these three rules: mechanically secure mounting in an area which provides safe and convenient operation; proper connection, fusing and routing of power and antenna leads; and a properly installed and matched antenna system.

Before starting the installation, it is best to plan the antenna location, transceiver mounting and cable routing ahead of time. In a mobile installation, the style and location of the antenna may be somewhat dictated by the customer. He may elect to use a combination broadcast/CB antenna for appearance sake. He may want a short base-loaded whip rather than a quarter-wave (108in.) style. Whichever antenna is used, point out that the most efficient radiation is with the antenna mounted in the center of the vehicle's roof as shown in Fig. 1. The shorter base-loaded whip is more suitable here. The rear deck or fender-mounted 108in. whip is also quite

common and provides a radiation pattern as shown in Fig. 1. Most CB mobile antennas are supplied with 52  $\Omega$ , RG-58/U coax. RG-58/U is normally used for mobile installation because of its smaller diameter. However, RG-8/U may be used if desired.

Base station antennas should be mounted as high as legally permitted (20 ft above the existing structure) and clear of trees, power lines and other obstructions. Because of the longer coaxial lead-in lengths normally required in base station installations, low loss coaxial cable such as RG-8/U should be used.

Plan the installation to provide the shortest possible length to the transceiver with appropriate routing to avoid noise generating sources such as the generator (or alternator), spark plugs and other electrical accessories. The same holds true for power leads to the transceiver. The transceiver, as well as being convenient for safe operation, should be mounted clear of heat ducts and in an area which will provide rigid support. In an automobile the normal location is under the dash panel. In a truck, tractor or other such vehicle, the transceiver may be



Antenna matching unit for use with CB transceiver. Courtesy E. F. Johnson.



Pearce-Simpson Companion IV CB transceiver.



Johnson "tone-alert" paging accessory.

mounted under the dash, on the dash or overhead secured to the roof. Base station transceivers follow the same basic location restrictions—clear of heat ducts and noise generating equipment.

Once locations for the transceiver and antenna have been selected, there should be a short inventory of tools to be sure you have everything to complete the job. There's nothing more embarrassing than to have a customer's vehicle drilled full of holes, the upholstery hanging out the doors and then suddenly find you need a small drill bit after the stores are closed. Another handy item to have around is a maintenance manual for the vehicle showing the interior and electrical assemblies. Some vehicles have access channels and cutouts which can save you a lot of time if you know where they are located.

Many transceivers have mounting brackets, either supplied with the unit or as an accessory. If a bracket is not available, one can be fabricated from angle iron or heavy aluminum. The bracket should be placed in the mounting position previously selected for the transceiver. Mark the bracket mounting holes. Before drilling the dash panel, check to make sure no cables or connectors are in the way to be accidentally cut. If the transceiver is heavy or long, it may also be necessary to install a support strap at the rear of the unit. Here again, the manufacturer can often supply the strap, if needed, or make it available as an accessory. The support strap may be secured to the firewall, floor board or

other convenient location and attached to the ground stud on the rear of the radio chassis. If there is no ground stud, install one either on the cabinet or the chassis using at least No. 10 hardware.

After securing the mounting bracket (and support strap, if needed), temporarily bolt the transceiver in place with the dc power lead attached. Dress the power lead to the supply source and trim off excess wire. The power lead may be connected to the battery, starter solenoid, accessory terminal on the ignition switch or on the vehicle's fuse block. Be sure to place the proper fuse in series with the primary power lead and check polarity before making connection. Most U. S. automobiles have negative ground systems, some trucks may be positive ground. Pay particular attention to the polarity of farm machinery like tractors and combines. If the customer wants the transceiver to switch on and off with the ignition, the power lead will have to be connected to the accessory (ACC) terminal on the rear of the ignition switch or to an accessory terminal on the fuse block.

### Antennas

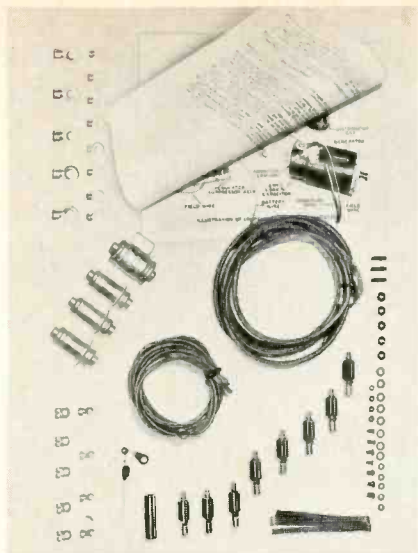
Next to the transceiver, the antenna is an important part of a 2-way radio system. No matter how good the radio is or how efficient, it will only be as efficient as the antenna to which it is connected. A little care and planning in the antenna installation can save a lot of time later on.

As previously mentioned, the best antenna location for mobile operation

is in the center of the roof. This location provides maximum coverage in all directions (omni-directional), see Fig. 1. The shorter base-loaded antenna can be mounted on the roof of the vehicle without having to remove the upholstery in most cases. The antenna normally comes with a mounting template which should be taped directly to the mounting surface. Use a center punch to mark the drill hole. Again, check the area in which you plan to drill to prevent accidental damage to wires, etc. In some automobiles, the center of the roof may be very close to an overhead light, so use caution. Drill the mounting hole with a smaller drill than the hole requires, then either ream or rat-tail file it out carefully to insure a snug fit. The 52  $\Omega$  coaxial lead-in can normally be routed across the roof to the door post or roof support brace at one corner of the windshield and then down the brace to the dash panel.

One method of routing the coax from the antenna hole through the upholstery to the dash panel is to tape or tie a length of cord to one end of a stiff wire (or straightened clothes hanger). Remove or loosen the cover on one of the door posts and work the free end of the wire up along the roof under the upholstery to the antenna hole. Pull the wire out of the antenna hole until you have the cord taped at the other end. Remove the cord from the wire and tie or tape it to the free end of the coax (transceiver end). Pull the coax back through the upholstery with the cord to the door post. Before pulling the coax too far, be sure the





Noise eliminator kit includes shielded ignition leads and suppressors. Courtesy E. F. Johnson.

other end of the coax is properly connected to the antenna, then secure the antenna in its mounting.

Route the free end of the coax under the dash panel to the transceiver location. Trim the coax to length and install the proper antenna connector. At this point, check the antenna and coax with an ohmmeter to be sure the antenna has not been shorted to the vehicle frame or that the antenna and coax are not open. If the antenna checks normal, replace the upholstery and the door post cover. Tie or clamp the coax in place under the dash.

If the antenna is mounted on the rear of the vehicle, the coax can be routed through an opening between the trunk and seat, under the carpet to the dash or out the bottom of the trunk along the chassis and up through the floor to the dash. If an installation of this type is used, check the vehicle for existing access holes. Use clamps to hold the coax in place, and avoid sharp edges and moving parts.

### System Operation

After installing the transceiver antenna, connect a VSWR meter between the coax lead-in and the transmitter. Switch the transceiver on and check for normal background noise and squelch action. If all seems normal, key the transmitter and check the VSWR. A VSWR of 1.5 to 1 is within the operating limits, however, the ideal VSWR is 1.1 to 1 and the closer the antenna is to this value, the greater the power transferred to the antenna and the more range you will have. Most

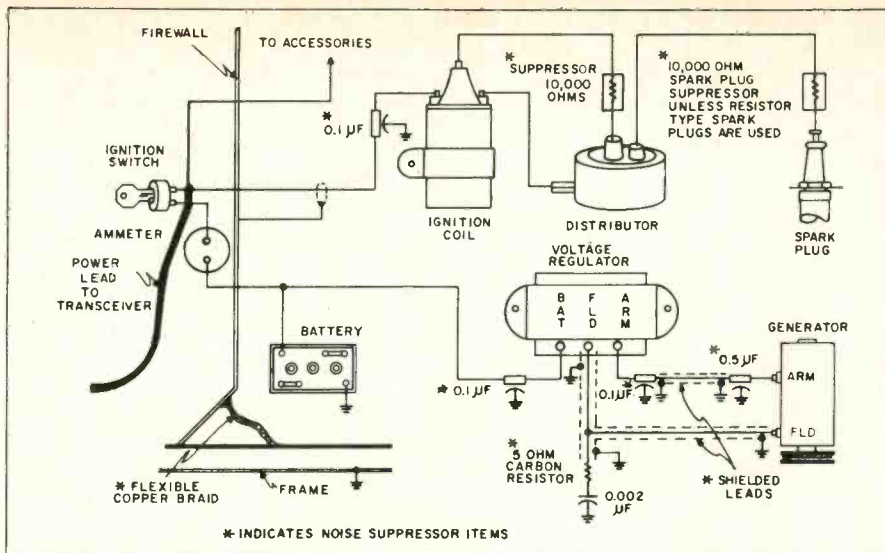


Fig. 2—Typical automobile ignition system showing location of noise suppressor components.

CB antennas are normally designed to operate over the 27MHz CB band. However, the VSWR will be higher on some frequencies in the band than it is on others because the antenna will resonate only at or near the center of the band.

VSWR is caused by mismatch in the antenna. Since the antenna is resonant at only a small portion of the band, a compromise has to be made for the rest of the frequency range. If the transmitter is to be operated on only one or two adjacent channels, the antenna may be trimmed for the lowest VSWR on those frequencies, providing the antenna to begin with is electrically longer than the lowest operating frequency. Trim the antenna a little at a time reducing the VSWR as low as possible. Further trimming will cause the VSWR to increase. The main point to keep in mind about VSWR is that since it is determined to some degree by mismatch in the antenna, tuning the transmitter will not improve it. Only antenna tuning can change the VSWR.

Another way that the VSWR may be decreased is by using a matching device between the transmitter and the antenna. An antenna matching unit simply acts to make the transmitter see the impedance it requires, and matches this impedance to the impedance of the antenna (much like an adapter between two different sizes of pipe). Some of these matching units can correct VSWR's as high as 5.1 to 1. Still, the most efficient system is one in which the antenna is tuned to the operating frequency and matches

the impedance of the transmitter. Remember, the customer expects a certain performance from his system. And the only way to guarantee satisfaction as far as the system itself is concerned, is to make a good installation of properly matched and operating components.

### Eliminating Ignition Noise

A mobile unit is continually subject to noise from passing vehicles and noise generated within its own system. The amount of noise a vehicle generates varies with each vehicle and may be checked by removing the antenna lead from the transceiver. Run the engine at different speeds and listen to the receiver with the volume up and the squelch open. A whine which increases with engine speed is generally caused by an alternator or generator. Spark plugs cause a "popping" noise which also changes speed with the engine. Other noise generating culprits are the voltage regulator contacts, ammeter gage and sometimes wheel static.

Complete ignition system noise suppression kits with detailed installation instructions are available to eliminate or reduce most of the noise problem. In addition, suppressors are available for the spark plugs and distributor coil. An RF bypass capacitor can be installed on the generator and 0.1 μ f bypass capacitors can be placed in series with the leads to the armature and battery terminals of the voltage regulator. A typical automobile ignition system with noise suppression components installed is shown in Fig. 2. ■

# TEKLAB REPORT

Part five of a series

## Using Audio Test and Alignment Instruments

**Use a specialized instrument for rapid, accurate indication of wow and flutter.**



**Gotham Model ME102  
wow and flutter meter.**



**Amplifier Corp. Of America  
Model 590A wow and flutter meter.**



**Sentinel Model FL3D flutter meter.**

■ Part four of this series covered the ac voltmeter, distortion analyzer and how they were used in various applications. We will now cover a very specialized instrument, the wow and flutter meter.

The wow and flutter meter is a complex test instrument which may not be the most popular, but as high-quality Hi Fi stereo equipment increases in use, the meter will become even more valuable.

This extremely sensitive measuring device was engineered to comply with standards set by the Society of Motion Picture Engineers for wow and flutter.

This instrument employs a rapid and accurate method of visual indication of wow and flutter content of all types of tape recorders and playback equipment including 33-1/3, 45 and 78 rpm discs and 16 and 35mm audio film mechanisms.

### **Causes of Wow and Flutter**

Wow and flutter are essentially similar distortions, except that wow is low-frequency FM and flutter is higher-frequency FM variation in tone reproduction. Both wow and flutter are caused by mechanical drive systems in the player.

Experts in the tape recorder field use the word "stiction" meaning a type of friction that causes the tape to chatter rather than to pass across the heads smoothly. Stiction at a lower frequency is known as flutter.

National Assn. of Broadcasters standards specify that flutter shall not exceed 0.2 percent when recording and playing back on the same recorder. Many of the better quality recorders will even exceed this specification.

According to standards, the take-up reel should have a constant tension of 5.5oz. This tension can vary on a 7in. reel having a standard 2.25in. diameter core. The pull at the start of the takeup can be as much as three times as strong as it is when the tape reel has been filled with tape.

The type of recording tape and thickness adds to the problem of flutter. Plastic recording tape has a tendency to be elastic to a certain degree.

The control of the speed and smooth movement across the tape head should be one of the most important points in holding wow and flutter to a minimum.

Even if the motor speed is kept constant, irregular operation of the mechanical parts in the deck can result in wow and flutter.

Mechanical parts, such as the tape deck, capstan bearings and head bracket should be rigidly designed to reduce tape displacement during operation. The tolerances between the capstan shaft and shaft bearing must provide smooth rotation of the capstan shaft. Also, the shaft must be round and a flywheel

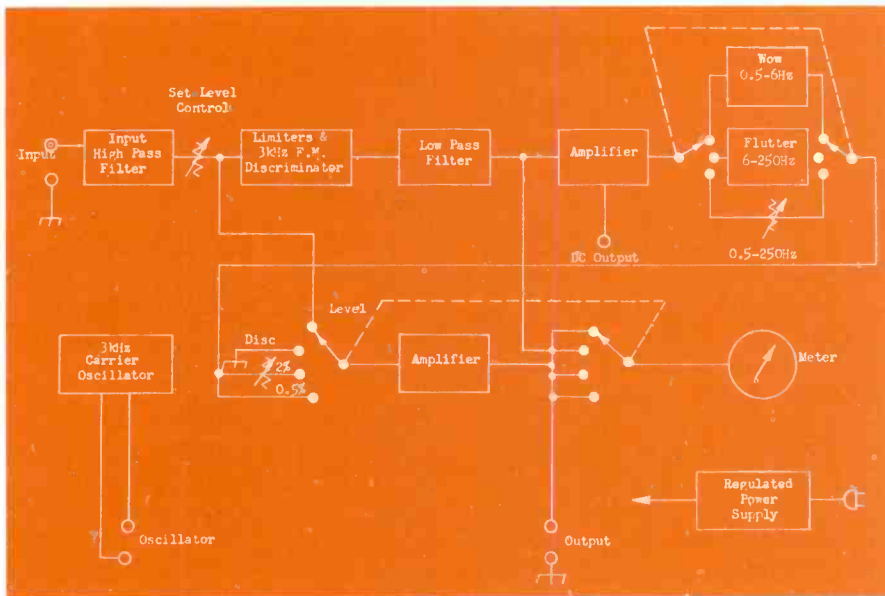


Fig. 1—Block diagram of Sentinel Model FL3D flutter meter.

must be square with respect to the shaft to prevent wobble which will cause wow and flutter.

### Circuit Operation

We will now explore the circuits of a typical flutter and wow meter, the Sentinel Model FL3D1.

The circuit employs the basic principles involved in the detection of FM signals. This includes using a limiter amplifier to prevent the amplitude modulation components from producing an indication in the output circuits. AM, for example, may be introduced by drop-outs in the magnetic coating of recording tape, clicks and pops in records and light fluctuations in photo recording. A frequency discriminator demodulates the flutter signals and presents them to an averaging-type meter circuit calibrated to read the RMS value of sinewave modulation. Suitable filters are provided to examine the wow and flutter spectra separately. A regulated power supply and internal 3kHz carrier oscillator complete the circuit sections. The meter functions are illustrated in the block diagram shown in Fig. 1.

A two-section highpass RC filter connects the INPUT terminals with the SET LEVEL control. The function of the filter is to remove the low frequency components from the incoming flutter modulated 3kHz tone. The network attenuates frequencies below 1kHz. The signal is

next amplified in a Class A amplifier stage and feeds a symmetrical double diode limiter. This circuitry has been designed for symmetrical clipping of the signal to avoid introducing phase modulation components on the main signal because of changes in the zero-axis crossings associated with nonsymmetrical limiting.

