The new performance standard in preamplifiers

New Jerrod Lightning-Protected Powermate® Preamplifiers now bring you a degree of reliability never before achieved in mast-mounted solid-state preamplifiers. Our extensive field tests in lightning storms prove it. Powermate models are available for every signal situation—VHF, UHF, and FM. And you can expect them to deliver snow-free, ghost-free, line-free TV in color or black and white for plenty of reasons:

- High gain
- Extremely low noise figures
- Unusually flat response
- Elimination of cross modulation and herringbone distortion
- Excellent overload capability

Get more details on the preamplifier designed to be an antenna’s best friend. The reliable, new Jerrod Lightning-Protected Powermate Preamplifier. The newest product in Jerrod’s Spectrum '67. Ask your Jerrod Distributor. Or write for further information to: Jerrod Electronics Corporation, Distributor Sales Division, 401 Walnut St., Philadelphia, Pa. 19105.
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.

Guaranteed means a full 12-month warranty against defective workmanship and parts failure due to normal usage. That's 9 months to a year better than others. And it's backed up by the only tuner repair service authorized and supervised by the world's largest tuner manufacturer—Sarkes Tarzian, Inc.

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. Shipped same day order received. Order custom tuners by TV make, chassis, and model number. Order universal replacement by part number:

<table>
<thead>
<tr>
<th>Part #</th>
<th>Intermediate Frequency</th>
<th>AF Amp Tube</th>
<th>Osc. Mixer Tube</th>
<th>Heater</th>
</tr>
</thead>
<tbody>
<tr>
<td>MFT-1</td>
<td>41.25 mc Sound</td>
<td>6GK5</td>
<td>6L8</td>
<td>Parallel 6.3V</td>
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<tr>
<td></td>
<td>45.75 mc Video</td>
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<tr>
<td>MFT-2</td>
<td>41.25 mc Sound</td>
<td>3GK5</td>
<td>5L8</td>
<td>Series 450 MA</td>
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<tr>
<td></td>
<td>45.75 mc Video</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>MFT-3</td>
<td>41.25 mc Sound</td>
<td>2GK5</td>
<td>5CG8</td>
<td>Series 600 MA</td>
</tr>
<tr>
<td></td>
<td>45.75 mc Video</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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.

FOR FASTEST SERVICE, SEND FAULTY TUNER WITH TV MAKE, CHASSIS, AND MODEL NUMBER, TO TUNER SERVICE CENTER NEAREST YOU

TUNER SERVICE CORPORATION FACTORY-SUPERVISED TUNER SERVICE

HOME OFFICE, MIDWEST 817 N. PENNSYLVANIA ST., Indianapolis, Indiana TEL: 317-632-3493
UNDER NEW MANAGEMENT, EAST 547-49 TONNELE AVE., Jersey City, New Jersey TEL: 201-792-3730
SOUTH-EAST 938 GORDON ST., S. W. Atlanta, Georgia TEL: 404-758-2232
WEST SARKES TARZIAN, Inc. TUNER SERVICE DIVISION 10654 MAGNOLIA BLVD., North Hollywood, California TEL: 213-769-2720

DECEMBER 1967
Sencore's Color King puts an end to cold weather instability.

Transistors just don't perform properly on those cold, cold winter days. So, when you bring in an ordinary solid state color bar generator from a freezing car or van, you wait and wait for stable patterns. Even then you can't be sure.

Only Sencore's new Color King is truly winter protected. Only the Color King has a built-in heating element surrounding the critical timing circuits. The instant you plug in the generator, this heating element warms up these circuits; also driving out excessive humidity. When optimum operating temperature is reached, a thermostat automatically turns off both the heating element and the Temp Control indicator light. Now you know the circuits are rock stable.

Protect yourself this winter. Go for the hot one. The CG141 Color King. The color generator that works when its hot and works when its COLD.

That's why the Sencore Color King stays sold.

Only $149.95 User Net
DECEMBER 1967 • VOL. 86, NO. 6

ELECTRONIC TECHNICIAN

WORLDS LARGEST ELECTRONIC TRADE CIRCULATION

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Our innovating photographers created this one by shooting part of the front window of a local TV-radio shop through a Christmas wreath.

TEKFAX • 16 PAGES OF THE LATEST SCHEMATICS • Group 184

CANADIAN GENERAL ELECTRIC: TV Chassis M685
CORONADO: TV Model TV2-7110A
PHILCO-FORD: TV Chassis 18N745
TRUETON: TV Model 2DC3818
ZENITH: Color TV Chassis 20Y1C37

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POSTMASTER: Send form 3579 to ELECTRONIC TECHNICIAN, Ojibway Building, Duluth, Minnesota 55802.
Channel Master smashes the 82 Channel size barrier!

Revolutionary VUtronic design* electronically interleaves U and V elements for compact size without sacrifice of VHF gain.

Deep Fringe Model 3661-G
Same VHF gain as Color Crossfire Model 3610-G

Fringe area Model 3661G has all UHF elements contained within the over-all length of the VHF section

A VHF only antenna with exactly the same VHF gain as the 82-channel Model 3661G is also practically the same size.

Usual design 82-channel antenna would have to be 34% longer to provide the same UHF and VHF gain as Model 3661G Color Crossfire 82

*Patent Applied For
Totally new concepts in UHF/VHF design are joined with Channel Master’s proven Crossfire principle to produce the first 82-channel antennas that meet UHF reception needs yet also provide unsurpassed VHF gain...and with no appreciable increase in over-all size.

Here is another example of a major development from Channel Master Laboratories where, as always, leadership begins with research.

Until now, antenna manufacturers have created combination UHF/VHF antennas by coupling a UHF section to the front of a VHF antenna. To avoid costly, unwieldy, and unsightly construction, this has always meant sacrificing VHF gain. Now Channel Master fills the 82-channel gain gap with Color Crossfire 82 antennas designed for metropolitan to fringe areas where maximum VHF gain is as important as UHF reception power.

In addition to the famous Channel Master Crossfire VHF Proportional Energy Absorption Principle, these new antennas employ unique series-fed folded UHF dipoles with carefully engineered dimensions so that they literally “disappear” and operate as a perfect 300 ohm line at VHF frequencies...no “lossy” couplers required as is the case with the usual parallel-fed UHF elements.

And, of course, every Color Crossfire 82 antenna features Channel Master’s famous E.P.C. golden coating and rugged preassembled construction.

Now the first and only complete line of full VHF Power 82-channel antennas.
ALIGNMENT OSCILLATORS
DESIGNED TO MAKE SERVICING EASIER
BOTH NEW FROM INTERNATIONAL

MODEL 812
(70 KHz — 20 MHz)
The Model 812 is a crystal controlled oscillator for generating standard signals in the alignment of IF and RF circuits. The portable design is ideal for servicing two-way radios, TV color sets, etc. This model can be zeroed and certified for frequency comparison on special order. Individual trimmers are provided for each crystal. Tolerance .001%. Output attenuators provided. Battery operated. Bench mount available.
Complete (less crystals) $125.00

MODEL 814
(70 KHz — 20 MHz)
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.
Complete (less crystals) $95.00
Both the Model 812 and Model 814 have positions for 12 crystals and the entire frequency range is covered in four steps.

Write for catalog

Editor's Memo
Color TV vs. the Customer
How many times have you heard this: "No matter what station or program I switch to, I constantly have to adjust the color."

Sound familiar? Television service-dealers hear it every day. In most cases the complaints are justified, but not through the fault of the dealer or technician. The cause — no standardization in the transmitted color signal levels.

True, a new color TV owner should be told of the differences in color quality between a cartoon and a live broadcast. But, did you ever try to explain to a man and wife who just put out $700 for a color set, that it will require constant adjustment because the TV signal levels vary from one station to another — in fact, signal levels vary from camera to camera on the same program! Even if you did explain to them why people may look normal on one camera, but turn green when viewed by another, who cares? They didn't spend all that money for a lecture on the shortcomings of the industry. They have a legitimate gripe.

Commercials don't have to pop in with color levels high enough to bloom the picture. People on live programs don't have to vary from normal to green during a switch in cameras. But they do, and as long as they do, set owners will beat a path to the dealer's door and expect adjustment.

Television manufacturers are trying to do something about it. They are designing special circuits to stabilize a wider range of signal levels, circuits to automatically fine tune the set when changing channels — circuits designed to eliminate problems which are not normally caused by the TV set in the first place!

Sure, it's tough for a dealer selling color TV to try to explain signal levels to his customer. But it won't hurt to tell the customer that there is a little more to receiving color than what it took to get a picture on his old black and white. If the dealer explains it well, the customer will probably forget all about signal levels, and think only of the beautiful color movies or ball games and the restful hours of kiddie cartoons.

Moving?
Be sure to let us know your new address. Please enclose a complete address label from one of your recent issues.
Close the sales your ads start. Use Ojibway’s total service to do it.

Effective merchandising. Tailored to your needs. Your market. Ojibway handles it for you. From beginning to end. Puts it where it gets the most action. From the people who make buying decisions. From unenthusiastic salesmen. From brokers and distributors who need a prod.

Solid market information. Facts and conclusions no one can argue with. Plus . . .

Business publications edited for the people who buy. Read by the people who buy for the companies that buy the most. This coverage and readership is basic. You get even more. The help of people who know your market, know the people in it.

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Every job becomes easier, faster, more efficient with the right equipment, and GC has the right equipment to do the job correctly. Whether for service or industrial use, choose from an infinite variety of service aids including TV service mirrors, degaussing coils, wire strippers, solder aids, fuse and tube pullers... all service designed, and made to rigid GC quality standards for the ultimate in reliability and service life. And, whether you need one or a thousand, all are available from stock for immediate shipment... today.

Insist on GC... and you'll get the best!

Write for your Giant FREE GC Catalog today... over 12,000 items including TV Hardware, Phono Drives, Chemicals, Alignment Tools, Audio, Hi-Fi, Stereo & Tape Recorder Accessories, Nuts & Bolts, Plugs & Jacks, Service Aids, and Resistive Devices.

...for almost 40 years!
Dear ANT Grace,

Our TV broke. Unkle Joe tried to fix it. They took Unkle Joe to the hospital and the TV was worse. Daddy called the TV man who fixed it. We are glad the TV works so good as new. But not Unkle Joe. He will be home soon but the Dr. said keep his handz out of the TV.

Love Bobby.


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?"

DECEMBER 1967
Perhaps this is what some of Astatic's competitors are talking about when they claim to be No. 1 in the phono cartridge field. They must mean that they have gone into the RENTAL car(tridge) business!

They can't mean cartridge manufacture or sales. Astatic has held that No. 1 position for more than 30 years. Astatic leads the industry with, far and away, the MOST COMPLETE line. ONLY Astatic has a replacement for EVERY need... the replacement that matches performance and fit as well as appearance. Astatic is also the largest OEM producer, creating the bulk of the replacement market you sell and service. From every standpoint, Astatic is No. 1.

Wonder how the competition keeps track of the mileage?

THE ASTATIC CORPORATION
Conneaut, Ohio 44030 U. S. A.
In Canada: Canadian Astatic Ltd., Toronto, Ontario
Export Sales: Roburn Agencies, Inc.
431 Greenwich Street, New York, New York 10013, U. S. A.

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LETTERS TO THE EDITOR

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est man on the totem pole — that's where the buck ends up.

One of the few companies still making concessions to the servicing end of the business is now pushing "number one." He didn't get in that position on his advertising budget alone. He simply produces products which most service technicians can live with and honestly recommend.

Since few consumers plan on orbiting their color sets, stereo or whatever, I'm puzzled about the source of the future Space Age youngster who is going to work as an apprentice technician while there's a possibility of getting a college sheepskin that automatically means a higher starting income than most technicians can command after many years in the game.

Whether your publication is the means for getting or calling attention to standards that would not only give technicians a "break" but the consumer as well, is of course something for you to decide. I think, however, it would promote interest and maybe get a few technicians' heads out of TV sets long enough to write you if you were to run a "Jackpot and Lemon" column featuring manufacturers names, model numbers and a short description of why the product is a stinker to troubleshoot and repair or is a delight to work on.

Heinz Neuman
South Beach, Ore.

---

Read ET carefully and you will see that many articles, including those produced in ET's TEKLAB, call attention to numerous servicing problems which arise because of design. The TEC DIGEST section also covers manufacturers' design changes — changes made after previous equipment runs have proven deficient in certain ways. We honestly believe that design trends are now moving toward fewer servicing problems. Standardization would be only one factor involved in accelerating this process. — Ed.

Long Distance Call
I have a model 153 signal generator and tracer made by Accurate Instrument Co. Understand they are no longer in existence. I need a spare variable capacitor and a complete schematic.

Y. L. Ong
10, Lorong 10 / 10A
Petaling Jaya,
Selangor, Malaysia

---

ELECTRONIC TECHNICIAN
NOW... a full-sized VOM in a palm sized "package"

Simpson Handi-VOM gives you the ranges, the time-saving conveniences and the sensitivity of a full-sized volt-ohm-milliammeter—yet it's only 3-5/16" wide, weighs a mere 12 ounces. Recessed range-selector switch never gets in the way... polarity-reversing switch saves fuss and fumble. Self-shielded taut band movement assures high repeatability and freedom from external magnetic fields. Diode overload protection prevents burn-out—permits safe operation by inexperienced employees and students. The demand is BIG, so get your order in to your electronic distributor, TODAY!

**RANGES**
- **DC VOLTS:** 0-0.25, 1, 2.5, 10, 50, 250, 500, 1000 @ 20,000 U/V
- **AC VOLTS:** 0-2.5, 10, 50, 250, 500, 1000 @ 5000 V
- **DC MILLIAMPERES:** 0-1, 10, 100, 500
- **AC VOLTS:** 0-2.5, 10, 50, 250, 500, 1000 @ 5000 V
- **DC MILLIAMPERES:** 0-1, 10, 100, 500
- **DB:** -20 to +10, -8 to +22, +6 to +36, +20 to +50
- **0** REFERENCE: 1 MW into 600Ω
- **RESISTANCE:** Rx1, Rx10, Rx100, Rx1K, Rx10K

*WORLD’S LARGEST MANUFACTURER OF ELECTRONIC TEST EQUIPMENT*

Simpson Handi-VOM gives you the ranges, the time-saving conveniences and the sensitivity of a full-sized volt-ohm-milliammeter—yet it's only 3-5/16" wide, weighs a mere 12 ounces. Recessed range-selector switch never gets in the way... polarity-reversing switch saves fuss and fumble. Self-shielded taut band movement assures high repeatability and freedom from external magnetic fields. Diode overload protection prevents burn-out—permits safe operation by inexperienced employees and students. The demand is BIG, so get your order in to your electronic distributor, TODAY!

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*WORLD’S LARGEST MANUFACTURER OF ELECTRONIC TEST EQUIPMENT*
Surprising what you can pick up in a good week's work.

Play along with us and we'll see that you get a little something extra to take home. Like a shiny new toaster or an electric percolator. Maybe a fishing reel or a Harris Tweed jacket.

For that matter, we'll get you a toboggan, if that's what you want most.

What we ask in return is that you use Sylvania tubes when you're repairing TV sets—both our own make and others.

As you know, we make color and black & white picture tubes and receiving tubes for virtually every make set on the market. In fact, 15 out of 21 color set manufacturers use some Sylvania picture tubes as original equipment.

So you shouldn't have much trouble moving a lot of our tubes, week in and week out.

When you use our tubes, you get our Sylvania Bright Guys award certificates as a bonus. They're not quite the same as money. But they will get you the kinds of things only money can buy.

Your distributor is the man to contact for details. He'll give you a Sylvania Bright Guys award kit (which includes a catalogue listing the good things we offer—about 1500 in all).

Naturally, the more tubes you buy from him, the more certificates he'll give to you.

It's a pretty fair way to work, wouldn't you say?
GENERAL ELECTRIC

TV/Phono Chassis M6/MW — Function Switch Availability

Replacement function switch assemblies, used in M6 and MW chassis TV/Phono combination models, will soon become "no longer available." The switch assembly catalog numbers are ET55X35 for the M6 chassis models and ET55X41 for the MW chassis models. Each switch assembly includes one wafer switch, two SPST switches and two DPST switches.

Nearly all defective switch assemblies can be repaired by replacing the faulty switch section or sections.

The illustration identifies the various individual switch sections.

Adjustable Line Voltage Transformer

Occasionally there is a desire to boost or cut the line voltage for a TV set or appliance. This can easily be done with a small filament transformer placed in series with the appliance power cord. A switch could also be added in the secondary to provide a step-variable shop supply for cooking out stubborn intermittents.

The 5a unit shown has enough capacity for a color TV set (about 350w). For other requirements you can roughly calculate the transformer needed by adding 30 percent to the wattage of the appliance and dividing it by 120v. This will give you the current requirement for the transformer secondary.

1. Purchase locally, a filament transformer with a 12.6v, center tapped, 5a secondary.
2. Construct unit in small metal box large enough to hold transformer (and switch, if desired). Use adequate ground and strain reliefs where wires enter box. Cut a number of small holes in the box for ventilation. Remove all burrs!
3. Attach VTVM to output — set on 150vac scale. Connect secondary leads to A and B, two at a time, until you get the desired voltage reading on VTVM. In diagram, connecting 1 to A and 3 to B would add 12v; 3 to A and 1 to B would subtract 12v.
4. Tape up unused secondary lead. Label box with input and output voltages and wattage limit.

RCA Victor

Stereo Phono Cartridge RMP205-2 — Cartridge Description

RMP205-2 is a high-performance stereo phonograph cartridge assembly fitted with ceramic pickup elements and a matching isolating integrated circuit designed to operate with solid-state preamplifiers.

The precision tracking and high compliance necessary to achieve high fidelity reproduction of a phonograph record require a small, light mechanical mass at the stylus and voltage generating element in the cartridge. To achieve optimum electrical performance in the preamplifier, however, the pickup element should be as large as possible. To secure both of these opposed conditions, the chip effectively separates the mechanical and electrical limitations to permit each to be designed for optimum performance. To achieve a small-mass mechanical system, the ceramic elements in the 205-2 are rectangular bars approximately 0.013 x 0.030 x 0.375in.

Because ceramic and crystal pickups function as high impedance, capacitive strain/voltage generators, they must be coupled to a low-input impedance preamplifier through a matching network to maintain optimum energy transfer and to insurne acceptable frequency response.

The chip is said to achieve the first of these matching parameters without the inherent insertion loss of an RC network by using a 4-NPN-transistor integrated circuit. Two transistors function in a Darlington configuration for each stereo channel. This circuitry achieves a current gain of approximately 0.013 x 0.030 x 0.037in.

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COLOR SPECTRUM T.M. ANTENNAS
are "signal customized" for better color reception...

"the ANTENNA that captures the RAINBOW"

FINCO has developed the Color Spectrum Series of antennas — "Signal Customized" — to exactly fit the requirements of any given area. There is a model scientifically designed and engineered for your area.

Check this chart for the FINCO "Signal Customized" Antenna best suited for your area.

<table>
<thead>
<tr>
<th>STRENGTH OF UHF SIGNAL</th>
<th>Strength of VHF Signal at Receiving Antenna Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO UHF</td>
<td>NO VHF</td>
</tr>
<tr>
<td></td>
<td>VHF SIGNAL STRONG</td>
</tr>
<tr>
<td></td>
<td>CS-V3 $10.95</td>
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<tr>
<td></td>
<td>CS-V5 $17.50</td>
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<td></td>
<td>CS-V7 $24.95</td>
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<td></td>
<td>CS-V10 $35.95</td>
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<td></td>
<td>CS-V15 $48.50</td>
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<tr>
<td></td>
<td>CS-V18 $56.50</td>
</tr>
<tr>
<td>UHF SIGNAL STRONG</td>
<td>CS-U1 $9.95</td>
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<tr>
<td></td>
<td>CS-A1 $16.95</td>
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<td></td>
<td>CS-A2 $18.95</td>
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<td></td>
<td>CS-A3 $18.95</td>
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<td></td>
<td>CS-A4 $22.95</td>
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<td></td>
<td>CS-B1 $29.95</td>
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<tr>
<td></td>
<td>CS-C1 $43.95</td>
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<tr>
<td></td>
<td>CS-C2 $43.95</td>
</tr>
<tr>
<td>UHF SIGNAL WEAK</td>
<td>CS-U2 $14.95</td>
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<tr>
<td></td>
<td>CS-A2 $22.95</td>
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<tr>
<td></td>
<td>CS-A3 $30.95</td>
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<tr>
<td></td>
<td>CS-B1 $29.95</td>
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<td></td>
<td>CS-C1 $43.95</td>
</tr>
<tr>
<td></td>
<td>CS-C2 $43.95</td>
</tr>
<tr>
<td>UHF SIGNAL VERY WEAK</td>
<td>CS-U3 $21.95</td>
</tr>
<tr>
<td></td>
<td>CS-A3 $30.95</td>
</tr>
<tr>
<td></td>
<td>CS-B1 $29.95</td>
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<tr>
<td></td>
<td>CS-C1 $43.95</td>
</tr>
<tr>
<td></td>
<td>CS-C2 $43.95</td>
</tr>
</tbody>
</table>

NOTE: In addition to the regular 300 ohm models (above), each model is available in a 75 ohm coaxial cable downlead where this type of installation is preferable. These models, designated "XCS", each come complete with a compact behind-the-set 75 ohm to 300 ohm balun-splitter to match the antenna system to the proper set terminals.

THE FINNEY COMPANY
34 West Interstate Street • Dept. 110 • Bedford, Ohio 44146

for more details circle 112 on postcard
TEST TRANSISTORS
IN SECONDS
in circuit

TR139
89.50

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TECHNICAL DIGEST

to-output impedance ratio. The input impedance to the chip is approximately 3.5M and the output impedance from the chip is approximately 22K. This matches the input of the solid-state preamplifier and is immune to capacitance effect, hum and noise pickup.

The second condition for acceptable pickup performance — frequency response — is accomplished by an RC equalizing, or compensating network having a high-frequency rolloff comparable to de-emphasis. The chip effectively isolates this network to provide optimum equalization without serious loading of the pickup element.

Color TV chassis CTC35 — Modification in Video Peaking Circuit

In some instances picture ringing and background noise may be encountered.

To minimize these effects, disconnect CI27 from connecting point "AN" of PW700 board and reconnect to junction of T705 and C761 and R782. Change C326 PW300 board from a 5pf capacitor to a 3.5pf Stock No. 117531.

TV Chassis KCS160/164 — Critical Lead Dress

Recent field reports indicate "arching" of the HV may occur in humid areas, from the 2nd anode to wiring close by or to ground. This arcing may cause a breakdown and deterioration of the 2nd anode connection cap.

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When service is required on these chassis it is recommended that the wiring in the vicinity of the 2nd anode lead be dressed straight down as illustrated, when plugged into the CRT.

**Color TV CTC22 Chassis — Capacitor Failure**

Various field reports indicate some failures of C601, screen B+ boost filter. When replacement of this capacitor is required a 0.01µf 1kV ceramic capacitor, stock # 79918 should be used.

When capacitor C601 is replaced, R610, a 33K resistor may also need replacement and R136, a 1K resistor (stock # 502210) should be added in series with B+ as shown in schematic. Late production will include this resistor.

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**ELECTRONIC TECHNICIAN**
Ojibway Building
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DECEMBER 1967
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Here's another gold-plated bandwagon you can ride on

Auto cartridge tape players are now moving like hot cakes at a Shriner’s breakfast. And thousands of TV-radio service-dealers are selling, installing and servicing them.

Today's automobile cartridge tape player is produced in 4- and 8-track types or a combination of both. Other units have a 4-track adapter that must be attached to the 8-track stereo player (See Fig. 1).

The typical unit has a frequency response from 40Hz to 15kHz. Power outputs range from 5 to 10w/channel. Some units have electrically governed motors with heavy flywheel and capstan drive.

The Lear-Jet Stereo 8 model, AS831, for example, has a direct capstan drive inverted dc motor. No belts or pulleys are used. Other units may control speed with mechanical governors, electrical and solid-state systems.

The new tape units have many features — including fast forward speed, precision pitch control and solid-state speed control. Some others have a dial light that indicates which track is being played. Still another type has a system for separate control of volume on both back and front speakers. Another feature is a fine tuning control operated from the front panel to eliminate crosstalk.

In the Automatic Radio Co.'s tape player (Fig. 2) the cartridge slot is designed to operate with eith-
er 4- or 8-track stereo cartridges. Separate AM or FM radio tuner "cartridges" are available to slip into the same slot. This model is also equipped with a built-in keylock mechanism — protecting against theft.

**Installation**

Practically all tape players are mounted under the auto dash by bolting a heavy-duty mounting bracket to the underdash cowl. Several perforated holes are provided for rigid support. Slotted positioning holes are used to push the mounting bracket forward or sideways (see Fig. 3).

Be sure to avoid mounting the equipment where it will be exposed to the sun or near the air conditioner vents. Install the player where dust, dirt and humidity are at a minimum. Mount the unit securely to minimize vibration.

In some cases it may be necessary to use only the first row of holes when mounting the unit under the dash. In this case, add a perforated strap at the rear of the unit. Attach the top of this strap to the firewall or a rigid structural point behind the dash.