The limited signal is amplified and fed into the pentode section of the 6U8 which acts as the amplifier of the Foster-Seeley discriminator. The detected flutter signal is taken from the 6AL5 detector and passed through appropriate filters to remove the carrier signal. A front panel control, DISCRIMINATOR CENTERING, is provided to allow the discriminator secondary tuning to be adjusted to the frequency of the incoming signal. Under most conditions, this control will be adjusted for 3kHz operation which is the frequency of the factory-calibrated internal-carrier oscillator. The control may require adjustment when using a prerecorded signal that is being played back at a slightly different speed, resulting in off-frequency operation. The bandwidth of the discriminator is such that a flutter modulation signal of 250Hz is attenuated no more than 3db from a reference frequency of 15Hz. Sufficient response is available to identify frequencies to 350Hz with an oscilloscope.

The demodulated flutter signal is amplified and fed to a selector switch which permits the wow, flutter or over-all wow, plus flutter components, to be measured. The cathode of this amplifier tube is also connected through an isolating resistor to the test point on the rear apron for recording purposes. While a small positive quiescent potential is on this point, it can be bucked off by the appropriate centering controls on the direct recorder amplifier or by using a small series battery. This dc response is valuable for drift measurements.

The filters to separate the wow and flutter components consist of three section RC filters designed to give the sharpest knee characteristics. The crossover frequency is 6Hz which is in accordance with the IEEE standards.

After the signal has passed through the filters, it is again amplified and fed to a diode averaging circuit. Full scale meter sensitivities of 2.0 percent and 0.5 percent are provided.

The selector switch for the flutter range also provides a position for monitoring the input signal for proper level setting and for connecting the meter across the discriminator to indicate proper center frequency adjustment.

The 3kHz carrier oscillator is a standard Hartley circuit. Through using toroids and stabilized tech-

## Test Instruments . . .

niques, the stability of this oscillator is remarkably good. The output of the oscillator is available on the front panel for recording purposes. Approximately 2.0vac is generated across a load impedance of 200  $\Omega$ . The frequency of the oscillator has been factory-adjusted to 3kHz. It may, however, be changed by the screwdriver control shaft on the rear of the unit. This control is normally locked in place with cement prior to shipment.

Regulated high voltage is provided by a voltage-regulated flow discharge tube and will provide stable operation of the meter over line voltage fluctuations of plus or minus 15 percent from 117vac. The power transformer will operate on a 50 to 400Hz input power frequency.

### Putting the Meter to Work

This particular meter operates by measuring the degree of frequency modulation which is present on the 3kHz signal fed to the INPUT terminals. Hence, it is necessary first, to employ the instrument, that a 3kHz signal be obtained which has been passed through the recording and reproducing media to be tested.

In the case of a tape system, the 3kHz signal can be obtained in a relatively simple manner. With the usual tape recorder, the output from the OSCILLATOR terminals on the front panel is fed to the input of the tape in the normal manner. The tape is then rewound and the output signal from playing the recorder tape is fed to the INPUT terminals of the meter. In this way the inherent flutter both of the tape recording process and the tape playback process of the particular tape machine being checked will be measured.

If the tape machine has a monitor head, the measurement of flutter is made even simpler. The procedure is as follows: The output from the OSCILLATOR terminals is fed to the input jack of the tape recorder and is recorded on the tape at normal amplitude. Then the output from the monitor provision of the tape recorder is fed to the INPUT terminals of the meter. In this way the flutter of the tape system may be measured

at the same time that the signal is being recorded.

To make a flutter measurement on a disc or film system it is normal that the 3kHz signal be recorded on a machine separate from the playback instrument. Thus, two problems are interposed: (1) the difficulty of obtaining a disc or film record that is actually on 3kHz and (2) isolating the flutter of the recording media from the flutter of the playback media. This is to say that it is extremely difficult to make a record in which the flutter recorded into the record is less than 0.1 percent. Also, it is less difficult to make the flutter lower than 0.1 percent in a disc playback turntable, than it is to make a recording system having an equivalent flutter level. This is true simply because the variable force components of a disc recording system are much greater than in the equivalent disc playback system.

### Making a Measurement

Switch the instrument on and allow it to warm for at least three minutes for a flutter measurement.

1. Connect the INPUT terminals of the meter to the flutter modulated 3kHz output signal of the recording or the playback system to be checked. With the function control on LEVEL position, adjust the SET LEVEL control until the meter reads mid-scale. The input terminal potential required is approximately 0.1v. This will provide limiting of plus and minus 20db. If the input signal is below this level, satisfactory operation may be obtained with a signal indicating 0.1 percent on the 0.5 percent scale with a corresponding amplitude modulation.

2. Rotate the function switch to the DISC position to check for discriminator center frequency tuning. Zero meter deflection indicates the discriminator is tuned to the incoming signal frequency. A positive indication means the input signal is above the discriminator center frequency, and a below zero reading shows a lower incoming frequency. Adjust the DISCRIMINATOR CENTERING control for zero reading.

3. The function switch may be set to the 2.0 percent or 0.5 percent position to measure the wow, flutter or over-all wow and flutter frequencies with the desired setting of the bandwidth switch. The indicated flutter is measured in terms of the RMS frequency deviation of the flutter or wow, expressed as a percentage of the average signal.

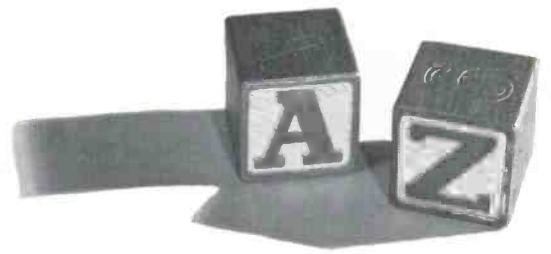
### General Information

It should be pointed out that the instrument will give a meter indication when the INPUT terminals are open and when the SET LEVEL control is adjusted up. This is caused by extraneous signals picked up by the INPUT terminals. This condition is characterized by a steady meter reading or when the OUTPUT signal is observed on a scope, a random, evenly distributed noise spectrum is seen.

The same effect sometimes occurs as a result of meter amplifier thermal noise when the 3kHz signal is absent. When the signal is applied, however, the signal plus noise-to-noise ratio allows only the flutter to be indicated. This phenomenon can easily be verified by observing the flutter signal with a scope and then removing the 3kHz input signal—leaving the amplifiers connected to the INPUT terminals.

In those cases where the incoming signal frequency is higher than the 3kHz internal oscillator, it is possible to obtain an estimate of the input frequency by first connecting the OSCILLATOR output to the INPUT terminals and adjusting the DISCRIMINATOR CENTERING control to a zero meter reading. The function switch should be in the DISC position. Next substitute the frequency to be measured for the carrier signal. An indication of 0.1 percent on the 0.5 percent scale means the signal is approximately 2½ percent higher than the 3kHz reference.

Because the meter discriminator coils, response is relatively broad and because of the CENTERING control range, signals that vary up to  $\pm 5$  percent away from the 3kHz input frequency may be accepted with little affect to the reading. ■



# Semiconductors from A to Z

Understand new photoelectric applications and your future servicing will be easier

The 21st article in a continuing series

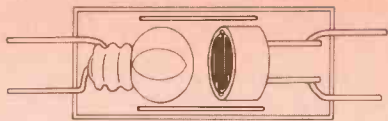


Fig. 1—Some of the optical-electronic insulators now on the market contain an incandescent lamp and photoconductive cell combined as a single component.

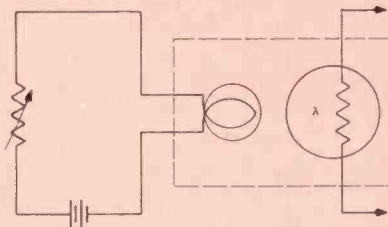


Fig. 2—Reducing the resistance between the battery and incandescent lamp increases the brightness of the lamp and reduces the resistance of the photoconductive cell.

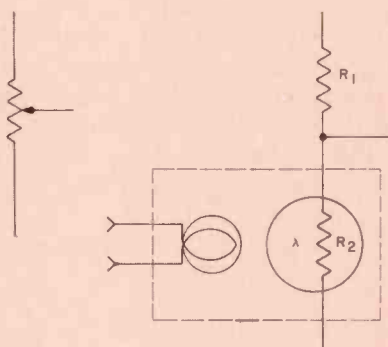


Fig. 3—An incandescent coupler and resistor can be made to function somewhat like a potentiometer voltage divider.

■ The last three articles in this series described photosensitive semiconductors, photoemissive semiconductors and basic optical systems. These can be combined to perform interesting functions in new electronic products that are already on the market or may soon be placed on the market.

## Incandescent Couplers

Incandescent lamps and photoconductive cells have been combined into a single optical-electronic insulator component (Fig. 1). These couplers prevent the transmission of virtually all signals from their output to their input, eliminating undesirable signal radiation or interference at the input. Since there is no electrical connection between input and output, there is generally no need for concern with differences in potential between the two.

A voltage applied across the incandescent lamp (Fig. 2) causes the lamp filament to glow, and the light emitted reduces the resistance of the photoconductive cell. Within the limits of the lamp's rated capacity, the greater the applied voltage, the smaller the output resistance.

An incandescent lamp cannot be heated to its full brightness the instant the maximum voltage is applied, nor can its brilliance diminish as rapidly as the applied voltage. The incandescent lamp's slow response time restricts its use as a variable light source to the lower audio frequencies (generally below 200Hz).

This is lower than the frequency response of the photoconductive cells, and therefore generally no reason exists for producing incandescent couplers with photosensitive semiconductors designed for a higher frequency response.

TEKLAB studies indicate that incandescent lamps can produce noise at higher frequencies than their frequency response. When exposing a photofet to an incandescent lamp used in a flashlight, we found that by tapping on the flashlight a microphonic audio signal was produced at the lamp filament's mechanical resonant frequency. This problem can be eliminated by diffusing the light (breaking up the image of the filament) before it strikes the photocell.

The incandescent coupler can be used in place of a potentiometer (Fig. 3) in such applications as a remote receiver's volume and tuning controls. (Volume controls are shown in almost all radio receiver schematics, while a radio tuning potentiometer is shown in Fig. 12 of the December 1967 article.) Potentiometers (left portion of Fig. 3) generally function as voltage dividers, and their total internal resistance remains relatively constant. By moving the potentiometer tap across the resistive material, the total resistance is divided into two parts, and it is the ratio of the tapped resistance to the total resistance that determines the portion of the applied voltage present at the tap. This is quite similar to the function

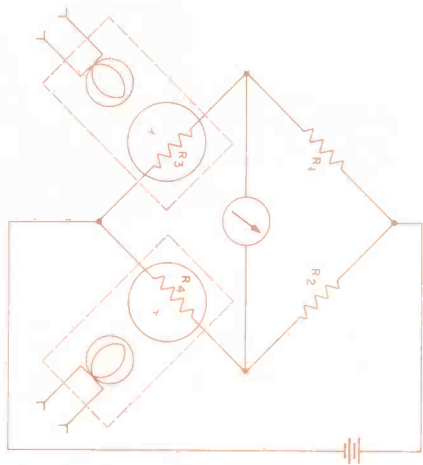


Fig. 4—Two incandescent couplers can be used in a Wheatstone bridge circuit to operate a stereo balance indicator.

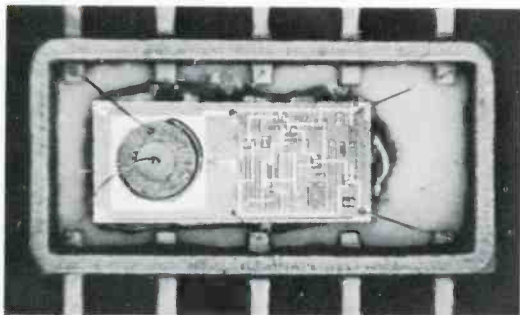


Fig. 5—A luminescent coupler (left) can be made small enough to be considered part of an integrated circuit (right). Courtesy of Texas Instruments Inc.

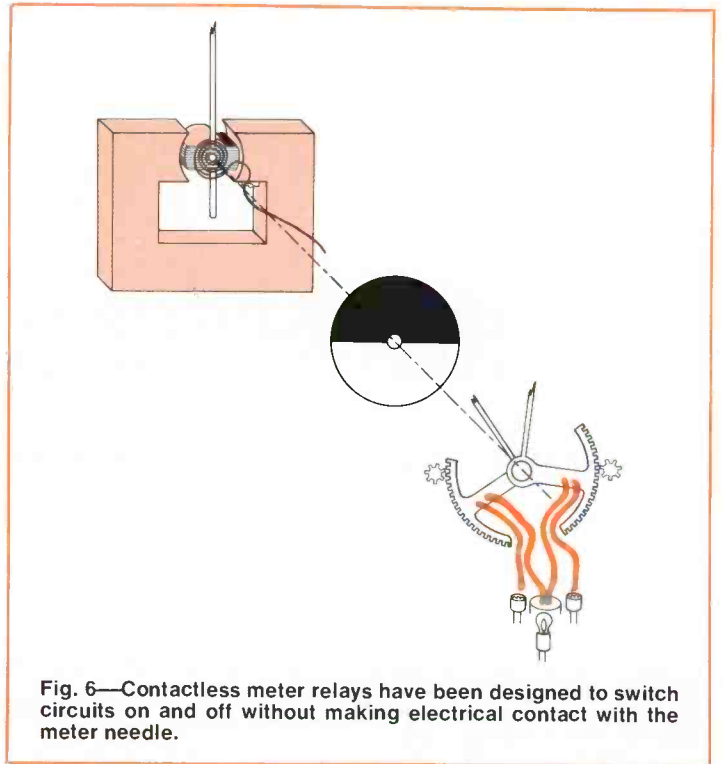


Fig. 6—Contactless meter relays have been designed to switch circuits on and off without making electrical contact with the meter needle.

of a voltage divider containing an incandescent coupler and a resistor (right portion of Fig. 3). Although the total resistance in this circuit ( $R_1 + R_2$ ) does not remain constant (the value of  $R_2$  changes with light intensity), it is the ratio of one of these resistances to the total resistance (like the ratio of resistances in a potentiometer) that determines the portion of the applied voltage present at the common lead. A remote potentiometer can alter the voltage applied to the incandescent lamp, which in turn alters the voltage drop within the voltage divider circuit.

A stereo balance indicator (Fig. 4) can be designed by combining two incandescent couplers in a Wheatstone bridge circuit. Each incandescent lamp in the indicator is connected with a capacitor to the output of one of the amplifiers in the stereo system. The amplifier's audio output signal lights the corresponding incandescent lamp, and the stronger the signal, the brighter the lamp and

the smaller the photoconductive resistance.

When the same signal is applied to both inputs of the stereo amplifier (a monophonic record, tape or radio program), the output of both channels and the resulting photoconductive resistances will be equal when the stereo amplifier is balanced. Under these conditions the Wheatstone bridge circuit is balanced and there is no deflection of the balance indicator meter.

When the stereo system amplifies the same signals and the amplifiers are not balanced, the output of both channels and the resulting photoconductive resistances will not be equal. Under these conditions the Wheatstone bridge is out of balance and there is a corresponding deflection of the balance indicator meter, showing which amplifier has the greater gain. The meter deflection will be reduced to zero as the amplifier gains are adjusted so that their outputs are equal and both incandescent lamps are of equal brightness.

### Luminescent Coupler

The frequency response of optical-electronic insulators can be improved by using a light-emitting diode instead of an incandescent lamp. One luminescent coupler component currently on the market reportedly has a frequency response exceeding 60kHz and as much as 5kv input-to-output insulation.

A small (gallium-arsenide light-emitting diode/silicon light-sensitive diode) optical-electronic insulator has been designed to function as part of an integrated circuit (Fig. 5) and transmit ac or dc signals while providing  $\pm 100v$  input-to-output insulation. When functioning as a broadband pulse transformer, the optically coupled integrated circuit reportedly has a frequency response extending from dc to 100kHz.

Luminescent couplers can eliminate a problem frequently encountered with present electronic scope switches. The two scope switch inputs do not have separate floating grounds; and ground leads basically

must be connected to the same portion of the circuit being tested. With such scope switches it is not yet possible to compare signals across two resistors biased at different potentials above ground. By using luminescent couplers however, an electronic scope switch can now be designed having separate floating grounds. The input leads are connected to ungrounded conventional voltage-divider circuits and the signal is amplified by a battery-powered field-effect transistor (FET) before passing through a luminescent coupler to the conventional, common-ground, scope switch amplifiers. (Batteries or a power supply driven by an RF transformer is required for this application since using a conventional ac power supply would tend to reduce the desired high impedance between the two floating grounds by capacitively coupling them to the common ground.)