Before drilling holes in the firewall or dash, make certain the drill will not penetrate into wiring or other working members.

All stereo tape units should be grounded for proper operation. This is usually accomplished with metal mounting bracket or perforated strap. In new automobiles having plastic undercarriage, bond the tape unit to the metal under dash or firewall.

Slip the tape player into the mounting bracket and level up. Do not mount the player more than 45-deg from horizontal. Simply unloosen the side bolts for easy removal (see Fig. 4).

**Speaker Installation**

Install two PM speakers in each front door or one on each side in both front and rear doors. The latest cars have metal cut-outs on each side of the rear deck. These are size 6x9 or 5x7. When using these two rear speakers, add only one on each side in the front doors.

Many of the new cartridge players have a custom installation speaker kit containing four PM silicone-treated speakers. Included are mounting hardware and grille covers. Correct speaker cable is included to be clipped to speakers with polarized amplifier plug.

Instant mount enclosures are also available for firewall, kick panels, or under-the-seat installation. These quick easy speaker enclosures do not require large mounting holes.

Before attempting to mount the speakers in the front door or kick panels check for speaker clearance. Make sure the magnet portion of the speaker will clear before drilling large holes in the door panels.

**Phasing the Speakers**

Whenever two or more speakers are connected together, they should be properly polarized and in phase. Polarity marks are located on the speaker frame near the terminals in the stereo speaker kits. Unmarked speakers should be polarized and marked.

To polarize the unmarked speaker use a small flashlight battery and clip leads. Now connect the negative lead to the speaker frame and clip leads. Connect the positive lead to the speaker terminal. Momentarily touch the positive terminal to the other speaker terminal. Check to see if the cone moves in or out. Mark this connection with a plus sign on the speaker frame. Check and mark all speakers in the same manner — using either an "in" or "out" movement of the cone as the departure point (see Fig. 5 for speaker connections).

**Battery Polarity**

Be sure the correct battery polarity is applied to the 12v cartridge player. Check the car battery to see which terminal is grounded. All cars made in this country use the negative ground system.

Incorrect battery polarity can damage a stereo unit. During the winter months this condition can happen. The car battery can be charged backward and still operate the auto electrical system. But the transistor car radio or tape player will not perform.

Polarity switches are installed in several tape players for either positive or negative ground installa-
tions. Always connect the A" lead of the tape unit to the fuse block or ahead of the ignition switch.

**Cleaning the Drive Assembly**

The capstan drive and pinch roller should be cleaned periodically with chemically pure alcohol. The tape head should be cleaned after every 15 to 20 hours of playing time. You can safely bet the tape player should be cleaned every time it is repaired. A regular tape head cleaning cartridge is available which can be used to clean the tape head automatically.

Wipe off all tape drives and pinch rollers. When the belt, pulleys and capstan drives become glazed with tape dust and oxide residue, clean and then lubricate with special tape lubrication. Slow and erratic music will result if this is not done.

After cleaning the tape drive and rollers, apply one drop of oil on each bearing. Use a lightweight oil — similar to sewing machine oil. At the same time, check for a dirty thrust pad. Clean off the dust and tape oxide and wipe away all visible lubricant on any moving parts.

**Head Adjustment**

Crosstalk is the reproduction of two audio sources simultaneously. This will render both reproductions unenjoyable. The tape head is picking up two separate tracks of the tape. This is especially true of the 8-track stereo players. Actually, the recorded tape is only 1/4 in. wide with eight channels of sound and seven silent guard channels between each recording.

Check several cartridges before attempting alignment of the head. If only one cartridge produces crosstalk, the cartridge is defective.

In the Ranger model RR41T (Fig. 6), a fine tuning control is mounted on the front panel to permit the listener to raise or lower the playback head manually. Other models have the tape head adjustment at the bottom of the tape player.

The Lear Jet stereo, for example, has a red painted screw on the bottom of the player. To adjust the head properly, place a good cartridge in the player and adjust the red painted screw. If the interfer-
Fig. 6 — Ranger tape player has a crosstalk fine tuning control on the front panel.

Fig. 7 — Speed can be adjusted on this player by adjusting the slotted speed control.

Fig. 8 — A speed disc indicator is located on the bottom of this tape player.

Fig. 9 — This Philco-Ford model tape player has a "shiny" belt and flywheel. Slow or erratic speeds can be eliminated by cleaning the glaze and oxide dust from belt, wheel and tape drive assembly.

If the crosstalk becomes louder, reverse the screw adjustment until the tape plays without interference. Place rubber or plastic glue in the screw slot to prevent vibration moving it out of position.

If the tape head is sitting or angling to one side, adjust the azimuth adjustment screw until the head is perpendicular with the tape guide. Demagnetize the tape head if noisy reproduction exists. Once again, check with several tape cartridges to make sure the one being used is not defective.

**Speed Checks**

If the speed of the player varies, always check the suspected player by substituting a new cartridge. Now select a recording with a vocal singer and listen for the pitch of the known artist's voice. If the pitch is high, the tape player is running fast, or if the voice pitch is low, the tape is running too slow.

To adjust the speed of a Lear-Jet stereo-8 player, remove knobs on the right and insert a thin-bladed screwdriver. If the unit is running fast, a counter-clockwise rotation of the screwdriver will slow the unit. If it is running too slow, turn the control clockwise. Only a fraction of a turn will do the trick.

As shown in Fig. 7, a small rheostat is located on top of the electronic control board. Adjustments of this control will govern the speed of the drive motor. At the bottom of the large flywheel (see Fig. 8) a speed disc is located which can be seen through a small hole in the bottom of the tape player. When a neon or fluorescent light shines against the speed disc, correct speed adjustment can be made. Adjust the small speed rheostat until the lines stand still.

When checking transistors in a solid-state speed control, remove them from the circuit. Several diodes and directly coupled transistors will produce false readings with an incircuit beta tester.

Intermittent transistors can easily be checked in a beta tester. Clip the suspected transistor to the correct test leads and push the beta test switch. Carefully watch the meter hand for any movements. Spray on freeze mist and see if the meter
needle moves toward full scale or indicates “open.” A transistor with any great change of beta reading should be replaced.

**Low Volume with Distortion**

The complaint on a Ranger model RR41T was “low volume and extreme distortion.” Both troubles were isolated to the left tape channel.

Since distortion is generally caused by faults in the output stages, we began with the two push-pull power output transistors. One was replaced and the second output transistor turned out to be the culprit.

In this model the bias should be adjusted after the output transistor is replaced. Connect the player to a 13.5vdc power supply and connect a 4Ω speaker across each speaker output. With no signal applied, carefully adjust the bias potentiometer, R133 for 7.5v at the collector of the output transistor.

**Slow Speed**

The owner of a Philco-Ford stereo player reported that all tapes were running very slow. Sure thing, when we placed the stereo player on the bench, it was running slow. From previous experience we checked the belt and flywheel assembly. The belt was glazed and the flywheel looked like a mirror.

We cleaned the belt and flywheel with cleaning solution. At the same time, we have found that a complete cleaning and lubrication of the tape capstan drive and pinch roller assembly are necessary. Intermittent speed and “wow” are symptoms of glazed belts or dragging tape drives (see Fig. 9).

**Intermittent Speed**

An Automatic tape DEK8 came into the shop with intermittent speed. We suspected a frozen or binding capstan drive, pinch roller or thrust bearing. Cleaning and lubrication of the complete tape player did not solve the problem, however. While checking the electronic speed control circuit we discovered, by pushing up and down on the PC board, that the speed would vary. All soldered connec-

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<tr>
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<th>CAUSES</th>
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<tr>
<td>Fails to play</td>
<td>Check fuse</td>
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<tr>
<td></td>
<td>Poor ground</td>
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<tr>
<td></td>
<td>Faulty power switch</td>
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<tr>
<td></td>
<td>Frozen capstan bearing</td>
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<tr>
<td></td>
<td>Broken drive belt</td>
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<tr>
<td></td>
<td>Dry pinch roller assembly</td>
</tr>
<tr>
<td>Tape plays slow or erratic</td>
<td>Belt dragging or slipping</td>
</tr>
<tr>
<td></td>
<td>Misaligned motor or capstan assembly</td>
</tr>
<tr>
<td></td>
<td>Glazed belt, pulleys or pinch roller</td>
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<tr>
<td></td>
<td>Oil on capstan drive</td>
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<tr>
<td></td>
<td>Defective motor</td>
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<td></td>
<td>Flat pinch roller</td>
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<tr>
<td></td>
<td>Check electronic speed control PC board</td>
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<tr>
<td>Doesn't change channels</td>
<td>Indicator arm binding on top of head index cam</td>
</tr>
<tr>
<td></td>
<td>Channel selector switch shorted or contacts spread too wide</td>
</tr>
<tr>
<td></td>
<td>Solenoid defective — check with ohmmeter. About 10Ω</td>
</tr>
<tr>
<td>No sound</td>
<td>Try another cartridge. See if unit will hum with volume control wide open</td>
</tr>
<tr>
<td></td>
<td>Check for defective playback head</td>
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<tr>
<td></td>
<td>Check to see if either left or right channel is dead</td>
</tr>
<tr>
<td></td>
<td>Use audio signal generator to locate dead stages</td>
</tr>
<tr>
<td>Distorted Output</td>
<td>Check bias adjustment</td>
</tr>
<tr>
<td></td>
<td>Check power output transistors</td>
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<tr>
<td></td>
<td>Difficult-to-locate distortion (Use square wave audio signal generator and scope)</td>
</tr>
<tr>
<td>Unbalanced Output</td>
<td>Check balance potentiometer</td>
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<tr>
<td></td>
<td>Check for poor ground on one speaker</td>
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<tr>
<td></td>
<td>Clean tape head</td>
</tr>
<tr>
<td></td>
<td>Check for weak stage</td>
</tr>
<tr>
<td>Noisy</td>
<td>Check for ignition noise and install capacitor on ignition coil</td>
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<tr>
<td></td>
<td>Install suppressor in distributor lead</td>
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<tr>
<td></td>
<td>Install new noise ignition spark plug cables for extreme conditions</td>
</tr>
<tr>
<td></td>
<td>Check playback head and demagnetize</td>
</tr>
<tr>
<td></td>
<td>Check drive motor flux noise by rotating motor field until magnetic null is lined up with the tape head.</td>
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TECHNICAL TIPS for

Fig. 1 — Schematic of an adjustable transformer focus control which is used in the RCA Victor CTC12 color chassis.

Fig. 2 — HV section of Zenith 20X1C36 color chassis showing selenium rectifier and adjustable pot used in focus voltage circuit.
Keep your customers happy by using a little technical know-how to solve those troublesome HV problems

In addition to the stabilized HV necessary for color CRT anodes, a stable but manually variable focus voltage must also be supplied to electrostatic focus elements of color CRT guns. Some high-voltage systems have a separate focus-voltage tap on the flyback which is connected to the anode of a solid-state diode or the plate of a separate focus-voltage rectifier tube (1V2, 1AU2, etc.), as shown in Fig. 1. A focus-adjust transformer or pot may be used to vary this voltage.

The most likely cause of poor focus is a defective focus-voltage rectifier tube or diode. Use a VTVM with HV probe and check it. Note the set manufacturer’s exact specifications on this. Specifications will probably call for 4.3 to 5.3 kv. If insufficient voltage is present after replacing with a known-good tube or diode, check associated circuit components. Pay close attention to all high-value resistors in these circuits as they do cause considerable trouble.

When adjusting the focus transformer or pot, the brightness and contrast controls should be set as close to the proper viewing level as possible. In general, the control should be adjusted to give maximum overall definition of fine picture detail. And you will need a VTVM with a HV probe that will handle up to 30 kv for making necessary over-all HV and focus voltage measurements. Extreme caution should be observed with these voltages.

An off-value resistor in the grid circuit of the 6BK4 voltage regulator, a tube element short, cathode-to-heater or grid-to-cathode short or a shorted capacitor which normally appears across the shunt regulator grid and cathode can cause HV and focus problems.

A color chassis using a selenium rectifier for focus voltage and employing an adjustable pot is shown in Fig. 2. Focus potentiometers sometimes become pitted—causing intermittent or varying focus conditions. If a replacement control becomes pitted also, you should check the circuit for a leaking or shorting bypass capacitor in the focus circuit. These pitted pots should be replaced. No effort should be made to clean them like we frequently do with volume and other low current carrying controls.

**HV and Focus**

Setting the HV properly and getting the best focus are two problems which many technicians find difficult. These two problems are closely related because, with improper high voltage, it is impossible to obtain good focus.

The HV on most color sets should be 24 kv. On some late model 25 in. CRTs, 25 kv is specified. The HV should never be less than 1 kv lower than the specified voltage. This is less than 5 percent tolerance. Understanding this, you can see why it is very important for your meter to be accurate. If you use a multiplier-type probe on a general-purpose VTVM, have it checked against a good electrostatic HV meter.

Too much HV is rarely a problem—but it happens occasionally. This can cause frequent shunt-regulator HV rectifier failures and insulation breakdown. Too much soft X-ray radiation may be caused also. It will not be possible to obtain good focus unless the HV is properly set. And even when it is properly set, the focus may change slightly with brightness level adjustments.

In some sets you may find the focus transformer running hot or it may burn up—like the one shown in Fig. 3 which went up in smoke. Generally, this is caused by a shorted winding or some defect in the focus transformer. If a new one is installed and it still runs hot, check the circuits for shorts. Also check for HV arc-over from the flyback to the focus adjustment transformer.

**Selenium Focus Rectifiers**

The stacked selenium rectifiers used for
focus voltage in some color receivers have been troublesome at times. They frequently open and you have a blurred picture. Some short and this may kill the HV.

We had a Zenith 20X1C36 chassis (see partial schematic Fig. 2) which had 4in.-wide vertical stripes that were alternately in and out of focus. At other times, streaks would dash across the screen. The technician with his ear “tuned” near the HV cage could also detect a faint arcing sound. A very close look at the individual scanning line revealed a ragged appearance. It should have been smooth. No HV arcing was located — nor loose connections. The selenium rectifier was substituted and this solved the problem.

Another Zenith 20X1C36 chassis had a very blurry picture which was full of lines and streaks. This turned out to be a defective focus rectifier. This type of selenium rectifier is made up of many rectifier units stacked or built together to properly rectify the 5kv for focus control. An arc sometimes develops between these selenium units. And this can cause all kinds of crazy focus problems.

**Focus Rectifier Checks**

You know that an ohmmeter check of a HV selenium rectifier will not reveal anything. If a selenium rectifier is shorted, the ohmmeter will detect this, but these selenium units seldom become shorted.

So how can we go about checking them to determine if they are defective — except by substitution? But substitute units are sometimes defective and you can waste a lot of time this way. Also, some small all-transistor B/W TV sets use these selenium rectifier units and it is a good idea to find out which one is at fault.

The following easy-to-build test circuit can be made to check these rectifiers accurately. A schematic of this unit is shown in Fig. 4. The test circuit may be enclosed in a small metal box (see Fig. 5). SW1 should be a spring return type to assure an open circuit during these checks. SW2 is for meter protection in the event of excessive leakage and should also be a spring return type. The neon lamp should be mounted in an enclosed neon lamp assembly.

Since the unit is connected to the power line, it should either be operated through an isolation transformer or have a 1 to 1 isolation transformer built into the case.

**To Check Focus Rectifiers**

1. Disconnect one side of the rectifier and use an ohmmeter to check for a short-
ed unit. Caution. If a shorted rectifier is connected into the test circuit, it is possible for the neon lamp to explode. That is why an enclosed neon lamp assembly should be used.

2). Connect the leads of the test instrument in the proper manner so as to obtain a forward needle movement on the milliammeter. This can be done by polarizing the test instrument leads to match the leads on the rectifier. At any rate, note that the lead from the plus side of the milliammeter, when connected to the cathode end of the rectifier, will provide a forward movement of the milliammeter if the rectifier is not defective.

3). Depress SW1 and observe the neon lamp. Proper rectifier action will produce pulsating dc and only one element of the neon lamp will light. If both elements light, this indicates ac current flow and the rectifier is defective.

4). Assuming proper neon indication is obtained, depress SW2 (SW1 also remains closed); then the meter should read from 1.0 to 1.5ma when the focus rectifier is good. Readings of 1.0ma or less indicate a defective rectifier.

The aforementioned system can also be used for HV rectifier checks in transistorized B/W TV receivers. These have several rectifiers connected in series. Disassemble the units and check out individually. The meter should read over 0.5ma for a good rectifier. Readings of 0.5ma or less indicate a faulty rectifier.

To test these units for an intermittent condition, tap the rectifier being checked and note if the neon lamp or the meter is erratic.

Green Flicks or Picture Streaks

Small green flicks and streaks in the picture have plagued some color receivers and technicians at times. This problem usually occurs in the sets with rectangular picture tubes that have small base socket pins. This problem is usually caused by corona discharge or some type of HV arc. These little flicks and dots (mostly green) may appear all the time or may be intermittent. This trouble also seems to happen more frequently in areas of the country having high humidity. The most common cause of this trouble is HV arcing at pin 9 — the focus socket connection of the CRT.

Pull the CRT socket off and inspect pin 9 for corrosion. If corroded, clean the pin and socket connection thoroughly. If the socket is badly burned or corroded, replace the complete CRT socket and wiring harness. This will usually clear up and solve the problem of flicks and dots.
An understanding of basic AM, FM and TV diode-tuning circuits will help prepare you to service future TV and radio receivers intelligently.

The fundamental principles of capacitor and coil impedances developed in the October and November 1967 articles of this series can be applied to all practical tuned circuits designed for receivers currently on the market or about to be produced.

The amount of signal current flowing through a receiver's parallel-resonant circuit varies with the frequency of the signal. From the curves shown in Fig. 14, 16 and 18 of the November 1967 article, we see that a minimum amount of applied signal current flows through this circuit at a resonant frequency, while greater signal currents occur at higher or lower frequencies (Fig. 1) — the tuned circuit presenting maximum impedance to the flow of current at the resonant frequency. Because of the circuit's greater impedance at the resonant frequency, when signal currents of different frequencies but the same strength pass through a parallel-resonant circuit, a greater voltage is developed across the circuit at the resonant frequency than at higher or lower frequencies (Fig. 2).

Fig. 1 — The ac current from a constant-voltage signal generator is smallest at the resonant frequency of a parallel-resonant circuit.

Fig. 2 — The ac voltage from a constant-current signal generator is largest at the resonant frequency of a parallel-resonant circuit.

Fig. 4 — The greater a parallel-resonant circuit's quality factor (Q), the smaller the bandwidth (BW) of the resonant frequency.
Resonant Circuit Q Factor

Practical tuned circuits do not have perfect characteristics. Their quality is limited. A portion of the ac current applied to a tuned circuit is unaffected by reactance. Their resonant-frequency current is not reduced to zero by the resulting impedance (Fig. 1) as theory would dictate for a perfect resonant circuit (Fig. 18 in the November 1967 article). Neither does the voltage drop developed across a parallel-resonant tuned circuit decrease to zero at frequencies above and below the resonant frequency (Fig. 2).

The quality factor (Q) of a tuned circuit, capacitor or coil, can be defined by the equation:

\[ Q = 2\pi \frac{\text{energy stored in electric and magnetic fields per cycle}}{\text{energy dissipated per cycle}} \]

The quality factor of a parallel-resonant circuit (Qp) is dependent on the quality factors of the capacitor (Qc) and coil (Ql) used in the circuit:

\[ \frac{1}{Q_p} = \frac{1}{Q_c} + \frac{1}{Q_l} \]

Where:
- Qc = Capacitor quality factor.
- Xc = Capacitor reactance.
- Rcp = Capacitor's effective parallel resistance.
- Rcs = Capacitor's effective series resistance.

A coil's quality factor is determined in a similar manner:

\[ \frac{1}{Q_l} = \frac{1}{X_L} + \frac{1}{R_{Ls}} \]

Where:
- Ql = Coil quality factor.
- Xl = Coil reactance.
- Rlp = Coil's effective parallel resistance.
- Rls = Coil's effective series resistance.

These equations can be combined to the following:

\[ \frac{1}{Q_p} = \frac{1}{Q_c} + \frac{1}{Q_l} = \frac{1}{Q_c} + \frac{X_L}{R_{lp}} + \frac{X_L}{R_{ls}} \]

In most of the older parallel-resonant circuits the values of Rcp and Rlp were so large while the value of Rcs was so small, with respect to Xc or Xl, that with little error the equation could be simplified to:

\[ \frac{1}{Q_p} = \frac{1}{Q_c} + \frac{1}{X_L} \]

In the new receivers that use varicap-tuning diodes, however, the capacitor's quality factor (Qc) is small enough to have a significant effect on the quality factor (Qp) of the parallel-resonant tuning circuits.

The quality factor of a parallel-resonant circuit (Qp) is dependent on the quality factors of the capacitor (Qc) and coil (Ql) used in the circuit:

\[ \frac{1}{Q_p} = \frac{1}{Q_c} + \frac{1}{Q_l} \]

Where:
- Qc = Capacitor quality factor.
- Xc = Capacitor reactance.
- Rcp = Capacitor's effective parallel resistance.
- Rcs = Capacitor's effective series resistance.

A coil's quality factor is determined in a similar manner:

\[ \frac{1}{Q_l} = \frac{1}{X_L} + \frac{1}{R_{Ls}} \]

Where:
- Ql = Coil quality factor.
- Xl = Coil reactance.
- Rlp = Coil's effective parallel resistance.
- Rls = Coil's effective series resistance.

These equations can be combined to the following:

\[ \frac{1}{Q_p} = \frac{1}{Q_c} + \frac{1}{Q_l} = \frac{1}{Q_c} + \frac{X_L}{R_{lp}} + \frac{X_L}{R_{ls}} \]

In the October 1967 article we saw that a capacitor's quality factor was:

\[ \frac{1}{Q_c} = \frac{X_c}{R_{cp}} \]

Where:
- Qc = Capacitor quality factor.
- Xc = Capacitor reactance.
- Rcp = Capacitor's effective parallel resistance.
- Rcs = Capacitor's effective series resistance.

The amount of voltage developed across a parallel-resonant circuit differs with the Q of the circuit (Fig. 3). The greater the Q, the greater the voltage developed and the sharper the reduction in voltage as the signal moves above or below the resonant frequency (fr).

A tuned circuit's bandwidth (BW) is defined as the range of signal frequencies that develop a voltage across a tuned circuit that is at least 0.707 times as large as the resonant voltage. The effect of Q on tuned-circuit bandwidth can be more clearly seen with the aid of a selectivity (S) curve (Fig. 4). The amplitude of this curve is determined by the equation:

\[ S = \frac{\text{nonresonant voltage}}{\text{resonant voltage}} \]

Since the peak voltage across a parallel-resonant circuit is always the resonant voltage, all curves drawn for these tuned circuits have a maximum value of one, whatever the cir-
circuit's Q. The bandwidth for these circuits can be calculated with the equation:

\[ BW = \frac{L}{Q} \]

**Tuning Receivers**

When a signal in a receiver is at the resonant frequency of the receiver's parallel-resonant circuit, the circuit's capacitive impedance equals its inductive (coil type) impedance (when \( f = f_r, X_c = X_l \)). The October 1967 article indicated that:

\[ X_c = \frac{1}{2\pi f L} \]

and \( X_l = 2\pi f C \). These equations can be combined, and at the resonant frequency:

\[ \frac{1}{2\pi f C} = 2\pi f L. \]

With algebra, this equation can be converted to a more convenient form.

\[ f^2 = \frac{1}{4\pi^2 LC} \]

\[ f_r = \frac{1}{2\pi \sqrt{LC}} \]

From the last equation we see that the larger the parallel-resonant circuit's inductance (L) or capacitance (C), the lower the resonant frequency, and the smaller the circuit's inductance or capacitance, the higher the resonant (tuned) frequency. Receivers can be tuned by changing either the inductance or capacitance in their parallel-resonant tuning circuits.

Some of the older receivers were mechanically tuned by changing the parallel-resonant tuned circuit's inductance by moving a metal core in-and-out of a coil, changing the effective number of windings in a coil or by varying the spacing between coil turns. Most receivers were mechanically tuned, however, by changing the parallel-resonant tuned circuit's capacitance by changing the spacing between capacitor plates or effective capacitor plate surface areas. Modern receivers can now be electronically tuned by varying the bias of varicap tuning diodes. (The theory behind all of these methods of changing capacitance or inductance was included in the October 1967 article).

**Superheterodyne Circuits**

Most receivers currently on the market have superheterodyne circuits (Fig. 5) containing a variable-tuned radio-frequency (RF) circuit, a variable-tuned oscillator circuit and a mixer circuit. The RF and oscillator circuits are tuned simultaneously, the oscillator circuit always being tuned to a frequency below that of the RF circuit.

Measurements indicate that when signals of two different frequencies are mixed, the combination produces a waveform having frequencies equal to both the sum and the difference between the two applied frequencies. When an FM receiver's RF circuit is tuned to a 96.0MHz station and the oscillator is tuned to 85.3MHz, the resulting signals can be combined to produce 181.3 and 10.7MHz signals. The intermediate frequency (IF) amplifier circuits are tuned to handle only those frequencies around 10.7MHz.