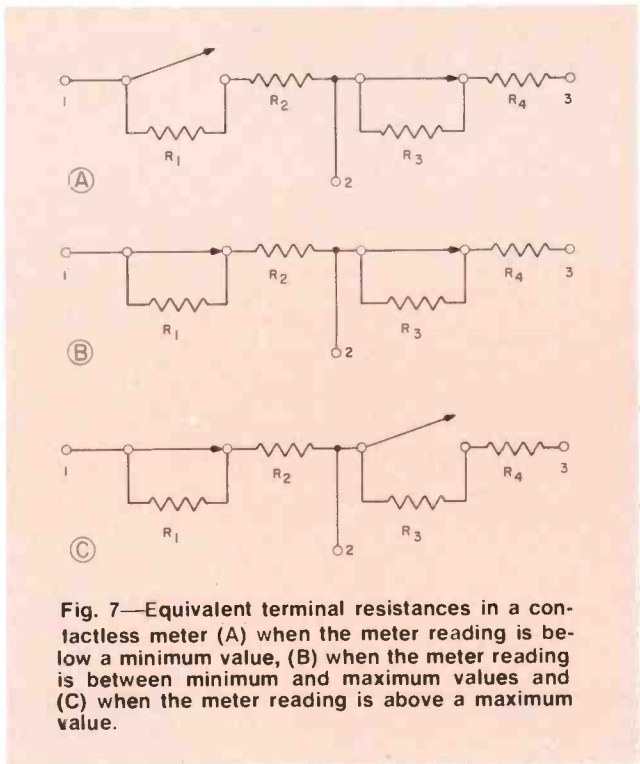


Fig. 7—Equivalent terminal resistances in a contactless meter (A) when the meter reading is below a minimum value, (B) when the meter reading is between minimum and maximum values and (C) when the meter reading is above a maximum value.

### Contactless Meter Relays

Optical meter relays have been on the market for only a relatively short time and may still be merely a curiosity for some technicians. Any meter reading on an optical meter relay can be used to switch circuits off or on. Their possible applications are numerous: If used in a VOM or VTVM, it can automatically switch off the circuit whenever the meter needle is deflected beyond a predetermined point. When connected to a power supply, the meter needle may be used to disconnect circuits when the needle falls below a certain point and reconnect those circuits when the needle rises above a certain point.

The basic meter movement in a contactless meter relay resembles that of a conventional meter (left portion of Fig. 6), with the exception of a lightweight disk (central portion of Fig. 6) that is secured to rotate with the meter needle. Half of the disk is black to absorb light, while the other half is white to reflect incident light.

The optical system (right portion of Fig. 6) is secured to the meter case behind this disk. A pair of flexible fiber optics are secured to each of two supports, which are rotated by pinions secured to knob

shafts. By turning the knobs, the pinions move the fiber-optics supports, changing their relative position behind the black-and-white disk.

When the meter needle, black-and-white disk and fiber-optics supports are in their present position, light, passing through the central pair of fiber optics from the light bulb, is reflected on the white surface of the nearby black-and-white disk. The reflected light passes through the outer pair of fiber optics and illuminates a pair of photoconductive cells, reducing the electrical resistance of these cells.

When the meter needle moves left of center, the attached black-and white disk must also move. Under these conditions, the left pair of fiber optics is then exposed to a black surface and not enough light is reflected to reduce the resistance of the left photoconductive cell, while the right pair of fiber optics is exposed to the white surface and enough light is reflected to reduce the resistance of the right photoconductive cell.

When the meter needle moves right of center, the attached black-and-white disk must also move again. Under these conditions, the

left pair of fiber optics is exposed to the white surface and enough light is reflected to reduce the resistance of the left photoconductive cell, while the right pair of fiber optics is exposed to the black surface and not enough light is reflected to reduce the resistance of the right photoconductive cell.

When the meter needle is right of center, the left photoconductive cell is not exposed to light and its resistance is at a maximum ( $R_1 + R_2$ ), while the right photoconductive cell is exposed to light and its resistance is reduced to a minimum ( $R_4$ ). (The electrical equivalent of this situation is shown in Fig. 7A.) When the meter needle is centered (Fig. 7B), both photoconductive cells are exposed to light and their resistance is reduced to a minimum ( $R_2$  and  $R_4$ ). When the meter needle is left of center (Fig. 7C), the left photoconductive cell is exposed to light and its resistance is reduced to a minimum ( $R_2$ ), while the right photoconductive cell is not exposed to light and its resistance is at maximum ( $R_3 + R_4$ ).

Pointers are secured to the two fiber-optics supports, and they indicate on the meter needle scale the readings at which the meter will

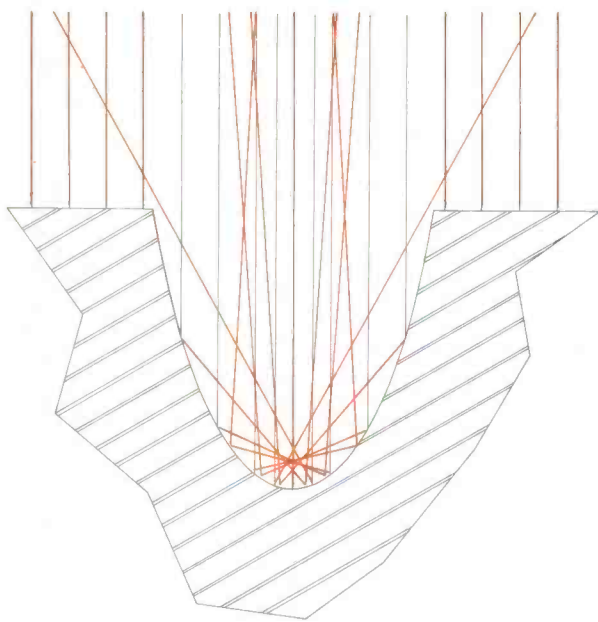


Fig. 8—Reflections that occur when light is focused vertically onto the surface of a phonograph record.

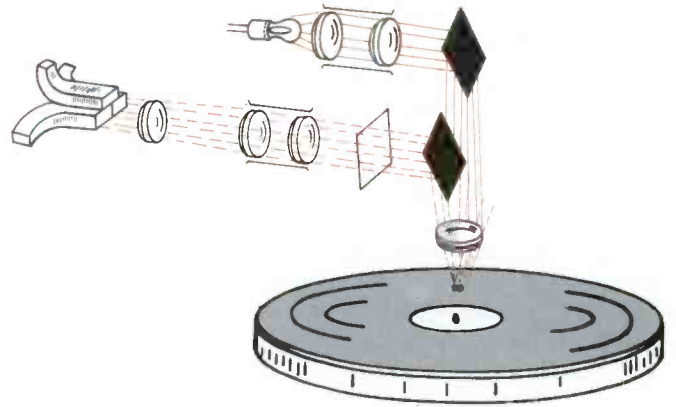


Fig. 9—Basic arrangement of components in an optical system designed for playing phonograph records. (Protected by French Patent No. 1,502,418. United States, Canadian, British, West German and Japanese patents pending.)

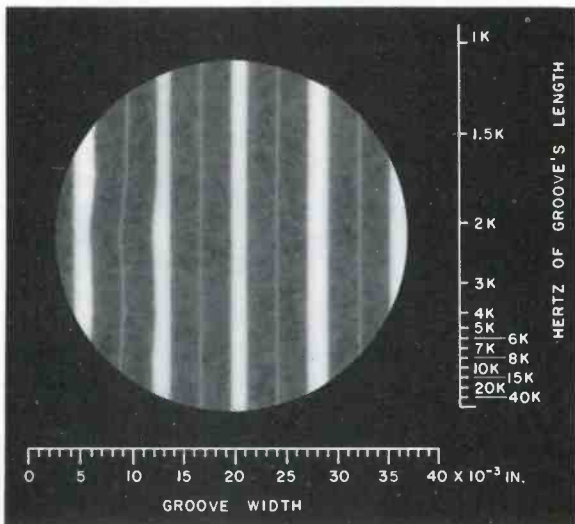


Fig. 10—The type of image produced by the grooves of a 78rpm phonograph record. Hertz measurements are appropriate for grooves 9in. from the center of the record.

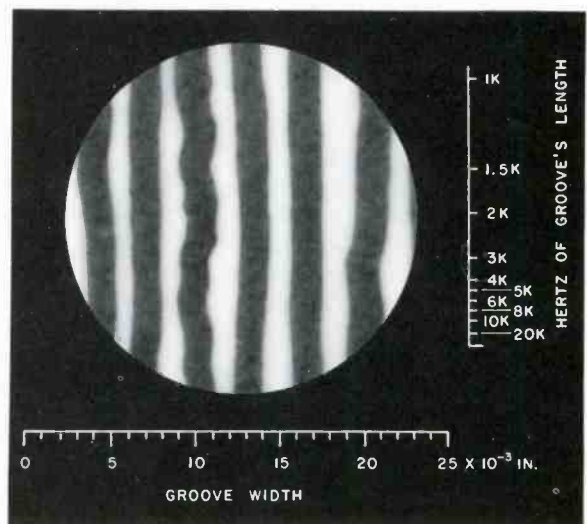


Fig. 11—The type of image produced by the grooves of a 33 1/3rpm stereophonic phonograph record. Hertz measurements are appropriate for grooves 9in. from the center of the record.

switch electrical circuits on or off. The position of these pointers and the fiber optics is changed by the knob-connected pinions.

### Needless Phonograph

An optical system has been developed that shines light vertically onto the surface of stereo and monophonic records (like those in current use) and produces an image of the record groove that can be converted into an audio signal by photosensitive semiconductors.

When light is focused vertically onto the surface of a phonograph record (Fig. 8), some of the light is reflected vertically — reflected from

the horizontal surface adjoining the groove, from the horizontal center of the groove and from multiple reflections on the sides of the groove that total a vertical reflection. Only the vertically reflected light returns through the optical system. The light reflected vertically as a result of multiple reflections along the sides of the record groove becomes polarized as it is reflected and can be removed with a polarized filter. Only light reflected from horizontal surfaces remains.

An optical system designed to perform the function described is shown in Fig. 9. There a pair of lenses (top of figure) is used to

focus the lamp's light into a nearly parallel beam (a beam of nearly infinite focal length). This light is reflected downward and through an objective lens by a mirror, or prism. A second mirror, or prism, casts its shadow over a portion of the objective lens and light from the lamp passes through only slightly less than half of the lens.

Light reflected vertically from the record passes through both halves of the objective lens, but the second mirror, or prism, is positioned so that it reflects only the light that passes through the shadowed portion of the lens. Light passing through that portion of the lens



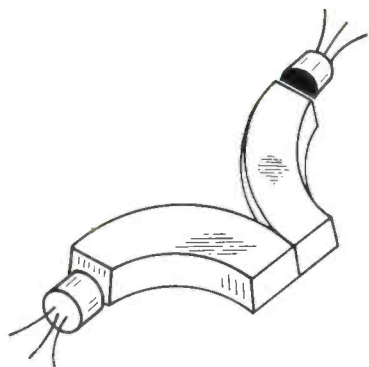


Fig. 12—A pair of fiber optics is used to split the groove image and transmit a portion of the image to each photocell.

does not contain reflected images of the light source but merely the less intense image of the record.

From Fig. 7 and 9 in the March 1968 article we see that the shape of an image formed at the lens' focal length (now the light focused on the record) is not affected by reducing to less than half the portion of the lens used to form it, and nearly half the light normally passing through a lens (now the light returning from the record) can be blocked without affecting the quality of the image it forms. By using a single lens, rather than two lenses, to perform this dual function, we are able to project and receive virtually a vertical beam of light.

The light reflected by the record and second mirror, or prism, passes through a polarized filter to remove light reflected by the sides of the record groove. The remaining light then undergoes further magnification, and the image of the record is focused on a set of fiber optics.

The central portion of Fig. 10 shows the type of image obtained from a 78rpm record. Each broad black band is formed by the record groove. The irregular white bands are formed by the flat surface adjoining the grooves, and the narrow white lines are formed by the bottoms of the grooves. The scale superimposed beneath the groove's

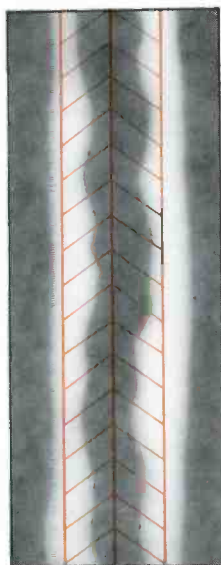


Fig. 13—Different patterns are used to illustrate the portions of a 33 1/3 rpm record groove seen by the two photocells—a different view for each photocell.

image indicates the groove's actual physical dimensions, while the vertical scale indicates the Hertz (cycle per second frequency) corresponding to the length of recorded sound waves at a distance of 9in. from the center of the record.

A somewhat similar image is obtained from a 33 1/3 rpm stereophonic record (Fig. 11). Standard stereophonic records are cut in such a manner that one recorded audio channel can be seen on one side of the groove, while the other recorded audio channel can be seen on the other side. This is most clearly demonstrated by the third groove from the left. Because 33 1/3 rpm grooves are cut much finer than 78rpm grooves, the central portions of these smaller grooves are not normally visible unless the optics are critically adjusted.

The two scales in Fig. 11 are basically the same as those shown in Fig. 10. The horizontal scales differ mainly because of a different degree of image magnification, while the vertical scales differ also because of different record speeds.

We observed that black-and-white images were produced by these vertical reflections even when red, yellow or transparent records were substituted for the regular black ones. Since, as indicated in the March 1968 article, there is no need



Fig. 14—Only the segments of the 33 1/3 rpm record groove seen at various random intervals of time are shown.

for having the semiconductors respond to more than one color of light, a color filter can be used to eliminate the need for achromatic lenses — the current model uses these lenses.

When the image of one of the 33 1/3 rpm grooves shown in Fig. 11 is focused on a pair of fiber optics (Fig. 12), the resulting image is split in two and each photosensitive semiconductor sees only a portion of the groove. (Fig. 16 and 17 in the March 1968 article showed how light from various portions of an image can be transmitted to different locations by fiber optics.)

As the record rotates (Fig. 13), each photocell sees only its portion of the record groove— designated by different patterns in the illustration. For simplicity, Fig. 14 shows only the segments of the groove seen at different random intervals of time. The left and right portions of these segments are split by the fiber optics (Fig. 15), one portion being seen by one photocell and the other portion being seen by the other photocell.

From Fig. 15 we see that the amount of light exposed to each photocell changes at various intervals of time according to the waveform of the recorded sound. The resulting changes in photocell output

*Continued on page 82*



Chuck Peterson demonstrates console TV and stereo combination to customer in their new showroom.

Arlin Sorenson points out the features of a stereo tuner and amplifier.



ET/D

**DEALERFAX**

ADVERTISING/MERCHANDISING/SALES/BUSINESS MANAGEMENT

# PARTNERSHIP TO PROFITS

---

## A PARTNERSHIP—

The relationship existing between two or more competent persons who have contracted to place their money, effects, labor and skill in lawful commerce or business with the understanding that there be a communion of profits between them.

---

■ Chuck Peterson and Arlin Sorenson, owners of Badger TV in La Crosse, Wis., are the first to admit that being a good technician does not necessarily make you a good businessman. But our ET/D reporter on a recent visit to that city reports that these two men themselves expose that idea to be "all wet."

Chuck and Arlin are proof that two experienced technicians can make good businessmen—and their growing annual gross income proves it. They didn't start out to be businessmen, but they did realize that they had one heck of an advantage—their combined knowledge of home entertainment equipment. That knowledge gave them the tool they needed to get started in a profitable sales and service business. And who is better equipped to know the problems in this field than the man who has to service it. Granted, he may not be a salesman. But, as a service technician he knows the product and what it has to offer.

#### **It All Began When—**

Badger TV was purchased by Chuck and Arlin in June of 1962. Arlin Sorenson had been a technician at Badger TV for five years at that time, while Chuck Peterson worked at a competitor's shop.

"We had been fishing partners for some time," Arlin smiles, "and one day we decided we should go into business for ourselves. When the opportunity to purchase Badger TV came along, we took it."

That was almost six years ago. At the end of 1962 the store was grossing about \$30,000. By 1966 this figure more than doubled. But 1967 has been the best year so far with a gross business of over \$80,000! Not bad for a couple of technicians, huh?

In December of 1967, Badger TV was moved to new and larger quarters. Chuck and Arlin leased a

2000-sq-ft building to increase the size of their over-crowded service and display areas. The new store, which is only two blocks from their previous location, provides customer parking and by working into the wee hours of the morning they managed to have it open in time for the Christmas rush.