Superheterodyne receivers have the advantage of containing additional amplifiers tuned only to the IF frequency, rather than additional amplifiers that must all be tuned to the frequency of the station being received.

Superheterodyne FM receivers at one time had a common problem with their oscillator circuits. As the oscillator's temperature changed, its frequency would shift. When cold, the RF circuit might be tuned to a 96.0MHz station while the oscillator frequency has shifted and is producing a 84.7MHz signal. Since the IF amplifiers are tuned to 10.7MHz, the signals passing through them must originate from a 95.4MHz station (84.7MHz osc. + 10.7MHz IF = 95.4MHz RF). Although the RF circuit is not tuned to that station, programs may still be received if that station's signal is strong. As the oscillator circuit warms up, the frequency it produces may gradually shift to 85.3MHz and the signals from the 96.0MHz station are heard. An automatic frequency control (AFC) circuit was required to prevent this apparent drifting of stations. It was in this circuit that technicians first encountered varicap tuning diodes.

**FM AFC Circuits**

FM receivers produce an audio input very similar to the audio input produced by integrated circuit IC201 (Fig. 1 in the September 1967 article). As the FM receiver's IF signal shifts in response to the shifting frequency of the FM station, the output voltage of the discriminator circuit (Fig. 2, 3 and 4 of the September 1967 article) also shifts. The audio signal consists of these rapid changes in output voltage.

By reversing the anode and cathode leads of diodes D3 and D4 in Fig. 4 of the September 1967 article, the induced current flow is reversed and a positive voltage is developed across capacitor C3 when the IF signal shifts above its mean frequency (4.5MHz for the TV in-
tegrated circuit, 10.7MHz for an FM receiver discriminator). It is this output voltage that regulates the AFC oscillator.

A typical FM AFC oscillator circuit is shown in Fig. 6. Any change in the transistor's emitter voltage results in an amplified change in its collector voltage — like the signals present in the common base circuit shown in Fig. 10 of the August 1966 article. A portion of the amplified signal is returned to the emitter by a 2.7pf capacitor, causing positive feedback. The maximum amount of collector signal voltage is developed across the tuned circuit at the circuit's resonant frequency. At that frequency the positive feedback is large enough to cause the transistor to oscillate.

The tuned circuit in Fig. 6 is basically the same as the tuned circuit in Fig. 20 of the November 1967 article, except that here two capacitors, rather than one, are connected in series with the varicap. The audio signal normally present with the discriminator circuit's output voltage is filtered from the oscillator circuit with a 0.011, f capacitor and 1M resistor.

Assuming that under some bias condition the varicap has a 2pf capacitance and ignoring the negligible effect of the 3.3K resistor, we can use the series capacitance equation derived in the November 1967 article to determine the total capacitance connected in parallel with the 2 to 7.5pf tuning and trimmer capacitors.

\[
\frac{1}{C_T} = \frac{1}{6.8pf} + \frac{1}{1000pf} + \frac{1}{2pf} = 0.147/\text{pf} + 0.001/\text{pf} + 0.500/\text{pf} = 0.648/\text{pf}.
\]

From these calculations we see that when capacitors are connected in series, their total capacitance is always less than that of the smallest capacitor.

An equation can also be derived to determine the total value of capacitors connected in parallel with the coil in the tuned circuit (Fig. 6).

When resistors are connected in parallel (Fig. 7), the total current passing through the circuit is equal to the sum of the currents passing through each resistor. \( I_T = I_1 + I_2 + I_3 \).

As you know, current is equal to voltage divided by resistance, and since the resistors are connected in parallel, the same voltage is applied across all of them.

\[
I_i = \frac{V}{R_i}, \quad I_T = R_T V
\]

By substituting the second set of equations for parts of the first, we can calculate the circuit's total parallel resistance.

\[
\frac{V}{R_T} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}
\]

If both sides of the equation are divided by \( V \), then we have the well-known parallel resistance equation:

\[
\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}
\]

The total reactance of parallel capacitors (Fig. 7) can be determined with the parallel resistance equation:

\[
\frac{1}{X_{CT}} = \frac{1}{X_{C1}} + \frac{1}{X_{C2}} + \frac{1}{X_{C3}}.
\]

By substituting for \( X_C \) in that equation, we get the following:

\[
\frac{1}{2\pi f C_T} = \frac{1}{2\pi f C_1} + \frac{1}{2\pi f C_2} + \frac{1}{2\pi f C_3}.
\]

This can be simplified to: \( 2\pi f C_T = 2\pi f C_1 + 2\pi f C_2 + 2\pi f C_3 \). After dividing both sides of the equation by \( 2\pi f \), we get: \( C_T = C_1 + C_2 + C_3 \). The total capacitance of a parallel capacitor circuit is equal to the sum of the individual capacitances.

When the FM oscillator tuning and trimmer capacitors (Fig. 6) have a 4.0pf total capacitance, and the varicap and the two capacitors connected in parallel with it have a 1.5-pf total capacitance, the tuned circuit contains 5.5pf (4.0pf + 1.5pf) of capacitance in parallel with the coil.

As the bias voltage across the varicap changes, the total capacitance of the tuned circuit also changes. When the IF signal drifts to a frequency slightly higher than normal, the discriminator's output voltage becomes slightly larger than normal and additional reverse bias develops across the varicap. This, in turn, reduces the diode's capacitance, lowering the oscillator's resonant frequency and returning the IF signal to normal.

**TV AFTC Circuits**

Automatic fine tuning controls in the newer TV receivers operate basically on the same principle as FM AFC circuits. A discriminator circuit (Fig. 5 of the June 1967
TECKLAB report), operating on the same principle as the one discussed earlier (Fig. 4 of the September 1967 article in this series), is connected to the receiver's IF circuit. Its response curve is like that shown in Fig. 7 of the June 1967 TECKLAB report. When the frequency of the IF signal increases and shifts into the discriminator's negative voltage area, a smaller positive potential is applied across the varicap diode in the TV receiver's UHF tuner (Fig. 8). The tuner's oscillator section is shown in a more familiar form in Fig. 9.

In this circuit coil L7 serves merely to supply the transistor's collector with negative dc current, while the coil's impedance prevents UHF signals from passing through it to ground. This coil is required since no dc current is able to pass through coil L6 because of a variable capacitor connected in series with it. Its impedance is so much greater than that of coil L6 (X_L7 > X_L6) that it (L7) has virtually no effect on the tuning of the oscillator circuit.

From the curves in Fig. 11 of the October 1967 article we saw that when a coil and a capacitor are connected in series and the coil's impedance is greater than the capacitor's impedance (X_L > X_C), the resulting ac voltage drop across the pair of components is like that across just a coil — their phase angles are the same. The capacitor has served the function of reducing the coil's effective impedance.

The effective impedance of coil L6 in the TV receiver's oscillator circuit (Fig. 9) is varied by the capacitor connected in series with it, tuning the oscillator's parallel-resonant circuit. This type of circuit is required for UHF tuners since even very small coils have relatively large impedances at these frequencies.

From Fig. 7 and 8 and in the November 1966 article we see that at ultra-high frequencies (UHF) the phase shift and capacitance in a transistor results in positive feedback. At the resonant frequency of the parallel-resonant circuit (the effective impedance of coil L6 in conjunction with the capacitors connected in parallel with it), there is sufficient collector signal voltage for the transistor, with positive internal feedback, to oscillate.

The varicap diode (X2), connected in parallel with the oscillator tuning coil (L6), also has a function in tuning the oscillator circuit. As the applied dc potential from the IF discriminator circuit decreases with a higher IF frequency, the varicap's capacitance increases, and the oscillator circuit oscillates at a lower frequency. This circuit, in effect, adjusts the receiver's tuner oscillator for the best TV signal reception.

AM Varicap Tuning

The single transistor circuit shown in Fig. 10 is typical of the circuits used in many transistor radios, and it performs all the functions of a tuned oscillator circuit, tuned RF circuit and mixer circuit.

In this circuit transistor collector-current signals pass through the primary windings of transformers T2 and T3. The secondary winding of one transformer (T2) and its parallel capacitors (65.2pf maximum total parallel value components) form a parallel resonant circuit, and at their resonant frequency maximum collector signals are induced across the transformer's secondary winding (T2). These signals return through the ferrous antenna secondary (T1) and 0.02uf capacitor to the base of the transistor. This positive feedback circuit results in an oscillation at the tuned resonant frequency of the transformer's secondary (T2).

The parallel-resonant circuit, formed by the primary winding of the ferrous antenna (T1) and the capacitors connected in parallel with it (148.1pf maximum total parallel value components), is tuned to the radio frequency (RF) of the station being received. The greater the voltage induced across the antenna's primary winding, the greater the voltage also induced across its secondary winding. The largest signal voltage is induced across these windings when the tuned parallel-resonant frequency of the primary winding is the frequency of the station received.

Both the oscillator signal, induced across the secondary winding of transformer T2, and the RF signal, induced across the secondary winding of the ferrous antenna (T1), pass through the 0.02uf capacitor and are applied to the base of the transistor. The pair of signals are amplified by the transistor and the resulting collector-current signal pass-
es through the primary winding of the IF transformer (T3). The primary winding of this transformer is tuned, with a capacitor connected in parallel with it, to a 455kHz resonant frequency. This frequency is the difference between the RF and oscillator frequencies.

The oscillator and RF resonant frequencies are tuned in this receiver by changing capacitor values in the oscillator and RF parallel-resonant circuits. The corresponding oscillator and RF tuning capacitor values required to maintain a 455-kHz difference in resonant frequencies are shown in Fig. 11.

The circuit shown in Fig. 10 can be modified (Fig. 12) to eliminate the mechanical tuning capacitors. The varicap diode functions in the RF tuned circuit (Fig. 12) in the same manner as it does in the parallel-resonant circuit shown in Fig. 20 of the November 1967 article. Variations in the dc potential applied across the varicap change the component's capacitance and the resonant frequency of the parallel-resonant circuit. The 5K potentiometer (Fig. 12), connected between a positive voltage source and ground, varies the varicap potential and the resonant frequency of both the RF and oscillator circuits. The 470K resistors between the potentiometer and varicaps serve to isolate IF and oscillator signals, while the varicap bias current is so small that any bias voltage drop across the resistors is insignificant.

The varicap capacitance range is more than adequate for the RF tuning circuit and, therefore, a trimmer capacitor was not required for that circuit. A trimmer capacitor, connected either in parallel with the 150pf capacitor or in parallel with both the 150pf capacitor and the varicap, is used to adjust the oscillator.
Don't Forget the Heat-Sink Compound

Silicone substance aids circuit stability

- As electronic components get smaller and smaller, the problem of dissipating excess heat becomes greater and greater.

Heat, of course, affects solid-state circuits and components in two ways: (1) it causes long-term drift in characteristics, caused by rapid aging, and (2) it can cause catastrophic “right now” failure if the temperature gets completely out of control.

The problem also includes distributing heat so as to minimize hot spots. One step in handling heat problems is to use heat sinks, and these have become necessary in many solid-state devices. But even good heat sink design does not provide the complete answer, since in practice, it is almost impossible to have two metal surfaces — even precision machined surfaces — make perfect contact over their entire mating area. Inevitably, the resulting air spaces between component and heat sink, will act as a heat insulator.

Using silicone compounds to displace this insulating barrier has become standard practice. Grease-like silicone materials are applied to the base and mounting studs of transistors, resistors, and diodes, thereby improving the heat transfer from the components to the heat sink or chassis.

The first silicone materials used, naturally enough, were the readily available materials which had been developed to seal moisture out of connectors, and to provide a soft, nonmelting, nongumming dielectric film in a variety of applications.

More recently, a material specifically designed for this function has been introduced. This compound is heavily filled with heat conductive metal oxides. It has about twice the heat conductivity of previously available materials, and has been designed to provide minimum bleed for lasting protection.

To ascertain the value of this newer silicone heat sink compound in use, a series of 1000-hour tests were run. It was decided to use 50-watt power resistors in order to simplify the tests and to more easily relate test results. The silicone heat sink compound was used in all tests where the resistor mounting surface was treated. The properties of the compound are as follows:

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>White, opaque</td>
</tr>
<tr>
<td>Bleed, percent after 24 hours at 200°C</td>
<td>-</td>
</tr>
<tr>
<td>Evaporation, percent after 24 hours at 200°C</td>
<td>0.5</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>2.45</td>
</tr>
<tr>
<td>Thermal Conductivity K factor, cal/cm²/C/sec/cm</td>
<td>0.0010</td>
</tr>
</tbody>
</table>

Heat Distribution and Stability Tests

For the first series of tests to determine heat distribution, a 50-watt resistor was mounted on a 0.04in. thick 5 x 7 x 2-in. aluminum chassis and operated at 40w for 1000 hours. Sixteen thermocouples were spotted on the chassis and one thermocouple was installed inside the resistor. Identical tests were run without and with the silicone compound. The heat distribution data, plotted as shown in Fig. 1, show at every point that more heat was transferred to the chassis when the resistor was sealed with the silicone material. This is also borne out by the internal temperature of the resistor: 233°C when unsealed and 201°C when sealed.

The second series of tests concerned the change in component characteristics. Again a 50w resistor was used, unsealed and sealed to the chassis using the heat sink compound. The curves in Fig. 2 reveal that for the first 300 hours the change in resistance of the sealed resistor was stable; whereas, the resistance continued to rise in the unsealed resistor. At 800 hours the resistance was stable in both cases.

So, when replacing power transistors, don't forget the silicone compound.
From Service to Sales-and-Service to . . . More Sales and Service

The interdependent sales-service links in the TV-radio merchandising chain can provide your operation with maximum survival and growth strength — even in the face of 'cut-throat' discounter competition.

Twelve years ago Ed Levitt started a home-based TV repair service. For the fiscal year ending in August this year, his Oceanside, Long Island, N. Y., shopping-center-based store, See & Hear TV, grossed $240,000. About 20 percent of the gross came from service. Mr. Levitt anticipates close to $300,000 gross in the upcoming year. The operation grossed only $120,000 in 1965.

"The change from service, to sales-and-service, was not a quick one," Ed Levitt told an ELECTRONIC TECHNICIAN field reporter recently.

Eight years ago, after discontinuing an unsuccessful phonograph record department, Ed Levitt decided to go into B/W TV sales. He began in a small way, investing $2000 in sets. At this point he was joined by his brother, Mack, who made all the home service calls at first. As business grew, however, it became clear to the brothers that they would have to spend all their time in the store — selling equipment and directing the operation. Technicians were hired to make home service calls.

According to Ed Levitt, one of the biggest factors in their success was the constant tie-in between sales and service.

"In this area," Mr. Levitt emphasizes, "people are price conscious but they are even more service conscious.

"But the greatest single boost we got came three years ago when the district sales manager of a leading company suggested that we carry a full line of home entertainment equipment," Ed Levitt smiles.

In addition to a Sylvania franchise, the Levitts also carry Admiral, RCA, Zenith and G.E. products.

Service Contracts

Every TV set sold by See & Hear TV is serviced at a minimum charge the first year. But, when the year is almost up, Mack Levitt calls the owner and asks if any repairs or adjustments are needed and informs the customer that the first year contract will shortly run out. Additionally, he informs the customer that a second year contract can be obtained at a cost of $70. So far, 80 percent of all customers have signed up for a second-year service contracts. "We have done the same for the third- and fourth-year contracts at a charge of $80 and $90, respectively," Mr. Levitt says.
A youngster observes himself on CCTV monitor in the store. A CCTV monitor is also kept on from 7 p.m. to midnight in the front store show-window.

“One important benefit you get from contracts,” Ed Levitt says, “is not generally understood by most service-dealers.

“For example, when a service technician goes to a customer’s home to service the set, he does not have to write up a bill and consequently the owner is usually willing to listen to a low-pressure pitch for a second set, a color console or some other home-entertainment equipment.

“Additional benefits also accrue from service contracts. During the term of the contract, for example, customers are unlikely to ever turn to another service-dealer for repairs on their other TVs or equipment in their homes.”

Advertising and Promotion

Home-call technicians are instructed to mention that the store carries a line of the latest portable TVs and Hi Fi stereo equipment. But equipment prices are not discussed in the home.

“Sales promotion at See & Hear TV is carefully planned,” Mack Levitt says. “For one thing, we don’t put the price of anything in our ads or on equipment in the store. We are selling quality and top-grade service. We’re not in the ‘bargain-basement’ or ‘discount’ business.”

Ads are run regularly in local newspapers and in the local shopper’s guide under manufacturers’ co-op arrangements. Additionally, flyers are enclosed with all bills sent to customers.

“The purpose of our advertising,” Ed Levitt explains, “is simply to let customers and prospects know what new items we are carrying. We don’t try to sell price; we sell our name and service through the ads.”

Mr. Levitt points out that only one new-stock item is usually mentioned in an ad, rather than flood the customer and prospect with a confusion of makes and models.

Advertising for Christmas is heaviest during October and November, although Christmas is not actually mentioned at that time. Ads are curtailed considerably in December. Ed Levitt explains that most people who are considering Christmas-present purchases, because of the expense involved, think about the purchases well ahead of time.

Because the Lincoln shopping center in Oceanside is very active, the Levitts have taken advantage of this activity by installing a CCTV camera and monitor plus a color TV set in the store’s show window. These are switched on every evening of the week from 7 p.m. to midnight. Since the shopping center has several restaurants, a fair number of passers-by stop to look at themselves on the CCTV monitor or watch the color TV.

A CCTV camera and monitor are also kept operating in the store during the daytime. This setup serves two purposes — customers are amused (the kids go wild) to see themselves on TV and, by using a small monitor in the office, thefts of small items like transistor radios have been prevented. Ed Levitt explains that a view of the main floor is blocked from the office, and the monitor makes it easy for one person to handle telephone calls and watch the shop at the same time.

“See & Hear,” originally a “Mama & Papa” operation, is now overseen by the two brothers and staffed by four technicians who are always out on service calls, installing antennas or making deliveries in the three company-owned trucks. Two permanent technicians are on the work benches. Two part-time assistants help with
Ed Levitt, who began as a service technician 12 years ago, watches one of his technicians working at the bench.

deliveries and antenna work and one woman in the office handles most calls and does office work.

The change from service to sales-and-service was gradual and carefully planned. And it has paid off.

“What’s the advantage of providing good service to the public?” ET’s reporter asked Ed Levitt.

“Quite simple,” Mr. Levitt smiles. “You can’t show increased sales, year after year, without providing fast and efficient service. And you won’t have many sets to service if you don’t sell 'em.

“Every good technician-dealer operation can provide fast and efficient service. A personal relationship develops with the customer at the time of the sale and is extended with the service. But the department stores, the big chains and the discounters just can’t do it. Neither can the hardware stores and white goods outfits who play around with electronic home-entertainment equipment on the side,” he concludes.
The service shop is a part of the sales floor at Ayoob Bros., San Francisco. Customers shopping the store or coming up to the low service counter can see the array of test instruments and the technicians at work. "This gives us a strong service image and is very good for business," Tom Ayoob says.

Mr. Ayoob has been in TV-radio sales and service for the past 20 years and is now sole owner of the firm, which he established with his two brothers. He is a service technician himself and still likes to troubleshoot sets when he can find the time.

Recognizing the importance of a proper service identity, he fixture the open-display service shop across the rear of the sales floor when he moved to a new location two years ago.

Seeing Is Believing

"Now our customers can see something of what's involved in repair work and we're getting fewer complaints about service charges," Mr. Ayoob continues. "People tend to be suspicious about repairs, but when they see the work being done in the shop, they realize a lot of test instruments and labor-time is involved.

"Why should we keep the shop hidden from view? It's good psychology to have it out in the open. It shows we're qualified to handle everything in service."

Setting up the service shop as an integral part of the sales floor has another advantage, Mr. Ayoob points out. The technicians can take care of customers at the counter and handle repair work when not busy at the front of the store.

A chime on the entrance door alerts personnel when anyone comes in. Thus Mr. Ayoob or one of the men working in the shop has only to turn around to see if a customer is being taken care of or if he needs help.

"With our increased business, it would have been necessary to add at least two more people to handle the sales floor and the counter," he says. "By setting up sales and service as an integrated unit, we're able to make more efficient use of our time."
Service Image

A view of the service shop as seen from service counter. Everything is bright and orderly and the big look shows customers something of what's involved in repair work.

your business behind closed doors

Well-Organized Shop
The shop is 30 by 15 ft. A white-topped, waist-high service counter, running along the front, is open at both ends for access between the shop and sales floor.

Work benches along the rear wall and one side of the shop are sectionalized to provide separate work areas, each with sufficient drawer and shelf space to hold tools. A centrally located battery of drawers holds small repair parts.

The shop is light, bright, airy — and always immaculate. Floors are waxed and shined monthly, along with the rest of the store. All service technicians wear white coats or smocks.

Increased Productivity
“We expect some effort from the men to keep the service area as attractive-looking as the rest of the store,” Mr. Ayoob comments. “At first, there was something of a problem in retraining, but the men have learned to pick things up and put them away. They know that we’re on public display now.

“It might seem that this would take up too much of the men’s time and cut down on efficiency, but just the opposite is true. With a well-organized shop and a place for everything — and everything in its place — productivity has increased.”

Ayoob’s Bros. has seven service technicians and they all keep busy. When service calls and over-the-counter work fall off, they service electronic equipment for a hospital, a home for the aged and two county jails. Tom Ayoob bids for this work and finds it an excellent “time-filler” which produces a modest profit.

“Sales outside our immediate neighborhood have increased since we set up the shop on the sales floor,” Mr. Ayoob smiles. “We confine our advertising to our neighborhood, so it’s apparent we’re getting more referral business.

“I can only conclude that emphasizing our strong service image by putting the shop on open-display is giving us more word-of-mouth advertising. It’s one of our best business builders.”

DECEMBER 1967
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You get maximum reliability with minimum maintenance. You get easy installation using standard fittings. You get attractive design and complete customer satisfaction. And, just as important, you get that feeling of personal satisfaction that comes from a job well done.

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Channel Control Couplers
Allow you to couple any number of VHF-FM antennas, equalize the signals to a predetermined level and match the 300 ohm antennas to a 75 ohm coaxial downlead. Any coupled antenna can be attenuated from 0 to -20 db with special plug-in attenuator pads.

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Ultra-Plex is a unique, solid state, 82-channel modular plug-in MATV distribution system. Components of the Ultra-Plex system are designed to match and work perfectly with each other. Ultra-Plex equipment will never become obsolete—new VHF stations, UHF stations and FM bands may be added at any time with negligible expense to the owner. Ultra-Plex gives the installer an unprecedented flexibility and complete signal control, regardless of system size. It works equally well in small or large systems—in apartment buildings, motels, hotels, hospitals, schools, etc.

Solid State Distribution Amplifiers
Winegard tv system amplifiers are designed to highest commercial standards with models and accessories available to provide optimum color and black & white reception to any number of sets. Each amplifier incorporates the most recent developments in solid state circuitry with the advantages of increased life expectancy, reliability and less power consumption. Higher gain, greater band-width, lower noise figures and improved VSWR are other advantages of Winegard's high performance amplifiers.

82-Channel Line Splitters
Line splitters divide the tv signals on a trunk line into equal parts and, when properly used, greatly increase the number of taps in a tv distribution system. Winegard line splitters have very low insertion loss, low VSWR and high isolation between outputs to insure perfect transmission of color tv signals.

TV Signal Equalizers
Broad band distribution amplifiers operate most efficiently when input signals are equal and total picture carrier signals are the specified level. Winegard makes equalizers that can couple and equalize up to four low band or FM single channel antennas—or couple and equalize up to four high band single channel antennas.

Variable Isolation 82-Channel Line Tap Offs
All Winegard line taps have 82-channel capability, and can be used for VHF, UHF or FM or any combination of the three. The variable isolation feature enables the installer to independently vary the VHF and UHF isolation values from 10 to 25 db through simple adjustment of "wiper arms" located at front of tap. Use of 82-channel line taps insures that a system cannot become obsolete regardless of what channels are later added to the system. Flush and surface mounts.

Solid State Booster-Couplers
Winegard offers several transistorized booster-couplers which will handle up to 4 TV/FM outlets or sets from a single antenna—up to 16 sets using 75 ohm outlets. Seven different models: some for channels 2-13 plus FM, some for channels 2-83 plus FM. Built to finest commercial quality standards. Available in both 300 and 75 ohm models. Extremely high (500,000 microvolt) input eliminates overload problems.

82-Channel + 25 db Amplifier
New "color system" amplifier is ideal for home and smaller systems. Solid state, printed circuitry with excellent stability. Can't become obsolete when new channels come on the air. By adding Winegard's unique line amplifiers, you can lay out and install most systems without calculations of any kind. Separate VHF and UHF inputs and power for VHF and UHF preamplifiers. Easy to customize each installation to exact signal conditions.

Plus... UHF single channel converters, antenna and back-of-set matching transformers, band separators, interference rejection filters, etc.

For more details circle 129 on postcard

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Weak Vertical Sync in Setchell Carlson Color TV

The following modifications to the vertical sync circuit in the CE unit will improve the vertical hold in areas where vertical sync is weak because of low line voltage or local signal conditions.