"We did our own interior finishing," Arlin Sorenson says, "and it was quite a job for a couple of amateurs. We learned to do paneling, lay carpet and install floor tile—much to our wives' delight. Now we can't get out of doing the same job at home."

#### **Sales Volume Increased With Additional Franchise**

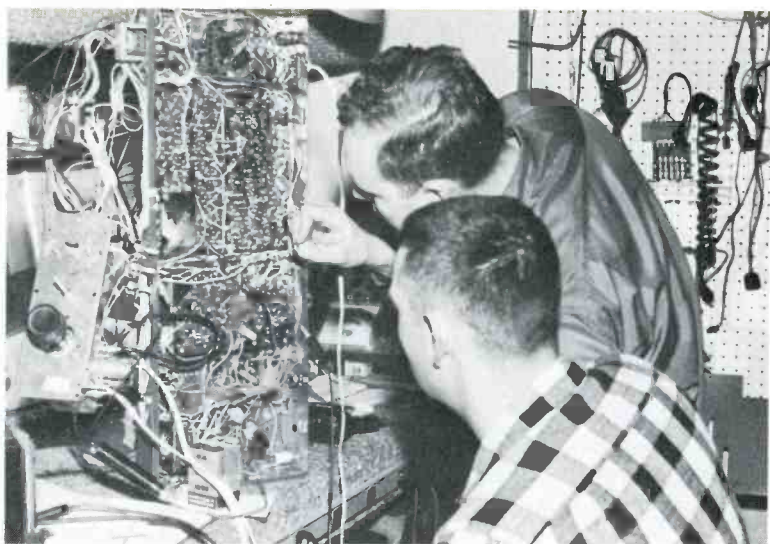
"We did not find it difficult to do a profitable selling job with the one name brand line of TV sets which we sold for years. But we felt that the addition of another brand would provide our customers with a greater selection," answered Chuck Peterson when our ET/D reporter asked him if they considered it a handicap to sell only one brand of TV, particularly since the general public's taste in style and decor are so varied. "We didn't consider it a handicap at all," Chuck answered. We came to know the product quite well. We knew what to expect from it and from the manufacturer in terms of operation, service problems and warranty. However, the added franchise gives our customers more to choose from and our sales volume goes up every year. That's a good indication that our customers are happy with the merchandise. Because we sell only two brands, our knowledge of the product is greater than if we had many—and especially service knowledge. The fact that we both service the sets we sell is a definite advantage to the customers. Neither of us would dare make any

promises that would stretch the capabilities of our service or our product.

"About half of our customers come here because we were recommended by customers we serviced or sold equipment to," adds Arlin Sorenson. "We spend an average of 4 percent on advertising, which is done mostly on the radio. We advertise seasonal sales in the newspaper. All of the advertising is on a co-op basis with the manufacturer and normally costs us about 25 percent and the manufacturer 75 percent except for radio which is split 50-50. We don't advertise for service work, but we have plenty of it."

#### **Bench Time Is Night Time**

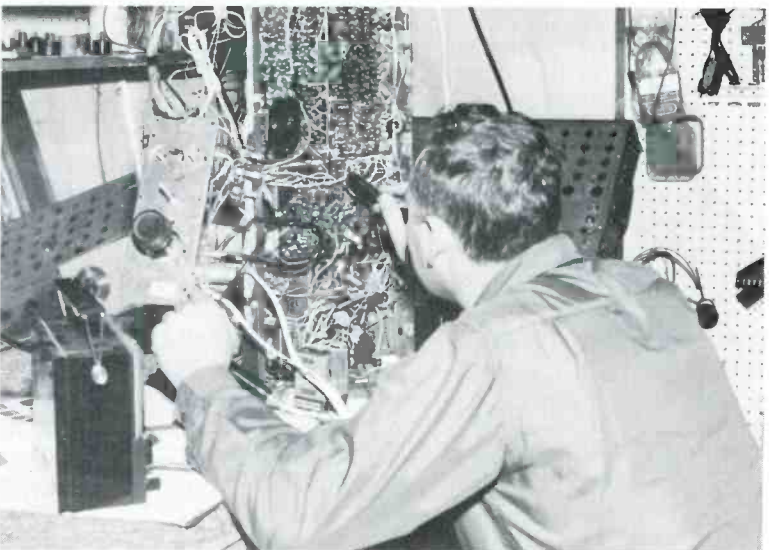
"It's not really funny, but we're happy," Arlin smiles as he explains their overloaded work bench. "A lot of our bench service work is done at night because we are too busy to handle it all during the day. We could sure use at least one more experienced full-time technician if we could find one. We try to work it so that one of us is on the bench all the time while the other is taking care of sales. But with sales, antenna installations and service contracts it is pretty hard to stick to that kind of arrangement. We do a lot of antenna work in this area and an antenna installation is almost a sure bet with every color TV sale. Many of the older TV sets around here are operating from rabbit ear antennas, a carry-over from when we had only one local station. When channel 13 became available from about 90 miles out, many people added an outside antenna just for that. Then channel 10 came along, also from some distance away, so we were busy adding another bay to the existing antennas. Consequently, many set owners have rabbit ears on the set or a two-channel antenna out-



A rare moment—Chuck and Arlin combine their efforts to check a problem on a color TV chassis.



The joy of bookwork is one of the responsibilities of Badger TV's smiling secretary, Janice Heitkamp.



If we weren't sure Arlin knew what he was doing, we could almost bet he would be saying something like "Holy circuit boards, the spot I'm looking for has to be here someplace."

side. Now there are four channels available in the area, none of which can really be considered local, and for color the old antenna systems can't provide a good enough signal.

Our ET/D reporter asked the boys what they normally charged for bench repairs, antenna work and service calls. "Our bench rates are not really fixed," answers Chuck Peterson. "We work on so many kinds of equipment, some tube operated and some transistorized. On some of the transistorized and hybrid equipment that we take in for repair, we don't feel justified in charging the normal bench rate. On the other hand, we charge more for work on a complicated circuit than we do for a simple tube-type house radio. We do have a bench rate of \$4 to check a B/W tube type set, and a minimum rate of \$10 for one hour on the bench. But here again it depends on the circumstances."

"Our service call charges are \$6.50 for B/W and \$7.50 for color for the first hour. After that the rate is \$6 per hour. Our antenna installations are usually figured as a package price when they are sold with a TV set. Otherwise, we do them on a time and material basis and charge \$6 per hour. The service contract work we do is limited. We service about 200 TV sets for a leasing company who rents to a local hospital."

Chuck Peterson and Arlin Sorenson have worked in La Crosse as technicians for over 12 years. They have become familiar with the area in terms of surrounding terrain and what kind of TV or FM signal can be expected in various locations, so they can design their TV and antenna sales to give the customer satisfaction. As both technicians and businessmen they are proving that a combination of efforts and skills can result in a gratifying communion of profits. ■

# COLOR GENERATORS

# FOR EVERY NEED

**4 reasons why Sencore is your best buy  
in professional test instruments**

# 1

## LOBOY CG10

America's lowest priced professional quality standard color bar generator. All solid state. Battery powered for maximum portability.

**\$89.95**



# 2

## LOBOY CG12

AC operated version of the CG10. Also has 4.5 MHz crystal controlled signal for fine tuning adjustment.

**\$109.95**



# 3

## COLOR KING CG141

Absolute stability assured by exclusive "Temp Control" and new timer circuitry. All standard patterns, plus new movable single dot and single cross. Analyzing features too.

**\$149.95**



# 4

## COLOR ANALYZER CA122B

The complete analyzer for color and B&W—far more than just a color generator. Has variable RF and IF outputs, composite video, chroma, and horizontal and vertical sync pulses.

**\$187.50**



Whatever the need, Sencore has the color generator that is just right for you. Each has the built-in quality you expect from Sencore. Each has standard RCA licensed color bar patterns.

Each is triple tested for guaranteed accuracy. Each is steel encased with chrome panel. See your distributor for more reasons why Sencore is your best buy, always.



# SENCORE

NO. 1 MANUFACTURER OF ELECTRONIC MAINTENANCE EQUIPMENT

426 SOUTH WESTGATE DRIVE, ADDISON, ILLINOIS 60101

... for more details circle 135 on postcard

# Service-Dealers and the BBB

Working with the Better Business Bureau to solve customer complaints



Al Limberatos, past president of the Santa Clara County BBB, works closely with the bureau in raising TV sales and service standards.

■ Better Business Bureaus throughout the country have registered an increase in complaints about TV sales and service since the advent of color, notes Al Limberatos, partner in Alco-Paramount Electronics Corp., San Jose, Calif.

As past president of the Santa Clara County Better Business Bureau, Mr. Limberatos believes that service-dealers have much to gain by working closely with the BBB to help solve the problems presented by the rising tide of complaints.

"All the service-dealers in our county belong to the BBB," says Al Limberatos, "so we've been able to work together through the bureau to improve considerably the sales and service standards to the benefit of all service-dealers."

## Improvements Made

In cooperation with the BBB, the dealers have established a code of advertising ethics endorsed by the San Jose Advertising Club, the news and other communications media and the district attorney.

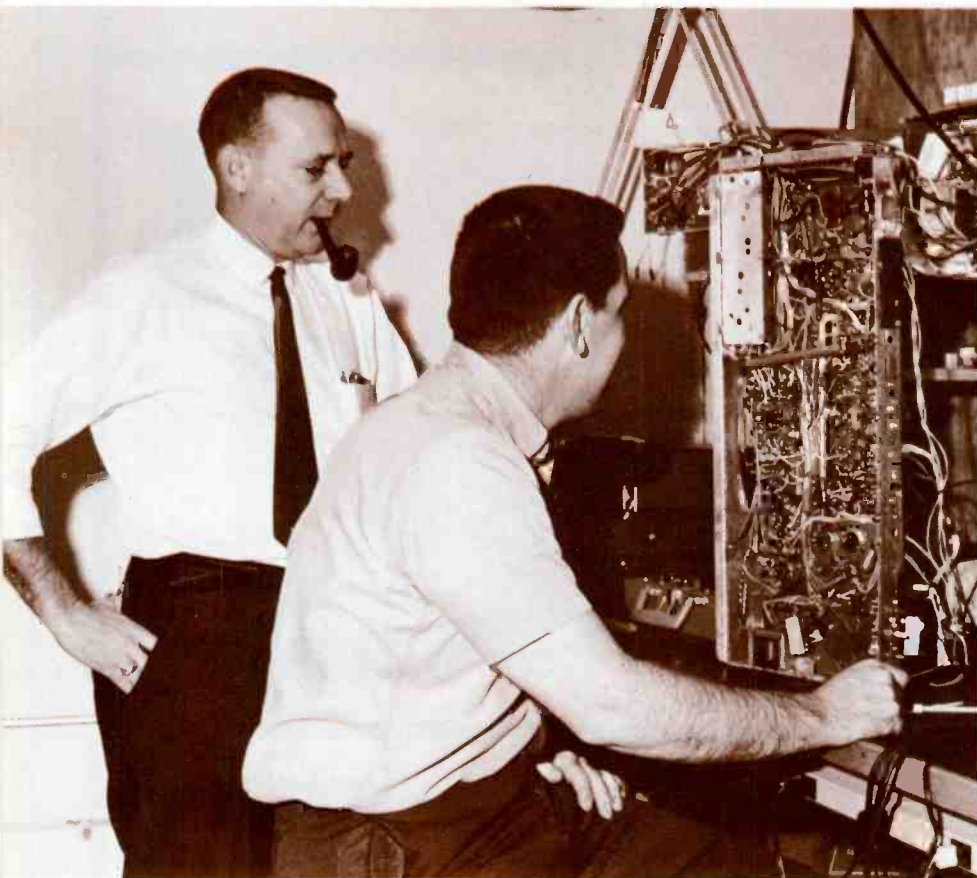
The code is an effective lever in screening ads to eliminate extravagant warranty claims and price gimmicks. Objectionable ads are refused.

The bureau also proved helpful in establishing some control over "transients" and "moonlighters." Many of these operate without a business license and some make up for their seemingly low service charges by billing the customer for parts not installed and services not performed.

The bureau, investigating as an impartial agency which has the confidence of the public, is proving a considerable force in publicizing and reducing these unethical practices.

## Unjustified Complaints

"The bureau also performs a use-

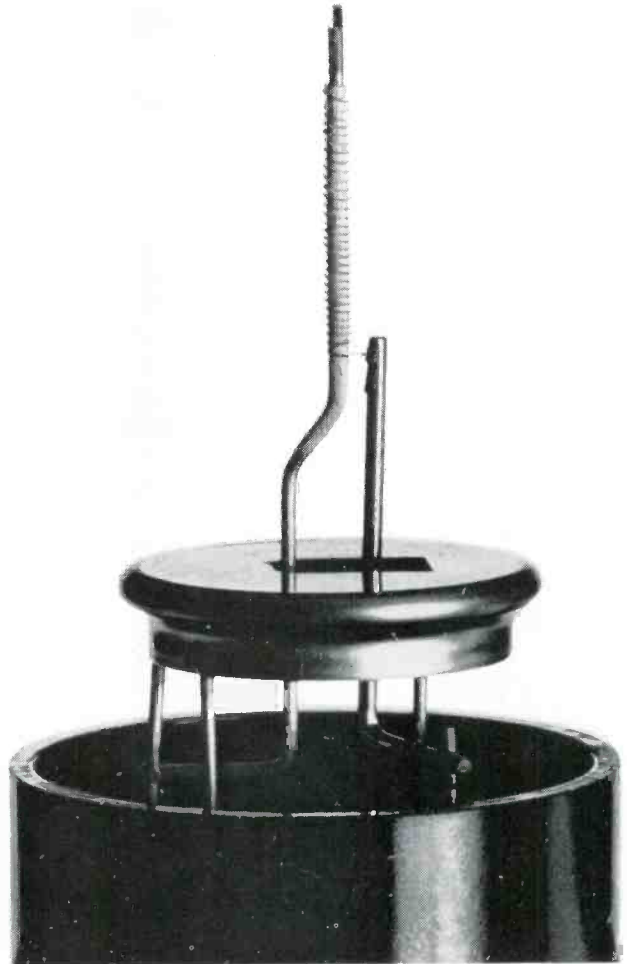


Mr. Limberatos and service manager Tom Conner check out a component failure. Too much shop time, Mr. Limberatos contends, is consumed in handling component failures.

# We've rectified high-voltage rectifiers.



How it used to be.



Our new 3CU3

Take a look at our new "Posted filament" design. There's no delicately suspended heater-cathode system. There's no need to heat up a metal sleeve and then an oxide coating.

It takes less than a second for the 3CU3 to start rectifying full swing.

In case of a break, there's no way for the 3CU3's filament to fall against the anode, creating a short and knocking out other components in the circuit.

The 3CU3's filament is always perfectly centered. It emits electrons uniformly in every direction. From a much larger surface than in the old design. There's no suspension post in the way to create an "electron shadow" that cuts down the plate current.

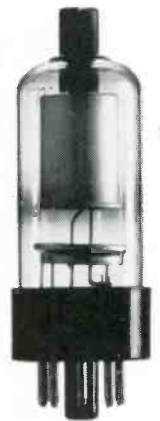
The uniform electric field around the rigid support reduces high voltage stresses. Arcing and its resulting troubles are eliminated.

The 3CU3 is interchangeable with 3A3 and 3A3A

high voltage rectifiers. And it's made exclusively by Sylvania.

The 3CU3 is just one of a new "posted filament" family which includes the new 3BL2 and 3BM2. They're designed for use in new color TV sets. These tubes are especially good for transistorized TV where their fast warm-up fits in with the "instant on" feature of solid state circuitry.

The new construction has higher reliability and longer life and should give you fewer and less troublesome callbacks.



From the outside you can hardly tell it's changed.

**SYLVANIA**  
A DIVISION OF  
GENERAL TELEPHONE & ELECTRONICS

## Service Dealers . . .

ful service to the dealers who receive unjustified complaints," Mr. Limberatos says. "When a complainant is unreasonably wrong and we know we're right, we suggest that the dealer lodge a formal complaint with the BBB so that an impartial investigation can be made. In this period when there are many unjustified complaints, that function alone makes the BBB an important asset for dealers."

Howard Emerson, secretary of the Santa Clara County Better Business Bureau, says his bureau is getting fewer complaints on TV sales and service than in most other areas. He attributes this to the active program that the TV service-dealers have developed through his office.

"At the same time, our statistics show that much more must still be done," he adds. "We get more complaints on TV sales and service than on any other type of business."

"In the first nine months of 1967, the Santa Clara BBB received 122 written complaints about TV sales

and service. Approximately half of these were cases of misunderstanding," Mr. Emerson says.

"But nonetheless, complaints on TV sales and service were 20 percent ahead of the number two cause of complaints, which is auto repairs," he says. "Other appliance sales and service was third on the list of complaints."

### Handling Complaints

A complaint is registered only when a customer fills out the BBB's rather lengthy form giving all the details of the transaction.

In the nine month period, the Santa Clara bureau received 52,000 calls (the county's population is approximately one million). TV-radio sales and service led the list with 1620 calls.

Of these, 555 were queries, asking for recommendations on reputable dealers and service shops. The bureau prepares a "reliability report" on retailers in the county, a service which is of value to both consumers and service-dealers.

According to a recent article in THE DEALER, published by the Pacific Gas and Electric Co., eight Bet-

ter Business Bureaus in northern California report that the 1966 total of TV-radio sales and service complaints rose 12 percent over 1965.

"All eight of the BBB offices recorded increases in the number of TV-radio complaints during 1966 while sales and service complaints on appliances showed an over-all decrease of 11 percent," THE DEALER reports.

### Quality Controls?

Mr. Limberatos says that failures during the period of this survey were mostly related to the picture tube whereas more recently it's been component failures.

"It's apparent that quality control at the manufacturers' level still needs quite a bit of improvement," he declares. "The service-dealer has a lot of money invested in his service department and frankly, it's costing us too much to take care of manufacturers' mistakes."

One simple procedure that manufacturers could follow which would help the service-dealer, is to update their service bulletins regularly and issue the needed technical informa-

*Continued on page 88*

BEST YEAR YET  TO SELL THE BEST

## 3 ZENITH WAVEMAGNET® INDOOR TV ANTENNAS built to the quality standards of Zenith original parts

Zenith has designed these Wavemagnet antennas for sensitive reception in color or B/W. Fully adjustable telescopic dipoles. Six-position selector switch for top performance on each channel. Handsome molded base of high-impact styrene. Individually packaged for effective sales display. Order now from your Zenith distributor.



**DELUXE  
ALL-CHANNEL**  
Part No. 973-56  
Two full-size UHF  
loops develop high  
front-to-back ratios  
equal to many  
outdoor antennas.



**VHF ONLY**  
Part No. 973-58



**ECONOMY  
ALL-CHANNEL**  
Part No. 973-55

# ZENITH®

*The quality goes in  
before the name goes on*

... for more details circle 145 on postcard

ELECTRONIC TECHNICIAN/DEALER



**ONE TV Repair Shop in your locality . . . will soon stand out head and shoulders above every other competitor in town. It could be YOU.**

**Want to know HOW? Very simply:**

by using a regular series of clever, inexpensive 'column' ads in your local newspaper! You doubt it? Well . . .

. . . A TV shop in Maryland had to hire more help within 3 weeks after starting their series!

. . . A dealer in Montreal has had people come in from all over Canada, from his ads.

. . . An enterprising repair man in Louisiana has acquired 4 other places in his area from the surge of business that his series brought.

. . . Two cousins in a New England community attribute 75% of their business to these ads.

You can see their secret . . . adapt their method . . . improve your business . . . gain an immediate edge on competition . . . and develop a friendly, permanent clientele . . . by judiciously using the same inexpensive idea!

Our new folio—which we'd like you to try out for six months—is called *"How to Double Your Business with Unique 'Column' Ads."*

It shows how others have done it . . . replete with case histories.

It shows how you can do it, too.

It shows how and when, where and why—the whole fascinating story of this cheapest means of advertising . . . with most effective RESULTS! Here are ads that will attract attention—stimulate curiosity . . . arouse interest, amuse readers and make YOU known and remembered for quality service . . . integrity . . . dependability.

All at trivial cost!

Among the Advantages you will learn . . . how to create interest among prospects who never even knew you existed!

. . . how to influence people to switch over to your business or service!

. . . how to create excitement—even though your business seems dull and drab!

. . . how to get the most out of your promotional dollar (something most business men never learn!)

. . . how to get your customers to "work" for you!

. . . how to get fast action from a \$3 investment!

. . . how to keep interest sustained over an extended period!

. . . how to make people laugh . . . and agree with you . . . and seek to meet you personally!

. . . how to get maximum assistance without charge from the newspaper staff!

. . . how to develop continuing ideas!

And, above all —

**A Special "TV REPAIR" PROMOTION SUPPLEMENT!**

**H. K. SIMON ADVERTISING**  
**BOX 236**  
**HASTINGS-ON-HUDSON**  
**NEW YORK 10706**

**"TV REPAIR" PROMOTION SUPPLEMENT —**

shows you:

- . . . How to out-smart (instead of out-spend) the competition!
- . . . Why most ads fail . . .

The ONE BIG SECRET of successful TV Repair advertising.

- . . . The Greatest Compliment any ad can Pay You.
- . . . The mistake that is made by 98 out of 100 local advertisers.
- . . . 94 examples of enticing "come on in" copy (distilled from thousands).
- . . . 26 Merchandising Ideas that you can adapt, to stimulate business.
- . . . 37 Illustrations that enliven the ad, attract the eye.

Here are "Big Time" ideas at "small time" prices. Prepared by a \$25,000 copy group . . . but your cost is less than 40¢ per week!

You'll refer to this for years—every time you need copy to promote special occasions . . . or an idea for a layout . . . or an eye-catching border . . . or a good illustration!

You'll see how to establish your name as an outstanding source: as helpful . . . friendly . . . sincere . . . intelligent . . . courteous . . . dependable.

You'll see how to have people looking forward to your ads—wondering what you will say next!

You run very little risk, if you accept this opportunity—because we GUARANTEE that any one using these ideas six months or more who does NOT hear favorable comment—who does NOT think his own staff has been stimulated—who does NOT see direct results at lower cost—can simply say so, and we'll REFUND 100% of every penny you paid us!

We think this offer is unique. We dare to make it only because we KNOW this will prove profitable to you.

Who in your community will benefit by this? Will YOU? Better advise us at once.

Write or wire us TODAY. Use the handy blank below.

**Suppose YOU spent 3 weeks with an advertising agency . . .**

. . . developing a year's program for your business that would make you well known—give you a competitive edge . . . bring customers to your door . . . stimulate your sales . . . save wasted efforts on unproductive promotion. Personal service, of course, is expensive. The agency's fee would be about \$2,000, plus your traveling and maintenance expenses.

But we have completed just such an intensive 3-week conference . . . and you may have the results for a tiny fraction of that cost! Let me ask: how is your present ad program going—now? Was it prepared well in advance, by a "pro"? Or do you promote your services, catch-as-catch-can, when you can spare a moment?

The difference between the two methods can mean a doubling of your annual gross.

Perhaps you've always thought, "I can't afford a high-priced ad man."

But surely, you COULD afford him if he cost you only 40¢ a week!

And if that 40¢ weekly expense brought you \$7,500 a year—you couldn't afford to be without him!

"True", you say, "If it is so good as all that."

We think it is. But we want YOU to be the judge.

Try the ideas for the next six months. Then—6 months from now—if you don't expect to get back at least \$1,995 for your \$19.95 investment (a return of 100 to 1—or better) simply send it back for full refund.

Could anything be fairer?

Since there's no obligation, why not accept? Promotion-wise, I doubt if you'll EVER get another opportunity to equal it. But . . . Better act TODAY. This offer may be withdrawn when our supply of copies run out. So write or wire NOW!

**H. K. SIMON, Advertising Co.**  
**Box 236, Dept. ET-41**  
**Hastings-on-Hudson, N. Y. 10706**

Kindly send "HOW TO DOUBLE YOUR BUSINESS WITH UNIQUE 'COLUMN' ADS" along with your "TV REPAIR" PROMOTION SUPPLEMENT to:

NAME \_\_\_\_\_  
 ADDRESS \_\_\_\_\_  
 CITY, STATE \_\_\_\_\_  
 ZIP \_\_\_\_\_

We enclose our check for \$19.95.

It is understood that if we use your ideas for six months or more and are not fully satisfied, every cent will be refunded.

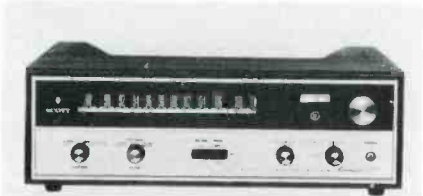
REFERENCES: Any publication in the U.S.A. • Rated by Dun & Bradstreet

. . . for more details circle 138 on postcard

For additional information on products described in this section, circle the numbers on Reader Service Card. Requests will be handled promptly

## FM Stereo Tuner 700

A solid-state FM stereo tuner features a silver-plated 3-FET transistor front-end and IC IF strip. The Model 312D includes the following additional features: Front panel meter switch al-



lows tuner meter circuit to be used for signal strength, zero-center tuning or multipath indication; front panel controls to vary the level of both phono and amplifier outputs independently; a circuit for fool-proof silent automatic stereo switching, not affected by momentary changes in signal strength; interstation muting control for complete quiet between FM stations; computer-type push-button switches; front panel output for direct tape recording without a separate amplifier; ultra-

wideband FM detector circuit for minimal distortion and oscilloscope output for laboratory-precise correction for multipath distortion. Usable sensitivity is said to be  $1.7\mu\text{v}$ ; capture ratio, 1.9db; cross modulation rejection, 90db; selectivity, 46db; stereo separation, 40db; Price, \$319.95. Scott.

## Stereo Cartridge Player 701

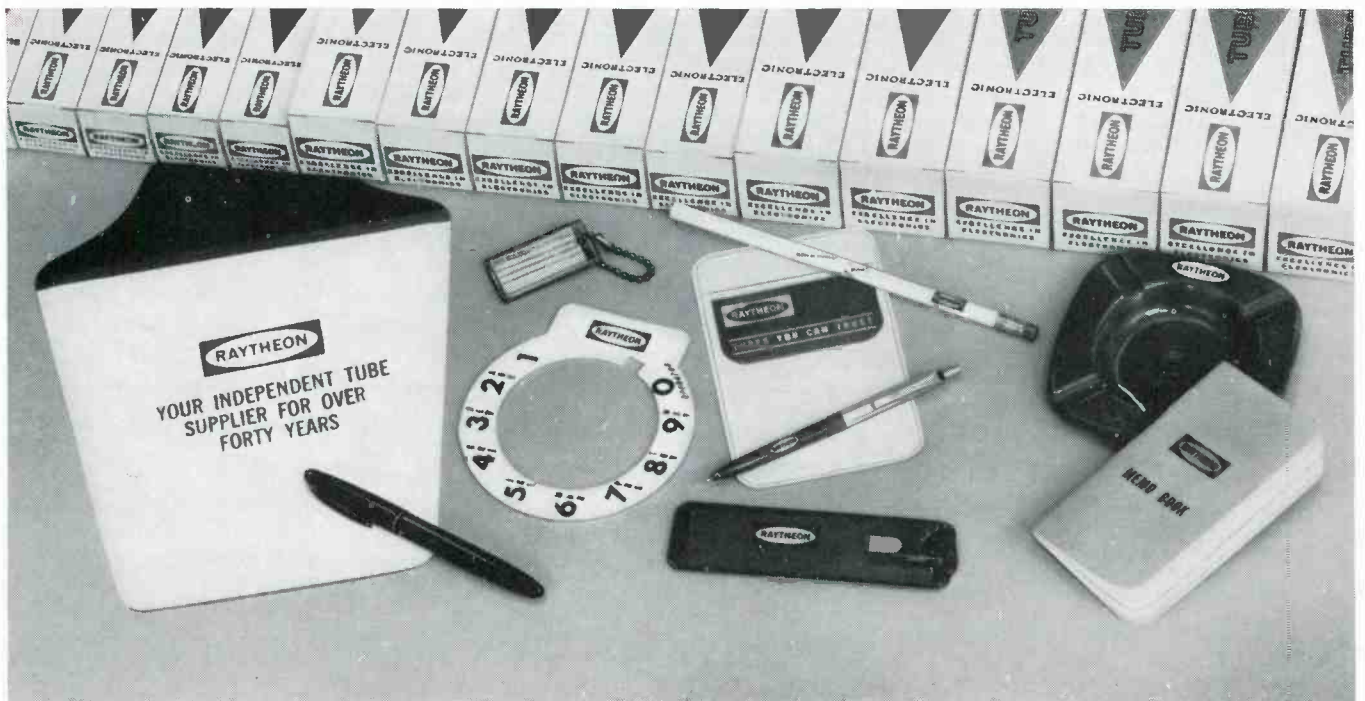
A home-type cartridge player accepts all eight-track and half-hour four-track tape cartridges. The unit features preamp outputs, said to ease tie-in to existing home Hi Fi systems.



Other features include fully automatic cartridge and track selection, six head positions for exact track alignment, computer-styled program indicator lamps and easy-eject cartridge release button. Unit with brushed aluminum front panel is housed in an attractive walnut-finish case. The unit plays up to 80 minutes with eight-track twin packs. Tape speed is  $3\frac{3}{4}$  ips. Specifications say wow and flutter are less than 0.25% wrms; signal-to-noise ratio better than 45db; frequency response 50 to 10kHz; channel separation better than 40db; cross-talk better than 50db. Unit contains 9 transistors and 7 diodes. Size  $9\frac{1}{2} \times 4 \times 9$  in. Weight 9.6 lb. Craig.

## Fathometer 702

A Fathometer depth sounder that combines a graphic recording with a digital read-out has been developed. The portable unit is developed especially for detailed depth surveys for charting, salvage, underwater con-



**Collect these items  
with your purchase of  
Raytheon receiving tubes.**

Ask for them at your distributor's—each time you buy Raytheon receiving tubes. They're an "EXTRA PLUS" for you—just like the extra reliability you get with famous Raytheon receiving tubes.



... for more details circle 131 on postcard  
ELECTRONIC TECHNICIAN/DEALER

# FINCO<sup>®</sup>

the company that brought you the famous Color Spectrum Antennas<sup>T.M.</sup>

now brings you a complete line of VHF & 82 channel MATV equipment

## Over 200 items including:

- Preamplifiers
- Amplifiers
- Passive Networks
- Wall Taps
- Test Equipment
- MATV Heavy Duty Antennas

Finco will work with you to plan your MATV installations *at no charge*.  
Send for FINCO's 45-page illustrated catalog and layout information forms.

*Mail this coupon today*



**THE FINNEY  
COMPANY**

34 W. Interstate St., Dept. 110 Bedford, Ohio 44146

Send FREE 45-page illustrated catalog of MATV Equipment and FINCO layout information forms.

Name \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

... for more details circle 111 on postcard

struction and oceanographic and seismic studies. As the depth is graphed and displayed numerically it is also presented as a four-bit digital code output for direct use with computers, analyzers or devices that will actuate other equipment dependent on the water depth. With a range of 0 to 240-ft or fathoms, the depth sounder is ac-



curate to within 3in. at 100ft and 30-in. at 1000 ft. It is said that excellent

bottom profiling is accomplished by a narrow transducer beam pattern operating at a frequency of 90kHz for optimum signal-to-noise ratio. Raytheon.

### Compact Phono/Radio 703

Announced is the SC740 which combines a 60w AM/FM solid-state FM stereo receiver; a turntable and two air suspension speakers having 10-in. high-compliance woofer and a



3/2-in. curvilinear tweeter. The complete unit is contained in a cabinet of handrubbed oiled walnut. Suggested list is East \$550, West \$560. Harman-Kardon.

### Vidicon Camera 704

Introduced is the model 6104 vidicon camera having a built-in reflex



lens viewfinder. Price \$300 (less lens). Craig.

### Solid-State CB 705

Announced is a compact citizens band transceiver—designed with frequency synthesizing circuitry for full 23-channel operation. Designated the Model 777, it is said to meet all FCC and DOT standards and will be type-



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ET/D

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accepted under pending regulations for U. S. CB equipment. The solid-state transceiver is packaged in a 6½ x 2 x 10-in. low-profile case. It can be dash-mounted for vehicular communications or placed upon an optional pedestal-mount power supply for home or office. Amphenol.

#### General Purpose Lantern 706

A hand lantern is introduced which is said to throw a powerful light beam for half a mile. The light comes with



an auxiliary red alert flasher which has its own switch. It is made of molded Cyclolac which outshines and outlasts metal, according to the manufacturer. Suggested retail is \$15.95 with battery. Burgess.

#### Cells and Charger 707

Cells that reportedly can be recharged 1000 times or more and a simple automatic battery charger are the elements of a "perma cell" system. The nickel-cadmium cells come in popular sizes (AA, C and D). Operating on 117vac, the flip-top automatic charger can charge two or four AA, C or D or any combination, simultaneously. G-E.