1. Remove C411 (sync coupling capacitor which is connected to the junction of R403 and R410).
2. Disconnect pin 1 of 6GF7 from ground. (Connect this ground wire to pin 5 of the 6GF7.)
3. Install a silicon diode, a 2.2M 1/2w resistor, 2.001 µf 1kv disc capacitor, and a 22K 1/2w resistor as shown in schematic.

Vertical oscillator drift as the receiver warms up or vertical lock-in at the end of the vertical hold control range can be caused by a defective 12M resistor (R404) in the vertical hold circuit.

Modify the vertical hold circuit to the schematic shown, removing R404 (12M), R406 (2.2M), and R405 (470K). The 470K resistor is then placed between pin 9 of the 6GF7 and terminal 3 of the plug strip (vertical hold control). A 0.003µf, 1kv disc capacitor is added between terminal 3 of the plug strip and ground.

Burst Amplifier and 3.58MHz Oscillator Circuit of the Magnavox T924 Color Chassis

The burst amplifier and 3.58MHz oscillator circuitry is shown here. The chroma signal and a positive horizontal pulse are applied to the grid of the burst amplifier. The burst amplifier conducts only during the interval that the grid is driven positive by the horizontal pulse. This coincides with the interval that the color burst reference signal is present on the grid, therefore, the burst signal is amplified but the chroma information is rejected.

If a scope is connected to the grid of the burst amplifier (scope sweep set to view horizontal rate), you can see the positive horizontal pulse with the burst signal sitting on the peak. The amplitude measured at this point is in the vicinity of 65v P-P.

Moving the scope lead to the plate would reveal a burst signal having an amplitude of approximately 180v P-P. This burst signal is then coupled through a low impedance link on the burst transformer to the grid circuit of the 3.58MHz oscillator. The injection of the burst signal in this fashion causes the frequency of the 3.58MHz oscillator to become “locked” with that of the burst signal.

The 3.58MHz oscillator is a version of the Pierce oscillator with the screen grid acting as the anode. Feedback is from the screen, through the link (on the burst transformer), through C742, through the crystal and back to the grid.

The free-running frequency of the oscillator can be precisely adjusted to 3.58MHz by the small trimmer capacitor, C743 (2-12pf). This adjustment is made during AFPC alignment.

The oscillator signal is electron coupled to the plate which employs a 3.58MHz tuned transformer for its load. The secondary of this transformer is used to couple the 3.58MHz CW reference signals to the R-Y and B-Y demodulators. These are identical 3.58MHz sinewaves having an amplitude of approximately 15v P-P. A phase shift network is connected across the secondary so that the CW signal to the R-Y demodulator will lag the B-Y CW signal by approximately 90deg. This relationship is necessary to demodulate the chroma signal properly. Remember that the 3.58MHz reference signals applied to the demodulators represent the reinserted carrier with which the chroma signals — originally modulated but suppressed prior to transmission. The chroma signal was modulated with a 3.58MHz signal on two different axes 90deg apart which accounts for this phase shift network in the receiver.

This phase shift network “fixes” the phase relationship between the R-Y and B-Y CW signals. Both signals can be phase shifted, however, by rotating the TINT control. Assuming the TINT control is centered and T703 is tuned to precisely 3.58MHz, the plate circuit of the oscillator will look resistive. Rotating the TINT control back and forth will cause the plate circuit to be tuned above and below resonance which causes the circuit to look capacitive and then inductive, resulting in a phase shift of the 3.58MHz signal.

This permits phase adjustment of reference signals so the demodulated signal will reproduce the same tint (or hue) on the screen of the receiver as the scene originally scanned by the television camera. (Normal phase shift is approximately ± 50 deg.) To be certain these circuits are performing their job, it may be necessary to perform an AFPC (automatic frequency and phase control) adjustment occasionally.

AFPC Adjustment

1. Tune in color bar generator.
2. Set TINT control to center of its range.
4. Connect VTVM to pin 9 of V706 (grid of killer).
5. Adjust T702 (burst transformer) for minimum dc (negative) voltage.
6. Adjust T703 oscillator trimmer capacitor, C743, for zero beat (color bars stand still or drift slowly). Note: At zero beat the color bars will be the same color from top to bottom.
7. Remove ground from burst amplifier grid and connect VTVM to plate of either demodulator.
8. Adjust T703 (oscillator plate transformer) for maximum dc reading.
9. Observe color bar pattern and touch-up T703 (if necessary) for correct tint. Check TINT control for sufficient range.

Motorola's Solid-State Color Chassis Fine Tuning Indicator and Fine Tuning Lock Circuit

In some solid-state color receiver models, an FT1 (fine tuning lock) AFC circuit is employed to assure correct fine tuning. FT1 compensates for normal tuner drift and aging of components. Also, an indicator light operates in conjunction with the
FTL to signal the customer when fine tuning is necessary.

Four NPN transistors, two diodes and a neon lamp make up the active components in the fine tuning indicator and lock circuits. This complete network is located on a single replaceable panel located on top of the video IF panel.

A selected portion of the 45.7MHz video IF carrier is coupled from the 3rd video IF collector through a 1pf capacitor to an FTL amplifier stage. Operating as a class "A" emitter-follower, the FTL amplifier minimizes loading on the video IF, sending the IF signal to the FTL output and fine tuning indicator (FTI) detector.

Located across the input of the FTI detector emitter-follower is a high "Q" 45.75MHz parallel tuned resonant tank (FTI coil). The tank selects the video IF carrier and presents the carrier to the FTI detector for detection and current amplification. The 45.75MHz video IF carrier is only present when fine tuning is correct. Here the 45.75MHz carrier is converted to a dc voltage and directly coupled to the FTL output.

Connected as a common-emitter, the FTI output is in shunt with the FTI neon indicator lamp. Conduction of the transistor extinguishes the neon lamp.

When 45.75MHz is present, indicating correct fine tuning, the FTI detector and output both conduct to extinguish the neon lamp.

If 45.75MHz is not present, indicating incorrect fine tuning, the FTI detector and output will become non-conductive, allowing the neon lamp to light. This signals the customer to re-adjust the fine tuning control.

Directly coupled from the FTL amplifier stage, the video IF signal is presented to a class "A" operated common-emitter FTL output. A discriminator transformer tuned to 45.75MHz center frequency recovers the amplified IF signal.

The discriminator secondary feeds two diodes. Rectification of the IF signal by the diodes produces opposite voltages across balanced diode load resistors. Across both diodes a dc correction voltage is coupled through a "pi" filter to a varactor (voltage-variable capacitor) across the tuner oscillator.

Tuner drift is counteracted by a varying dc correction voltage applied to the varactor from the FTL circuit. If the tuner drifts, the 45.75MHz video IF carrier change frequency. This frequency change is sensed by the discriminator coil, causing unequal conduction of the discriminator diodes. A resultant correction voltage is developed because the voltage across each diode is no longer equal. Coupling this correction voltage to a varactor in the tuner pulls the tuner's oscillator back on frequency.

With correct fine tuning, no correction voltage from the discriminator diodes is developed. An incorrect fine tuning adjustment will cause a corresponding dc correction voltage to be developed by the FTL for the tuner. An FTL defeat switch located in shunt with the correction voltage is provided to defeat FTL, allowing manual fine tuning, then switched back to FTL position.

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NEW PRODUCTS

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

**Tape Recorder/Radio 700**
A system is announced for AM/FM listening and off-the-air recording on magnetic tape. Specifications indicate that the tape recorder is detachable and may be removed for any portable tape recording or dictation elsewhere. Up to two hours of music can reportedly be recorded at 17/8 ips on a single cassette and commercials can be eliminated by a remote control switch. Concord.

**CB Base Station 701**
A 23 channel CB base station reportedly contains a solid-state preamplifier designed to permit its use with a high-impedance desk microphone. Specifications indicate that this enables the operator to have both hands free while communicating, and permits the operator to remain from 1 to 1½ ft away from the mike while still retaining 100% modulation. Price $269.90. Pearce-Simpson.

**Cable Tie 702**
A cable tie is reportedly being made in four sizes and will fit all bundle diameters from 1/16 to 4 3/16 in. Specifications indicate that the self-locking head is designed with dual-grip tie hooks that improve its tensile strength. According to the manufacturer, it is lightweight, abrasive resistant, has good dielectric properties and is chemical resistant to common solvents, alkalies, dilute acids, oils and grease. Electrovert.

**Turntable 703**
A turntable is announced that reportedly features a 12 in., 7 1/2 lb balanced nonmagnetic platter. Two low-speed synchronous 16-pole motors on a single rotor shaft are designed to provide 33 1/3 and 45 rpm speeds. Specifications indicate that a spring-loaded suspension system minimizes vibrations and acoustic feedback. The dimensions are 15 5/8 x 12 7/8 x 3 3/4 in. Price $85. Thorens.

**High-Voltage Probe 704**
Announced is a CRT high-voltage test probe with a built-in voltmeter. Specifications indicate that all a technician has to do is ground the instrument, contact the high-voltage anode with the probe tip and read the voltage (up to 30 kv) from the self-contained meter. The probe reportedly contains no batteries and needs no warm-up time. Net price $19.95. Pomona.

**Tone Caller 705**
A 10-channel tone caller is announced that reportedly contains a 23-transistor, 5-tuning fork circuitry designed to permit the private push-button calling of any one, assorted quantity up to 10 or all 10 stations at one time. Calls reportedly may be initiated at the remotes or from the master to activate mobile/base CB sets. Specifications indicate that lights visually identify the station calling, and dual-tone coding signals minimize false triggering on stray signals. The case measures 10 1/8 x 7 3/8 x 3 3/4 in. Price $129.95. Lafayette.

**Electronic Tool Kit 706**
A 20-piece tool set is announced that reportedly contains all the major tools essential for the repair of electronic equipment. The manufacturer indicates that these tools include one chain-nose plier, groove-grip plier,
diagonal cutting plier, standard screwdriver, Phillips screwdriver, round magnifier, soldering iron, bent-nose tweezer, straight-nose tweezer, solder aid, alignment tool, contact-type burnisher, pin vise, solder core, 3/16-in. nut driver, 1/4-in. nut driver, plus two needle files, two miniature screwdrivers and a package of 12 burnisher blades. The manufacturer's specifications indicate that these tools come in (±5%) with a temperature increase from 75 to 255°F. Specifications indicate that they are made in sizes ranging from 0.1 to 0.5w as well as in various network configurations. Dale.

Continuity Tester 708
Announced is a continuity tester designed for locating open transistors and diodes, and to determine diode polarity in circuitboards and assemblies. Specifications indicate that the current through the circuit under test is less than 50ua. Desco.

FM Mobile Unit 709
Announced is a two-way FM mobile radio that is reportedly adjustable from 120 to 220w in three steps, making it possible to use the unit on either limited power or high power channels. The 150 to 174MHz band unit will reportedly operate on six channels and has solid-state circuitry throughout, except in the final RF power amplifier stage. Kaar.

Remote Station Console 710
A solid-state, remote-control console has been designed to provide complete control of remote base stations in a radio communications system. Specifications indicate that the new unit also features lighted push-button switches which indicate the state of all control functions. Motorola.

How to break into the big money servicing 2-way radios!

**How Would You Like to Start Collecting Your Share of the Big Money Being Made in Electronics Today?**

To start earning $5 to $7 an hour... $200 to $200 a week... $10,000 to $15,000 a year? Your best bet today, especially if you don't have a college education, is probably in the field of two-way radio.

Two-way radio is booming. Today there are more than five million two-way transmitters for police cars, fire trucks, taxis, planes, etc. and Citizens' Band uses—and the number is growing at the rate of 80,000 new transmitters per month.

This wildfire boom presents a solid gold opportunity for licensed radio service experts. Most of them are earning $5,000 to $10,000 a year more than the average radio-TV repair man.

**Why You'll Earn Top Pay**

One reason is that the U.S. doesn't permit anyone to service two-way radio systems unless he is licensed by the FCC (Federal Communications Commission). And there aren't enough licensed electronics experts to go around.

Another reason two-way radio men earn so much more than radio-TV service men is that they are needed more often and more desperately. A two-way radio user must keep those transmitters operating at all times, and must have them checked at regular intervals by licensed personnel to meet FCC requirements.

This means that the available licensed experts can "write their own ticket" when it comes to earnings. Some work by the hour and usually charge at least $5.00 per hour, $7.50 on evenings and Sundays, plus travel expenses. Others charge each customer a monthly retainer fee, such as $20 a month for a base station and $7.50 for each mobile station. A survey showed that one man can easily maintain at least 15 base stations and 85 mobiles. This would add up to at least $12,000 a year.