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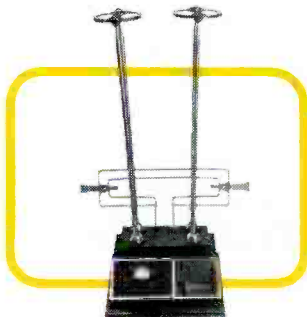


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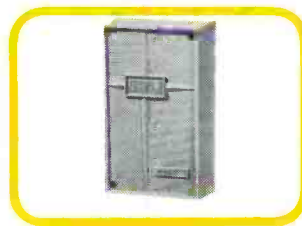
\*Model STO-82 also available with "F" fitting.



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# COLORFAX

## WESTINGHOUSE

### Color TV Chassis V2655 — Demodulator Circuit Description

The demodulator system is a two-stage circuit that consists of V306, called the "X" demodulator, and V305, called the "Z" demodulator, and their associated components. Both demodulators employ 6HZ6 tubes.

Referring to schematic, it can be seen that the 6HZ6 is a multi-element tube. It has two independent control grids. (Pins 1 and 7), each demodulator requires two input signals. The two inputs are:

1. The output signal of V302B, the bandpass amplifier (waveshape 14). This is the chroma information sent to the grids, pin 1 of both demodulators.

2. A 3.58MHz CW signal from V310B, the local oscillator (wave-shape 15 and 16).

The purpose of the demodulator is to convert the phase and amplitude differences of the two input signals into information that the color difference amplifier circuit can accept and enlarge to magnitudes necessary for driving the CRT grids. The output of tube V306 and "X" demodulator stage (waveshape 17), is shown after the 3.58MHz component has been filtered by coil, L504, and capacitor, C518.

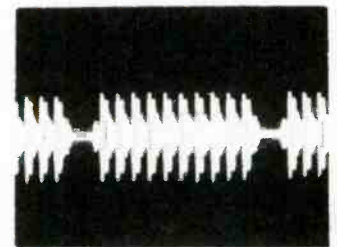
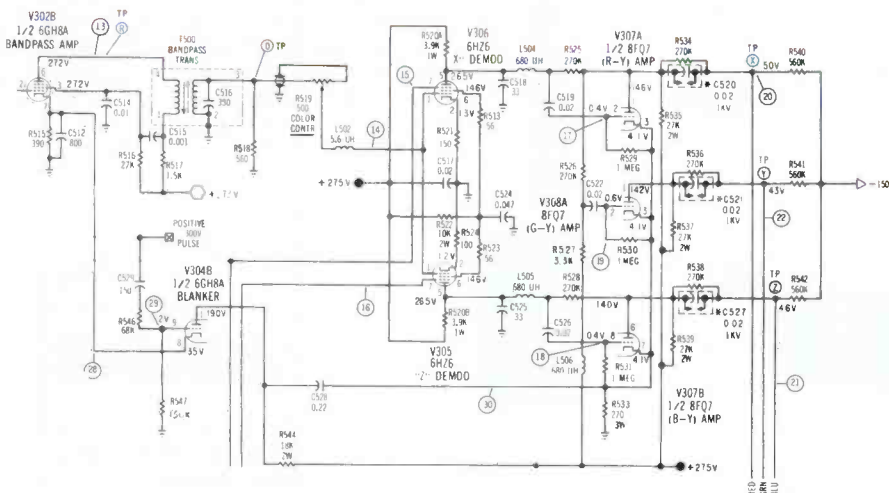
As the filter network operates the same in all instances narrated, it will not be mentioned each time, but all outputs of the demodulators referred to will be after passing through the filter network.

When the color signal input and the

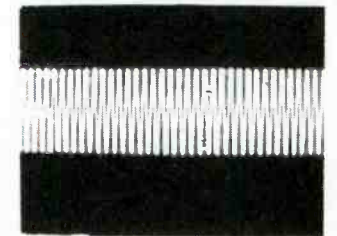
local oscillator signals are in phase, the output of the demodulator is at maximum negative amplitude. When the two input signals are 180deg out of phase, the output amplitude reaches a maximum in the positive direction. A 90deg phase shift between the color signal and the local oscillator signal results in zero output. Any phase angle difference that lies between the points referenced above will result in some output.

The local oscillator signal that is applied to pin 7 operates as an on/off switch to the demodulator tube. When the applied signal is in the positive half cycle, the tube conducts and when the signal is in the negative half cycle, the demodulator tube is shut off. Therefore, if the incoming color signal at pin 1 is in phase with the local oscillator signal applied to pin 7, the demodulator tube is conducting during the entire positive half cycle of the color signal. As a result, the average plate current increases and the average plate voltage becomes less positive than when the demodulator is cut off and is shown in the output as the most negative point. When the incoming color signal reaches pin 1, 180deg out of phase with the local oscillator signal present at pin 7, pin 1 and 7 become negative—allowing the demodulator tube to conduct. The result is a lower average plate current flow and that means a more positive plate voltage in comparison to the previously described conditions. When the incoming color signal is 90deg out of phase with the local oscillator signal, the de-

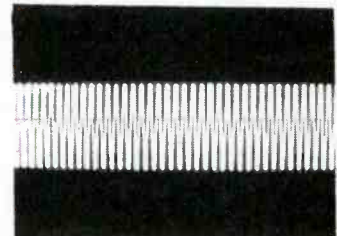
modulator tube is conducting during half of the positive cycle and half of the negative cycle. As the plate current of the demodulator tube increases and decreases equally during this condition, the average plate current shows no change. No change in current means no change in voltage and the output is zero.



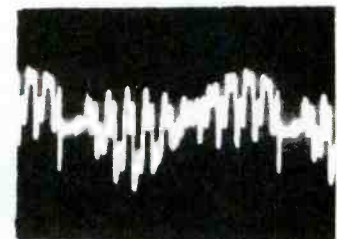
14 "H" 3.5V P-P  
Pin #1-V306



15 "H" 25V P-P  
Pin #7-V306



16 "H" 25V P-P  
Pin #7-V305



17 "H" 15V P-P  
Pin #2-V307A



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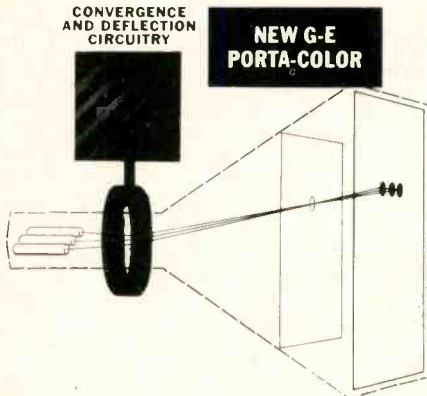
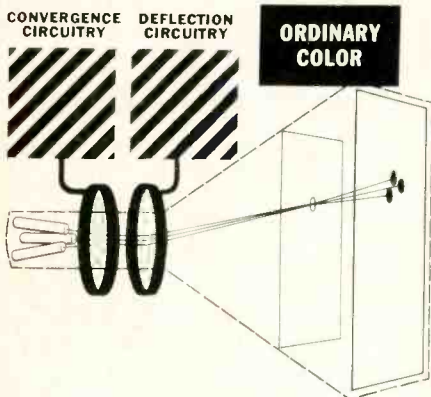
COLORFAX

GENERAL ELECTRIC

Porta-Color TV — New 14in. CRT

G-E's exclusive "in-line" CRT system will be employed in a new 14in. (picture diagonal) color TV soon to be introduced.

In announcing the new color portable, W. A. Estrabrook, general manager of the company's personal television department, predicted the "in-line" system would eventually ob-



solete the now widely used "delta" system in color portables.

The in-line design — referring to the arrangement of the three cathode guns in the neck of the CRT — is substantially less complex than the triangular or delta systems used in other color picture tubes.

The three electron guns are placed in a horizontal row instead of a triangle. This means convergence can be accomplished in the horizontal axis — one of the axes used in deflection. Thus, the two functions of convergence and deflection can be handled by one set of circuits, eliminating much of the circuitry that ordinary color receivers require. Result — less weight, smaller size, lower cost.

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drive the horizontal output grid in a positive direction. Full power will then be delivered to the horizontal transformer and associated circuits.

If the HV regulator should stop conducting, its cathode will become less positive and SC408 will become reverse biased and cut off. When this happens, the positive polarity influence of R480 is removed and the high grid leak bias from the blanker stage reduces conduction of the horizontal output stage. The extra bias is also applied through R431 to the video output stage grid. The video output stage delivers less video, its plate voltage rises and causes the CRT guns to go almost to cutoff.

The result of this biasing is a dim picture, reduced horizontal drive and no excessive high voltage.

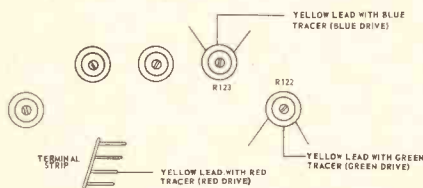
It should be noted that the HV regulator grid received a correction bias automatically as a function of the boost B+ voltage, horizontal output tube and video output grid bias.

## GENERAL ELECTRIC

### Color TV Chassis KC/KD—Using CRT 25XP22 To Replace 25AP22A

Color CRT type 25XP22 may be used to replace type 25AP22A in the KC and KD chassis. When this is done, the 25XP22 may not match the drive ranges in the chassis.

The 25XP22 is made to match the drive ranges in the KC and KD chas-



sis by interchanging the red cathode lead with either the blue or green cathode lead, when necessary.

The need to interchange leads is determined only after the CRT has been installed and the grey scale (color temperature) adjustments.

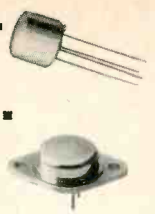
If the grey scale is incorrect after the adjustments have been completed, interchange the leads according to the following rules:

1. If the completed grey scale is yellowish in the highlight areas, interchange the red and blue cathode leads at the drive control bracket. In this instance the blue control adjusts the red drive and the blue drive is not adjustable. Green drive is normal.

2. If the completed grey scale is red-dish-purple in the highlight areas, interchange the red and green cathode leads at the drive control bracket. In this instance the green control adjusts the red drive and the green drive is not adjustable. Blue drive is normal.

The illustration shows the rear view with drive leads normally connected.

# Test this signal transistor at 1mA collector current... and this power transistor at 1Amp collector current... or any collector current you select, from 20 $\mu$ A to 1 Amp with the **WT-501A in-circuit/out-of-circuit transistor tester**



Battery operated, completely portable, RCA's new WT-501A tests transistors both in-circuit and out-of-circuit, tests both low- and high-power transistors, and has both NPN and PNP sockets to allow convenient transistor matching for complementary symmetry applications. The instrument tests out-of-circuit transistors for dc beta from 1 to 1000, collector-to-base leakage as low as 2 microamperes, and collector-to-emitter leakage from 20 microamperes to 1 ampere.

Collector current is adjustable from 20 microamperes to 1 ampere in four ranges, permitting most transistors to be tested at rated current level. A complete DC Forward Current Transfer Ratio Curve can be plotted. Three color-coded test leads are provided for in-circuit testing, and for out-of-circuit testing of those transistors that will not fit into the panel socket.

See your Authorized RCA Test Equipment Distributor, or write RCA Electronic Components, Commercial Engineering Department D46-WB, 415 South Fifth Street, Harrison, New Jersey.

Extra features... RCA reliability... for only \$66.75\*.

\*Optional distributor resale price. Prices may be slightly higher in Alaska, Hawaii, and the West.

# RCA



... for more details circle 130 on postcard

# NEW PRODUCTS

For additional information on products described in this section, circle the numbers on Reader Service Card. Requests will be handled promptly

## Desk-Top Calculator 708

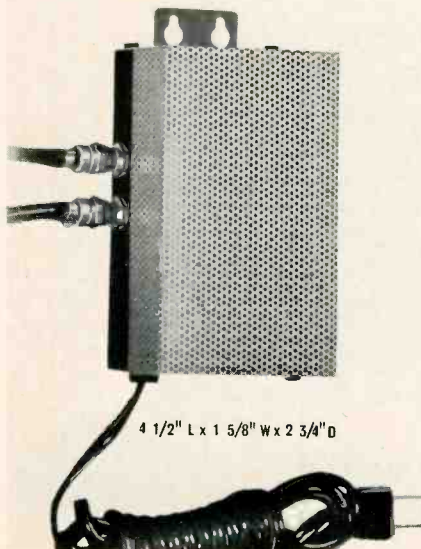
Announced is a high-speed electronic calculator, 130S, which is said to take up less space than a stand-



ard electric typewriter. Features include: grand totals; reverse key which is used for interchanging the dividend and the divisor in division; direct credit balance, constant in both division and multiplication; negative multiplication; automatic floating decimal; overflow warning light. Canon.

## MATV Power Supply 709

A 17vdc power supply capable of handling up to five MATV amplifiers is announced. Designated Model SL-6514, the unit is an addition to the recently introduced "Smoothline" of MATV equipment. The supply is said to be regulated so that output voltage will not vary by more than 2% during load changes up to 10:1 and line voltage swings of  $\pm 10\%$ . Designed for indoor mounting, the power supply



sends 17vdc to remotely located amplifiers along the same coaxial cable that carries RF signals. RF signals from 54 to 890MHz pass through the unit with negligible loss, the manufacturer says. JFD.

## Radar Detector 710

Announced is a miniature microwave receiver which clips to car sun visor to alert drivers of approach to a controlled radar speed zone well in advance of critical clocked area. The detector weighs 12oz, operates on two penlite cells, is said to have up to a



two-mile range and is completely transistorized. Device picks up radar signal from police vehicle and emits a steady beep to warn driver to slow down to posted limits before he reaches the critical zone where his speed is clocked. The detector is said to have no radiation of its own, will not interfere with any transmitting beam and is completely noiseless when not picking up transmitted radar signals. Solar.

## Mini-Scope 711

Weighing just 5lb and measuring only 1 3/4 x 7 1/2 x 14in. a dc to 10MHz scope is said to be small enough to slip into a briefcase on field trips. The solid-state scope is said to be ruggedly constructed to withstand rough handling and features a dc vertical amplifier and integrated circuitry. Input impedance is 1M at 75pf. The linear time-base is repetitive with a range from 0.5Hz to 500kHz in six steps and automatic synchronization. The display tube is a 1 x 2 1/2in. rectangular CRT scaled in 0.25in. squares, with 1kv accelerating potential, P31 phosphor with polaroid filter standard (other phosphors are available as options).



Power requirements are 115/230-vac at 25va, 50 to 400Hz, through a three-wire grounded line cord. Operating temperature range is from  $-40^{\circ}$  to  $131^{\circ}$ F. Available accessories include a fitted leather carrying case, plus half-rack or full-rack brackets for rack mounting. Price \$339. Measurement Control.

## Temperature Regulator 712

Announced is a temperature regulating stand which is said to prevent soldering irons from overheating, saving tips and minimizing warmup time. The stands hold irons at preselected temperatures when the tool is idle or being used intermittently—the periods when almost all overheat damage is done to irons and tips. Stands are available in two sizes, with or without



safety guards; one for irons up to 85w. (No. 476), the second for irons between 85 and 660w, (No. 475). American Beauty.

## Cable Clamps 713

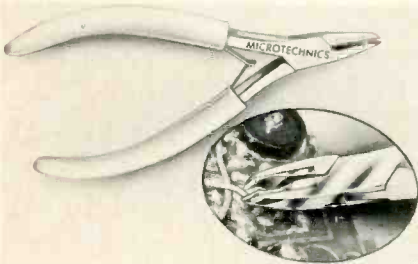
Announced are clamps for holding cable, tubing, small parts, etc. Thirteen sizes of both plain and insulated metal clamps are available from stock and range in size from 1/8in. to 1 in. diameter. Clamps are made of 0.032in.



steel and zinc plated. It is said the design permits clamps to be closed without being supported and the clamping circumference remains round. All clamps are 1/2 in. wide. Holub.

### Microloy Tipped Cutters 714

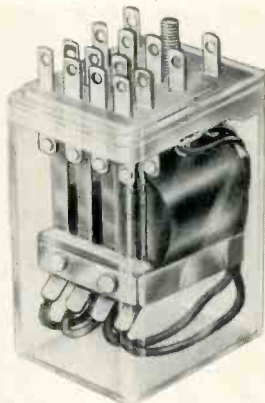
Designed for micro miniature work in the electronics field, these "Microloy" (a super hard and tough tool steel), tipped cutters are said to have a lifetime five times that of ordinary cutters. The 45deg 1/4 in. long miniature head reaches easily into the most



complex and hard-to-get-at circuitry, producing a square, flush cut. They are well suited for cutting nickel ribbon and soft fine wire. All cutters are supplied with comfortable Plastisol grips and nonjamming return springs. Microtechnics.

### Miniature Relays 715

A complete stock of RA type 4PDT relays is announced. These relays are made in Vienna to highest technical standards, the manufacturer claims,



and are designed for a wide range of applications in the computer, communication and instrumentation fields. Other relay types are also offered. Schrack.

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10 UNITS

**SNAP PAK**

Original Equipment Part

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revolutionary new resistor package from



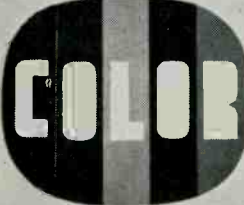
Snap Paks save time and eliminate loose parts and clutter in the shop or on the job. Handy five-card strip fits shelves, bins, or racks. Belongs in every tool kit or tube caddy.

The next time you need resistors, order IRC Snap Pak packages. They're available now at all IRC distributors.

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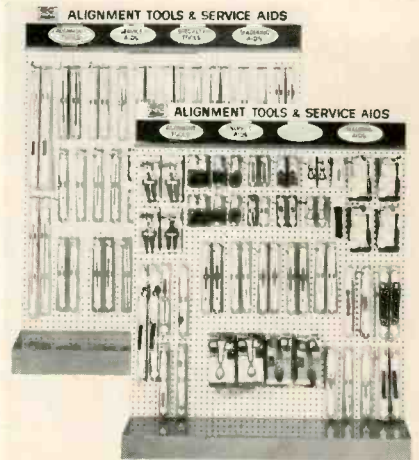
City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

## NEW PRODUCTS

716

### Alignment Tools

Announced are distributor displays of alignment tools for technicians. It is said that the tools and service items selected were based on a recently completed computerized survey of service tool needs. The displays include TV alignment and adjustment screwdrivers, Delrin hex



wrenches, hex tools, double end iron core tools and duplex aligners. In the field of service aids such items as inspection mirrors, fuse pullers, solder aids, voltage testers, pocket oilers, burnishing tools and wire strippers are included. All items are attractively carded, clearly identified by name or use, and prepriced showing both a suggested list and a coded net price. GC Electronics.



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ELECTRONIC TECHNICIAN/DEALER



### Miniature Torch

717

Announced is a torch for welding metal smaller than 0.002in. and up to 16ga, approximately. It is claimed to be ideal for heat bonding, welding and soldering applications requiring a small, intense flame. It uses oxygen and fuel gas (acetylene, hydrogen, LP-gas or natural gas) to produce a flame

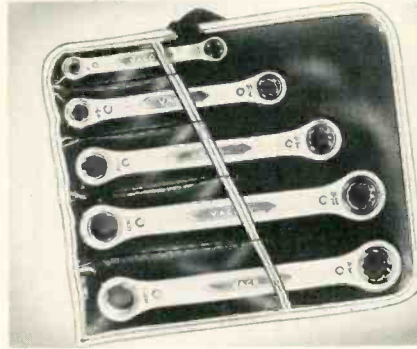


temperature of 6300°F. It is said to operate at 2 to 4psi, and uses gas at 0.023 to 2.54cfh. It is equipped with five different-sized tips that swivel 360deg for handling ease. The two smallest tips have sapphire jeweled orifices that are said to prevent oxide contamination in the joint and provide extra precision and durability. Special accessories are also available. Tescom.

### Ratchet Wrench

718

Announced is a set of five ratchet box wrenches with openings ranging from 1/4 to 3/4 in. Made of durable materials and nickel-chrome plated, the wrenches are said to provide turning ease to stubborn, hard-to-reach hex nuts and bolts. The largest wrench No. 2024, has 5/8 and 3/4 in. double hex

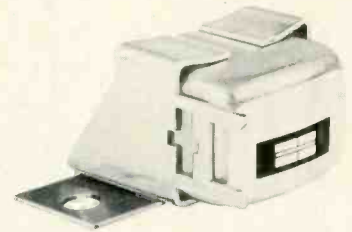


openings and is 8 5/8 in. long. Model No. 2022, has 5/8 and 11/16 in. double hex openings and is the same length. The next largest wrench, No. 1618, has 1/2 and 9/16 in. double hex openings and is 7 1/2 in. long. The fourth model, No. 1214, has 3/8 and 7/16 in. single hex openings and is 6 1/4 in. long. The smallest wrench, No. 810, has 1/2 and 5/16 in. single hex openings and is only 4 1/2 in. long. Vaco.

### Cassette Heads


719


Announced is a tape recorder head for cassettes. Designated the model 09CR2PX4, this stereo record/play



cassette head has laminated pole pieces for extended frequency response and premium shielding for maximum cross-talk rejections, it is said. Glass-filled molding material is used for longer life. Michigan Magnetics.

2.7 Ω      10%  
1/2 WATT  
MIL-R-11      STYLE RC20  
**CARBON COMPOSITION RESISTOR**





10 UNITS

**SNAP PAK**

Original Equipment Part

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### takes the guesswork out of resistor identification

Complete product identification —no reading of color code

Resistors stay put —won't fall out even if one is removed


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Technical data or helpful replacement information

674




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- Fine-tuning adjustment. VSWR 1.5:1 or better.
- 17-7PH stainless steel whip. Length, just 38"!



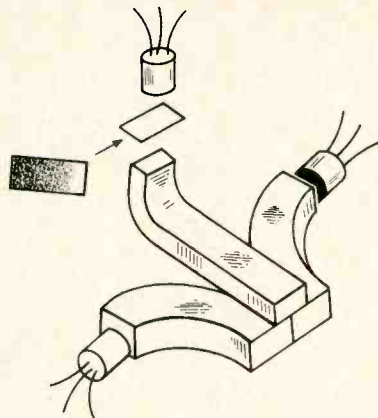
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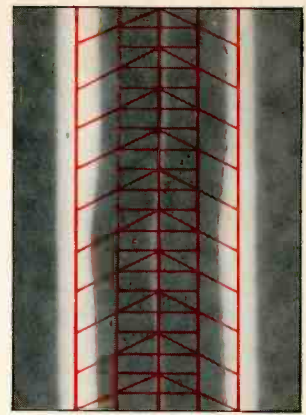
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**SEMICONDUCTORS . . .**

*Continued from page 57*



**Fig. 16** Some needleless phonographs may use a third set of fiber optics to view the white line formed at the very bottom of 78rpm record grooves.



**Fig. 17** — Different patterns are used to illustrate the portions of a 78rpm record groove seen by the three photocells. A slightly different view of the record groove is transmitted to each of the three photocells.

corresponds to the audio signals recorded on the record. Once amplified, these signals are like those produced by a conventional phonograph.

When the photocells are properly tracking a record groove, the average amount of light exposed to each photocell remains equal. By connecting the photocells to a dc amplifier (direct-coupled analog integrated circuits are becoming relatively inexpensive and should lend themselves well to this application), the average dc output from each amplifier is equal when the photocells are properly tracking the record groove.

The Wheatstone bridge circuit shown in Fig. 4 can be used in conjunction with the photocells for tracking the record groove. The lamps in this circuit are connected directly to the amplifiers, their aver-

age brilliance depending on the amplifiers' dc output, and a motor with speed-reducing gears is substituted for the meter. If the groove's image is right of center on the fiber optics, one photocell sees more light than the other, one amplifier has a greater dc output than the other, the lamps are no longer of equal brilliance, the Wheatstone bridge becomes unbalanced and the motor receives power to center the phonograph tone arm over the record groove. This function of the Wheatstone bridge circuit in the phonograph is similar to its function in the stereo balance indicator described earlier.

A third set of fiber optics may be used in some needleless phonographs (Fig. 16) to view the white line formed at the very bottom of 78rpm record grooves. (This portion of the groove is generally pro-

**Fig. 20** — One experimental model of a needleless phonograph with all the optics enclosed at the end of the tone arm. (No licensing agreements have yet been announced.)





Fig. 18 — Only the segments of the 78rpm record groove seen at various random intervals of time are shown.

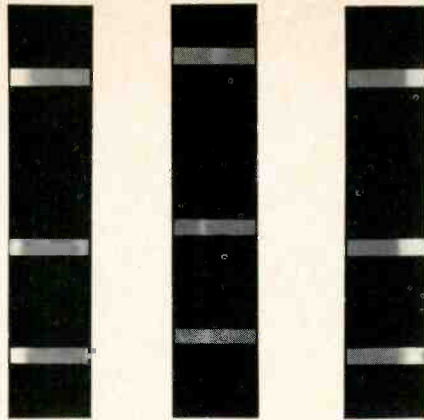


Fig. 19—The amount of light exposed to the central photocell varies with the relative position of the central line—after its image passes through a graduated filter.

tected by its sides from surface scratches normally found on old records — distorting their sound on conventional phonographs.) A graduated filter is located in front of the third photocell.

As the record rotates (Fig. 17), each photocell sees only its portion of the record groove — designated by different patterns in the illustration.

For simplicity, Fig. 18 shows only the segments of the groove seen at different random intervals of time. As in Fig. 14, the first two photocells see the left and right portions of the groove and are used in tracking the record. The third photocell sees only the central portion of the groove (Fig. 19).

Because of time delays in the



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"So easy to use! With my Sencore scope I can read high or low frequency signals without band switching. As easy to use as a voltmeter."—R. L., Portland, Ore.

"I've only had my PS127 a couple of months, but it's more than paid for itself already with the extra jobs I've been able to handle."—S. O., New Orleans, La.

"With the direct peak-to-peak readout I can compare voltage readings to those on the schematic without wasting valuable time setting up my scope with comparison voltages."—J. M. F., Plymouth, Michigan.

"Those Sencore exclusives really sold me, like the extra 500KC Horizontal Sweep range and the free high voltage probe."—D. N., Brooklyn, N.Y.

You'd expect a wide band scope of this quality to cost at least double."—W. L., Chicago, Ill.

"With the PS127, I find I can trouble-shoot those tough ones twice as fast as before—especially color TV."—F. C., Burlingame, Calif.

"Once I compared the specs, I knew Sencore had the best buy in scopes. We now have three PS127's in our shop."—J. S., Ft. Lauderdale, Fla.

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Vert. Freq. Resp. 10 CPS to 4.5 MC  $\pm$  1 db, - 3 db @ 6.2 MC • Rise Time .055 Microseconds • Vert. Sens. .017 Volts RMS/inch • Horiz. Freq. Resp. 10 CPS to 650 KC • Horiz. Sens. .6 Volts RMS/inch • Horiz. Sweep Ranges (10% overlap) 5 to 50 CPS, 50 to 500 CPS, 500 CPS to 5 KC, 5 to 50 KC, 50 to 500 KC • Input Impedance 2.7 megohms shunted by 99 MMF, 27 megohms shunted by 9 MMF thru low-cap. jack • High Voltage Probe 5000 Volts Max. • Dimensions 12"x9"x15½", Wt. 25 lbs. • Price Complete \$199.50



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tracking system, the third set of fiber optics is positioned at the average left-to-right location of the groove's center. As the image of the line seen by the third photocell appears to move left or right of center, the image is seen through less or more dense portions of the graduated filter and its brightness appears to vary as its relative position shifts. This apparent motion of the groove's central line changes the output of the third photocell and produces an audio signal.

The needless phonograph shown in Fig. 20 uses prisms rather than mirrors for reflecting light within the optical system. Additional prisms were used to contain the optical system in an enclosure at the end of the tone arm.

By inserting fiber optics between the lamp and objective lens and extending the length of the fiber optics shown in Fig. 9, the lamp and photocells can be contained beneath the phonograph and only a relatively small tone arm — without moving parts or electronic circuits — can be positioned above the record. The tone arm can be connected to the light source and photocells with a relatively inexpensive cable of plastic fiber optics like the one shown in Fig. 12 and 13 of the March 1968 article. This will permit the construction of needless tone arms no larger than tone arms in current use.

Records played with a needless phonograph will experience virtually no wear, and the frequency response of recorded music need not be limited by the mass of a vibrating needle and related components.

The next article in this series will describe the characteristics of uni-junction transistors, field-effect diodes, zener diodes, temperature-compensating diodes, thyrectors, four-layer diodes, SCR diodes, diacs and triacs. The function of these semiconductors in power supplies and power regulating circuits will be described the following months.

**MOVING?**

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ELECTRONIC TECHNICIAN/DEALER

# TECHNICAL DIGEST

Continued from page 34

include a VDR across the output transistor which protects it from the large flyback pulse. A VDR is also used to stabilize the bias voltage of the oscillator transistor.

The over-all performance of the vertical circuits of this chassis delivers a linear, stable vertical scan. Circuit refinements insure good noise immunity, freedom from line-voltage variations, independence from varying transistor characteristics and full control of the vertical-sweep waveform with the usual height, linearity and hold controls.

Service can be performed on transistor vertical-deflection circuits by using signal injection. The circuit can be treated as a 60Hz amplifier, and when 6.3vac is fed through a blocking capacitor (5  $\mu$ f to 10  $\mu$ f) to various points, an isolation to a particular stage can be made. Voltage and resistance readings are then used to isolate a component.

# NEWS OF THE INDUSTRY

## Visual Electronics Introduces 1-Inch Vidicon for Color Cameras

Visual Electronics Corp. announces the availability of a series of 1 in. electrostatically focused vidicon tubes for transistorized film and live broadcast color cameras, military and space systems and for medical and industrial applications. The tube series uses an electrostatic focusing electrode requiring virtually no current, eliminating the need for a focus coil and its associated bulk and high power consumption, it is said.

## Sangamo, Microsonics To Merge

Sangamo Electric Co., Springfield, Ill., and Microsonics, Inc., Weymouth, Mass., have reached agreement whereby Microsonics will be merged into Sangamo through an exchange of stock.

The plan calls for one share of Sangamo common stock to be exchanged for six shares of Microsonics. At present, Sangamo owns 76 percent of Microsonics. The agreement is subject to the approval of shareholders of Microsonics.

Microsonics manufactures specialized electronic components and is recognized as a leading producer of ultrasonic delay lines, crystal filters and related electronic systems.

## Zenith Enters Small-Screen Color Market

Zenith Sales Corp. announces its entry into the small-screen color TV market with the introduction of two 14in. diagonal screen personal portables.

Walter C. Fisher, Zenith Sales Corp. president, says the new small-screen color sets with a 102sq. in. picture, "add a fourth rectangular screen size to our 1968 color line and broaden the range of choice in our color receivers."

# New Dual Purpose OSCILLOSCOPE / VECTORSCOPE

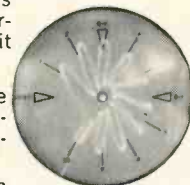


NOW — YOU CAN HAVE BOTH IN ONE INSTRUMENT:

- A CONVENTIONAL WIDE BAND OSCILLOSCOPE
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The PS148 wide band scope is identical in features and specifications to the PS127. In addition, it provides a vectorscope for complete simplified troubleshooting and alignment of color TV chroma circuits. Now, you can view the vector patterns as recommended by Zenith or display the standard "S" pattern as recommended by RCA. Both methods are at your fingertips with the PS148. Now, for only \$20.00 more than the PS127, you can view vectors and still own a deluxe wide band scope for all other work. Why pay many times more?

- Converts at the flick of a switch on rear panel from a professional wide band scope to a large 5-inch vectorscope. All vectorscope connections and controls are located on rear for ease of operation and to prevent color demodulator circuit loading.
- Simplified instructions for using the vectorscope in color TV chroma circuits and for troubleshooting and alignment are packed with each instrument.
- Comes with special vectorgraph screen which shows exact degree of chroma demodulation; also includes viewing hood.
- Use with any standard 10 bar color generator, such as all Sencore, RCA, etc. Use your present color generator and save money.
- Vectorscope connections on PS148 rear also speeds up other work where direct connections to the CRT deflection plates are required; such as, modulation checks and lissajous patterns for communications or lab work.



Typical Vector pattern

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**\$219<sup>50</sup>**



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## FTC Action on Stereo and Stereophonic

The Federal Trade Commission announces it will take steps to prevent deception in using the words "stereo" or "stereophonic" on phonograph records, and in the future will require members of the phonograph record industry to conform more strictly with the provisions of Rule 16 (a) of the trade practice rules for the phono-

graph record industry. The mentioned rule provides:

"No member of the industry shall use the words 'stereo' or 'stereophonic', or any other word or phrase of like meaning, to describe or refer to a recording that does not have two distinctly separate modulations derived from an original live recording in which a minimum of two separate channels were employed; except that such word or phrase may be used in connection with a recording having two distinctly separate modulations derived from an original monophonic recording if a clear and conspicuous disclosure is made, in immediate conjunction therewith, that the recording has been altered, changed, or re-recorded to simulate stereophonic reproduction."

This action by the commission was in the form of guiding instructions to its staff in the discharge of the commission's responsibilities under the Federal Trade Commission Act which are aimed at the prevention of unfair methods of competition and unfair or deceptive acts or practices in commerce.

## Mosley Appoints Reps

Mosley Electronics announces the appointment of two new manufacturer's representatives. Thomas Shelby and Co., 17 S. Walnut St., New Bremen, Ohio, newly represents Mosley in Ohio, western Pennsylvania, and West Virginia. Steve Fisher Sales Corp., 121 Cedar Lane, Teaneck, N. J., represents Mosley in northern New Jersey and metropolitan New York.

## Jerrold Appoints Regional Manager

Wendell Woody has been appointed Midwest regional manager by the Distributor Sales Div. of Jerrold Electronics Corp., Philadelphia. In this position, Mr. Woody is responsible for the sale and promotion of Jerrold's home TV antennas, TV reception aids,

master antenna TV systems and educational TV systems throughout the Midwest. He is headquartered at Jerrold's Kansas City facilities.

## Astatic Buys Euphonics Patents

Patent rights and all production tools, materials and equipment involved in the manufacture of ceramic cartridges and needles by Euphonics Corp., San Juan, Puerto Rico, have been acquired by The Astatic Corp., Conneaut, Ohio, it is announced by James Ross, chairman of the board of Astatic.

Astatic has been a leading producer of microphones, cartridges and phonograph needles for over 35 years.

## Johnson Announces New Two-Way Line

The E. F. Johnson Co., Waseca, Minn., manufacturers of electronic components and two-way radio equipment, announces a new line of commercial single-sideband (SSB) radios for long-range communications will be introduced to the international market in early 1968.

Also scheduled for introduction in 1968 are several new CB radio products and industrial electronic components designed to fill the requirements of newly developing portions of these markets.

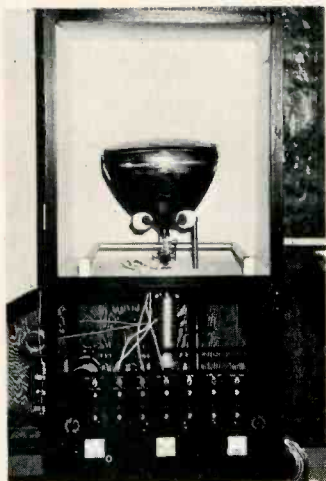
## IC Sales Climb

U.S. factory sales of semiconductor integrated circuits (ICs) totaled \$183 million during the first 10 months of 1967, climbing 59 percent from sales of \$116 million during this period in 1966, according to the Electronic Industries Assn.'s Marketing Services Dept.

## Philips Appoints Reps

Philips Electronic Instruments appoints Burlingame Associates as sales representatives for the Northeastern

## CRT Rebuilder



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Increase your income by \$1,000 or more, per month.

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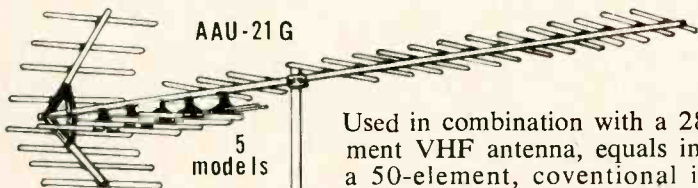
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# KAY-TOWNES ANTENNA

KAY-TOWNES ANTENNA CO.  
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ELECTRONIC TECHNICIAN/DEALER

United States to handle a new line of Norelco electronic measuring instruments. The territory includes Maine, New Hampshire, Vermont, New York, Massachusetts, Connecticut, Rhode Island, New Jersey, Pennsylvania, Maryland, Delaware and Virginia.

### 3M Centers Extend Background Music Franchises

The 3M Co. announces its business products centers will offer franchises to audio system dealers to sell its background music unit.

Previously available only from the corporation's network of 200 3M business products centers, the 3M brand "Cantata" 700 background music system will now be available also from audio system dealers who will operate under franchises from these established 3M distributors.

### Home News Service Makes Debut

An all-electronic news service for home TV sets is being used by more than 8000 residents in the Grand Island, Neb., area. The service, "Alpha-matic News," is said to be the first installation of its kind in the Midwest.

The system brings to home TV sets UPI world and local news 24 hours a

day directly from the worldwide facilities of United Press International. Simultaneously, at the bottom of the screen, the symbols and prices of the New York Stock Exchange appear, on a 15-minute delayed basis.

The system has been installed by Television Presentations, Inc., a subsidiary of Sterling Communications, Inc., and Multi-Vue TV Inc., a CATV system available to Grand Island, Neb.

### Hickok Extends Digital Meter Warranty

The warranty period on Hickok digital measuring systems is now one year, a major change from the previous standard 90-day warranty.

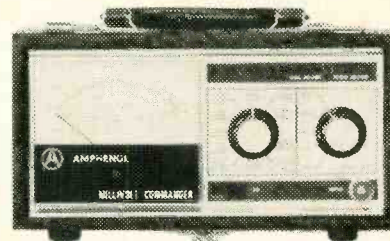
According to Ken Petersen, vice president of marketing, "Field performance of the system, deliveries of which began in 1966, has been so outstanding that an extension of the warranty on all new systems being shipped is in order. Our customers should be provided with this additional protection."

### Jerrold Names Rep

The Jerrold Electronics Corp. names Fisher Sales, Minneapolis, as its manufacturer's representative.

The firm, headed by Lowell Fisher,

## New sensitivity for transistor servicing



The new Model 870 Millivolt Commander from Amphenol is a low-cost, field-effect transistor instrument; it's designed with the needed low ranges for servicing transistorized equipment. Never before have such sensitive measuring capabilities been available in an instrument under \$100.

With the portability of a VOM and the accuracy and input impedance of a VTVM, the Millivolt Commander offers extreme versatility, with a price that will fit almost any budget.

The Model 870 Millivolt Commander's measuring capabilities are:

- 1/10 to 1000 volts DC, full scale, in 9 overlapping ranges, within  $\pm 2\%$  accuracy.
- 1/100 to 300 volts RMS AC, full scale, in 10 overlapping ranges, within  $\pm 3\%$  accuracy.
- $-40$  to  $+50$  db in 10 steps of 10 db. Resistance from 10 ohms center scale to 10 megohms center scale within  $\pm 3$  degrees of arc in 7 overlapping ranges.

Other features include: battery life equal to shelf life; elimination of warm-up time; automatic shut-off when lid is closed; and a sturdy, single-unit probe with a built-in DC/AC-OHMS switch and shielded cable.

The Amphenol Millivolt Commander is  $9\frac{1}{4}$  inches wide,  $5\frac{3}{4}$  inches high and  $6\frac{3}{8}$  inches deep and weighs only five lbs with batteries.

Suggested list price of Model 870 Millivolt Commander is only \$99.95.

Amphenol Corporation, Department ET2-48, 2875 South 25th Avenue, Broadview, Illinois 60153.



**AMPHENOL**

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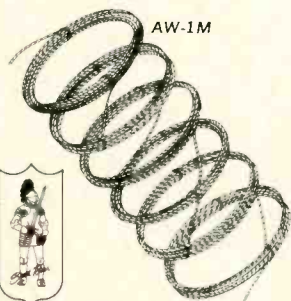
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will represent the TV antenna and distribution equipment firm in Minnesota, North and South Dakota and western Wisconsin.

"Because of Fisher Sales' broad experience at the factory, distributor and dealer levels," commented Milt Dienes, sales manager of Jerrold's distributor sales division, "the new representative will strengthen the firm's marketing program in the North Central states."

## RCA Increases Two-Way Mobile Prices

Price increases of 5 percent on most items of two-way mobile radio equipment are announced by RCA. The new prices became effective Feb. 1, 1968.

## New Jersey Specialty Prexy

Jersey Specialty Co., manufacturer of TV wire and related cables, announces the election of Robert A. Foster as president of the firm, succeeding Peter Hagedoorn who recently passed away. Mr. Foster has been

with Jersey Specialty for 32 years, working closely with Mr. Hagedoorn as executive vice president.

## SERVICE DEALERS . . .

*Continued from page 64*

tion—particularly when defects are discovered.

"Six months ago, for example, we discovered a component failure in one of the major lines we carry," Mr. Limberatos says. "We promptly informed the manufacturer, and yet there's no information on this in his recent bulletin and there probably won't be for another six months."

## Qualified Technicians?

Mr. Limberatos notes that a common reply manufacturers make to dealer complaints is that there is a shortage of technicians who are qualified to handle color. Technicians, he contends, are much better qualified today than they ever were.

"We operate 25 service trucks and employ up to 50 service technicians," he says. "We have no prob-

lem finding qualified technicians so I can't accept the lack of good men as a reason for failures."

Alco-Paramount operates a block-long store in downtown San Jose. Mr. Limberatos and his partners, Jim Nelson and George Akers, are all oldtime service technicians.

They came out of the Navy together and opened a car radio service shop. As their business expanded, they found that a central problem was lack of public confidence in the service work performed.

Consequently, they took the problem to their local BBB and helped the bureau develop a program which Mr. Limberatos asserts has raised the quality standards of service-dealers in Santa Clara County well above the national average.

"It appears that service-dealers throughout the country are not doing enough about the growing number of complaints involving our industry," he continues.

"Sooner or later, we're going to get a lot of government regulation unless the legitimate dealers work together for self-regulation. In our experience, the BBB is the place to begin." ■



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ELECTRONIC TECHNICIAN/DEALER



**Education Brochure 400**

This brochure contains seven case histories of industries using job-related correspondence instruction programs. A wide range of companies is covered. Some are large, others relatively small, each with its own particular problem. In some cases, a dollars-and-cents yardstick was used to determine production savings. But, in each case, the results are indicative of the growing role of correspondence training in modern industry. ICS.

**Antennas/Accessories 401**

A 23-page catalog lists a variety of outdoor and indoor antennas, antenna kits, couplers, splitters, lead-ins, mounting hardware and other associated items. Audiotex.

**Silicon Transistors 402**

A 65-page catalog describes more than 350 different high reliability silicon transistors. Specifications are tabulated for transistors used as general purpose, medium and high-speed amplifiers, low level amplifiers, UHF amplifiers, ultra-high-speed logic

switches, core drivers, choppers, differential, dual and Darlington amplifiers. Raytheon.

**Circuit Protection 403**

A data sheet describes a surge arrester for multiple circuit protection. The device is designed to protect communications and other circuits subject to over-voltages resulting from lightning, mechanical or electrical failure or other causes. Raytheon.

**Semiconductors 404**

A 55-page guide cross-references 12,000 transistors, rectifiers, zener diodes, dual diodes and SCR semiconductor devices of interest to hobbyists, experimenters and professional service-dealers. Listings are in alpha-numeric order. Motorola.

**Home Study 405**

A folder lists over 100 schools which offer a large variety of courses supervised and approved by the National Home Study Council's Accrediting Commission. National Home Study Council.

**Test Instruments 406**

A catalog lists a complete line of service test instruments; includes rotary scale clamp-on volt-amp-ohmmeters. Amprobe.

**Amphenol's  
new 857 tests  
for second anode  
leakage to  
CRT gun structure.**



Have you ever checked a color CRT that read "good," but actually the tube was bad? Now you can check for that hidden problem—internal high voltage leakage—at actual operating voltages . . . right in the customer's home. The CRT Commander, Model 857, can test every performance characteristic of a picture tube. Black and white or color.

There are many outstanding features that set the CRT Commander, Model 857, apart from the rest. It's the only CRT tester that functions as a voltmeter capable of measuring 0 to 1000, 0 to 5000, to 50KV (DC) with optional 857-9 probe. It's the only CRT tester that performs 2nd anode test. It reads gas direct on sensitive 50 u/amp meter. The CRT Commander rejuvenates tubes, too. Tubes you may have thought were beyond hope. The CRT Commander comes in a professional luggage-type case. Only \$99.95.

See the new CRT Commander, Model 857, now. Write for all the details and the name of your local distributor. Dept. ET4-48, Amphenol Distributor Division, 2875 South 25th Avenue, Broadview, Illinois 60153. Then go to your Amphenol distributor.

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 for the pro's.**



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Three color patterns: (1) exclusive single-bar, (2) exclusive three-bar, (3) familiar ten-bar gated rainbow. Plus, six line and dot patterns. To top it all off—instant pattern stability from 0° to +125°F without using old-fashioned heaters. True AC/DC operation.

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Other features that separate the Amphenol Deluxe Color Commander from other color alignment equipment: color coded control panel. Two preset channels. Built-in gun killers with lead piercing clips. Laminated gloss-epoxy circuit boards. Storage space for leads and tools. Automatic shut-off. Luggage-type case measures 8¾" wide, 7⅝" high, 5½" deep and the whole unit weighs only 4¼ pounds. Runs on AC line or batteries.

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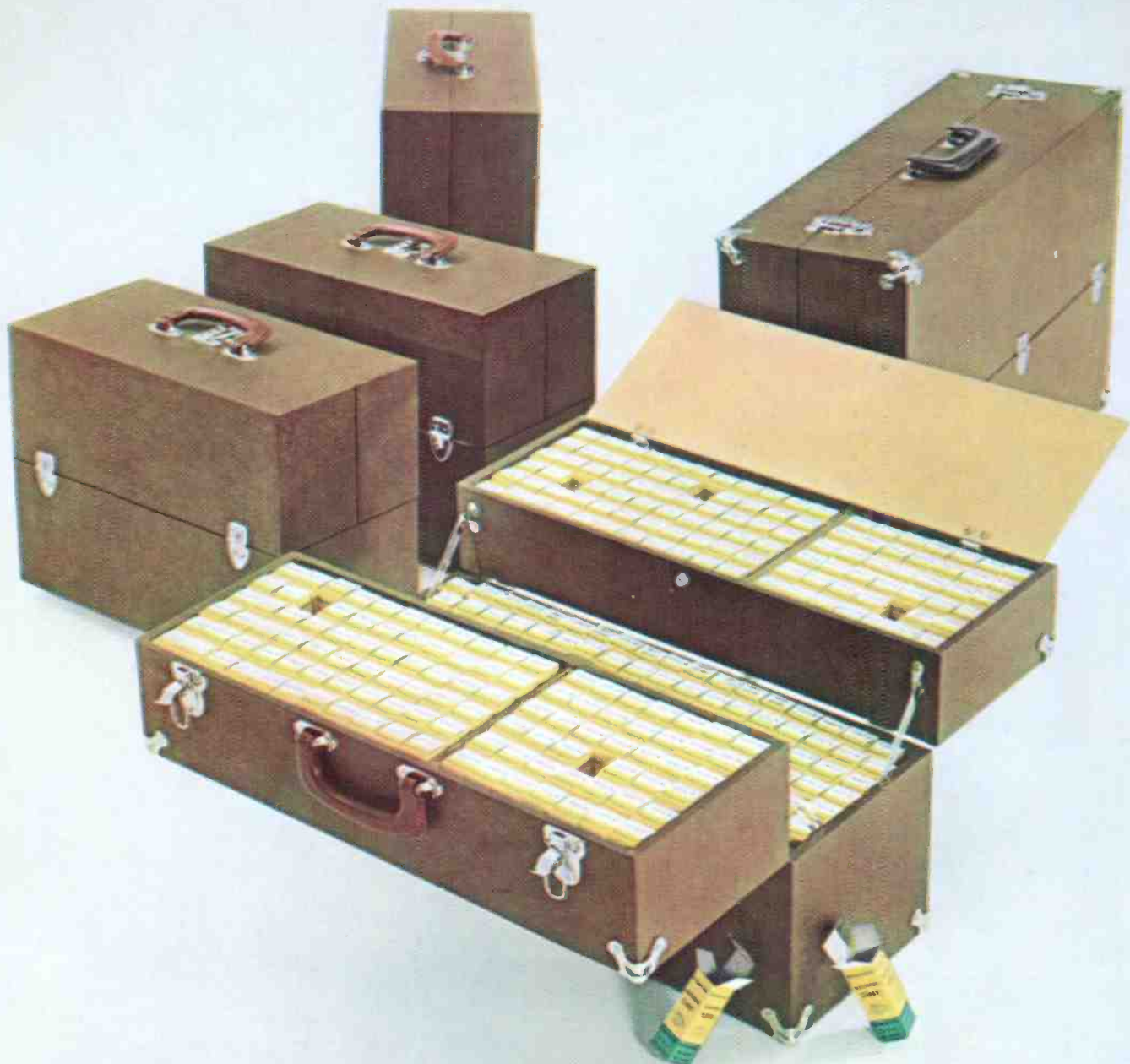


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