**How to Get Started**

How do you break into the ranks of the big-money earners in two-way radio? This is probably the best way:

1. Without quitting your present job, learn enough about electronics fundamentals to pass the Governmental FCC Exam and get your Commercial FCC License. Then start getting practical experience in servicing two-way radio systems in your area.

2. As soon as you've earned a reputation as an expert, there are several ways you can go. You can add mobile radio maintenance to the present services offered by your shop, or start your own separate mobile radio business. You might become a franchised service representative of a big manufacturer and then start getting into two-way radio sales, where one sales contract might net you $5,000. Or you may be invited to move up into a high-prestige salaried job with one of the major manufacturers.

The first step—mastering the fundamentals of electronics in your spare time and getting your FCC License—can be easier than you think.

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Digital Voltmeter

A solid-state 3-digit voltmeter is announced that reportedly features 100µV sensitivity on the 100mV range. Specifications indicate that non-segmented, in-line, high-intensity, non-blinking 3-digit readout is provided in five ranges: ±100.0mV, 1.000V, 10.000V, 100.0V and 1000V. It is designed to select and display the applied polarity automatically. In addition, the manufacturer indicates that a fourth digit provides over-range readout at full rated accuracy to 120% of full scale for all ranges. Rated accuracy from 60° to 105°F is ±0.1% of full scale, ±1 count. The portable unit measures 3½ x 12 x 12-in. Price $375. Roback.

CATV Weather Channel

A weather channel originator has been developed for use in CATV systems and closed-circuit TV systems for hotels, motels and schools. It reportedly consists primarily of a vidicon camera focused on a rotating mirror. Specifications indicate that the mirror picks up successively the following six positions: a clock, a thermometer, a humidity indicator, a barometer, a date indicator, and a six-sided rotating card holder. All of the weather instruments reportedly come complete with outdoor sensors. The rotating card holder is designed to accept photos, drawings, diagrams and lettering. The manufacturer indicates that the output is 1.5v P-P or can be switched to RF, tunable channels 2 through 6. Price $2195. Vikoa.

AM/FM Stereo Receiver

Announced is an AM/FM receiver that reportedly contains 82 semiconductors plus a nuvisor tuner front end. The manufacturer indicates that its controls include: clutch-type base and treble for each channel, flip-type switches for AFC, loudness, speakers on/off, high and low filter, 7½ and 3¾ ips tape equalization switch, and a tape monitor switch that is combined with the stereo/individual-channel selector. Specifications indicate 1.5µV FM sensitivity, 5µV AM sensitivity and 122w total IHF power output across a 4Ω load. Allied.
**NEW PRODUCTS**

**Soldering Station**  714
Announced is a low-voltage soldering station that reportedly consists of a light 12v soldering pen, a heat cap-
sule and a control unit that reduces the 120vac line voltage to the proper voltage for the desired temperature. The control unit includes a line-
voltage meter, a power setting knob and a table that indicates the proper power setting for the line voltage and desired soldering iron temperature. Ungar.

**Tension Gage**  715
Announced is a spring tension gage designed to measure the tension settings of relays or springs from 0 to 300g in 10 gram steps. Specifications indicate that the scale is calibrated on front and back for left to right or right to left readings. The frame is reportedly 4½ x 1⅝in. Price $7.60. Neuses.

**FM Receiver**  716
Announced is an FM receiver that reportedly uses integrated circuitry, a FET tuner section and silicon transis-
tors throughout. Specifications in-
dicate that the FM stereo tuner em-

**Stereo Preamplifier**  717
A solid-state preamplifier reportedly has a pair of tone controls with flat frequency response when the dials are centered. Specifications indicate that some of the preamplifier's features include three steps of high frequency filtering, provision for a center channel without requiring an extra power amplifier, headphone output, front panel input that can handle an electric guitar. Dynaco.

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**NEW PRODUCTS**

**FM Receiver**
Announced is a 30w peak AM/FM and FM stereo receiver with plug-in connections for tape recorder and record changer. Specifications indicate that the receiver has a controlled injection AFC, a broad-scale logging dial all solid-state circuitry. Rheem.

**Power Transistor**
A plastic-encased silicon power transistor has been designed to provide easy mounting and collector isolation without the need for extra hardware or washers. Maximum ratings reportedly are: $V_{CEO}=35\text{V}$, $I_{C}=3.0\text{A}$, $T_{J}=-65^\circ\text{F}$ to $+300^\circ\text{F}$. Specifications indicate that the $h_{FE}$ is from 20 to 250 and $14.3\text{w}$ can be dissipated at $212^\circ\text{F}$. Bendix.

**VTR Splicers**
A line of video tape splicers has been developed to handle 1/2- and 1-in. tapes, and they reportedly use pressure-sensitive patches. This method of splicing is reportedly the same as used in the computer field on the paper tape input devices. Robins.

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**FM Receiver**

**Power Transistor**

**VTR Splicers**

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NEW PRODUCTS

Transistorized Microphone 721
A transistorized dynamic microphone has been designed to directly replace an assortment of carbon mobile microphones. Specifications indicate that it contains a two-transistor preamplifier that improves the quality of transmission by providing a more uniform output level. Turner.

AM/FM Receiver 722
A solid-state AM/FM stereo receiver is announced that reportedly incorporates an integrated circuit IF strip for improved capture ratio and selectivity, and a FET front end for maximum sensitivity with minimum interference. Specifications indicate 1.9uV FM sensitivity with 90db cross modulation rejection, 2.2db capture ratio, 46db selectivity and 36db tuner stereo separation. It has a 90w rated output. Price $439.95. Scott.

AUTO TAPE PLAYERS

continued from page 43

... Children Must Play...

After playing all channels except the last one, this Lear-Jet stereo-8 developed crosstalk. A new cartridge was inserted and the same thing happened. The player was slipped out of its mounting bracket and placed on the bench.

In this model, the tape alignment screw is located at the bottom of the player. Adjustment of this plastic-coated screw did not remedy crosstalk on the last channel. We removed the top cover and checked the head adjustment.

Now we could actually see the trouble. A piece of tin foil wrapper from chewing gum was wedged under the head assembly.

Don’t forget to inform the customer of possible theft of his tape player in an unlocked car. In some cities up to 200 stereo thefts a month are taking place at the present time.

When installing a new tape player, record the model and serial number and give it to the customer for safe keeping.

Refer to Chart I for common trouble symptoms and possible causes.

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Amphenol and Sangamo Plan Merger

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The terms of the transaction reportedly call for the issuance of 1/2 share of Sangamo common stock and 1/16 share of a new 4½% convertible preferred stock for each share of Amphenol common stock. The announcement indicated that upon surrender of the convertible preferred stock and payment of $50 in cash, each preferred share will be convertible into three shares of Sangamo common stock.

The proposed transaction is subject to the execution of definitive legal agreements, tax rulings and approval by the shareholders of each company.

Sangamo, the surviving company, will change its corporate name to Amphenol-Sangamo, Inc.

Distributor Sales Figures Shifted Slightly This Year

Comparative distributor sales figures prepared by the Electronic Industries Assn.’s Marketing Service Dept. indicate the following for the first seven months of 1966 and 1967:

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<td>2,729,555</td>
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<tr>
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<td>7,014,371</td>
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NEWS OF THE INDUSTRY

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Perma-Power Appoints Regional Sales Manager

Eugene O'Brien has been appointed regional sales manager for Perma-Power. He will coordinate the company's sales activities and work with its sales representatives in northern California, Oregon, Washington, Nevada, Utah, Arizona, New Mexico, Colorado, Montana, Wyoming and Idaho.

Supreme Court will Decide FCC Authority over CATV

The question of whether or not the Federal Communications Commission has authority to regulate the community antenna TV industry has finally reached the Supreme Court. Traditionally telephone and telegraph companies have been regulated by this section. When originally asserting its new jurisdiction, the FCC indicated that it would need additional time to prepare permanent CATV regulations but that in the interim no CATV system in the nation's 100 largest cities could handle signals from additional out-of-town TV stations without prior FCC permission.

The FCC's authority and the interim rule have been challenged by suits filed by a number of CATV systems. The Supreme Court agreed to review a case brought by three San Diego area CATV systems.

TV Antennas Designed For Travel Trailers

The Finney Co. of Bedford, Ohio, has developed two TV antenna kits for use on travel trailers and mobile homes. One reportedly consists of an all channel UHF/VHF/FM antenna mounted on a telescoping mast and a rotator mechanism that allows the antenna to be rotated from inside the vehicle. The manufacturer indicates that when traveling, the antenna is folded down, closed up and locked in a travel position below the vehicle roof top.

The second model consists of an all channel UHF/VHF/FM antenna mounted to the vehicle on a wall mount. The antenna and top mast section of this model must be removed for travel, and the preassembled antenna elements reportedly snap closed for storage.

Warranty Returns of Philco 'P' and 'Q' Line Color-TV Horizontal Output Transformers

Engineering evaluation of a large percentage of horizontal output transformers returned in warranty has shown that those tested were good and had no defects. Technicians have been returning the transformers because of wax drippings which appear on the base of the transformers. The manufacturer indicates that these wax drippings are normal and are caused by heat generated by the transformer.


Electronic Sales Corp. has been appointed to represent Perma-Power Co. in the Pacific Northwest for its TV service and audio equipment lines. The sales territory will cover Washington, Oregon and Alaska.

ARE YOU CASHING- IN ON THE PROFITABLE 2-WAY RADIO SERVICE BUSINESS?

* Motorola will train you for this rewarding, elite profession
* Send for our FREE EVALUATION EXAM. Prove to yourself that you are ready to learn FM 2-way radio servicing.

Opportunities in 2-way radio servicing are virtually unlimited.

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- Send full details on Home Study Course on FM 2-way Radio Servicing
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State

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SAVE your time...

YEATS DOLLY for RADIO and TV

just 47 inches high for STATION WAGONS and PANEL PICK-UPS

Designed for TV, radio and appliance men who make deliveries by station wagon or panel truck . . . the short 47 inch length saves the space for loading into the cargo box or pick up. Tough, yet featherlight aluminum alloy frame has padded felt bottom, front (30 seconds) web strap ratchet fastener and two endless rubber belt glides. New folding platform attachment, at left, saves your back handling large TV chassis or table models. Call your YEATS dealer or write direct today!

"Everlast" COVER and PADS
YEATS semi fitted covers are made of tough water repellent fabric with adjustable web straps and soft, scratchless white flannel linings. All shapes and sizes — Write

FURNITURE PAD

YEATS Model No. 5
Height 47"
Weight 32 lbs.

APPLIANCE DOLLY SALES COMPANY
1313 W. Fond du Lac Avenue • Milwaukee, Wis.

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ELECTRONIC TECHNICIAN
CATALOGS
AND BULLETINS

High-Fidelity Equipment 400
A 20-page brochure covers a line of high-fidelity components including a variety of furniture component cabinets and speaker systems. Altec Lansing.

Motor Switches 401
Manual motor starting switches for single-speed, two-speed and reversing functions are described in a four-page bulletin. G-E.

Coaxial Cables 402
Coaxial cables engineered for community antenna TV, closed circuit TV, and FM, CB and amateur antenna transmission lines are described in an eight-page catalog. Alpha Wire.

Conductor Selector Chart 403
A free slide-rule chart has been designed to provide a simple method of converting from standard copper wire gages to an equivalent of aluminum wire gage and/or strip conductor in width and thickness. It reportedly provides information automatically concerning cross-sectional area in square inch, weight and equal electrical resistance of copper and aluminum wire and strips. Included is basic data for the design of electrical windings, also factors of weight, space and current carrying capacity. Permaluster.

Write-On Labels 404
A full-color bulletin lists 130 different stock preprinted, color-coded, write-on labels for a large variety of needs. It also refers to special labels that can be designed to include trademarks, symbols, colors, shapes and whatever wording is required. W.H. Brady.

Captive Hardware 405
An illustrated eight-page catalog describes a complete line of stainless-steel captive hardware for soft or thin metal panels, parts or chassis. Listed are seven types of captive nuts and studs that reportedly will not pull, push or torque out after their press fit installation. Precision Metal.

CATV Cable 406
A complete line of transmission and drop line cable for community antenna TV applications is described in a two-color, four-page brochure. Performance charts and mechanical and electrical data are also included. Amphenol.

Why not sell the best

ZENITH TUBES
built to the quality standards of Zenith original parts

"Royal Crest" Circuit Tubes
More than 875 tubes—a full line with the same quality as original Zenith equipment. Get Zenith tubes for greater dependability and finer performance.

Order all genuine Zenith replacement parts and accessories from your Zenith distributor.

DECEMBER 1967
and similar controls. Xceljte.

Nutdriver Set 408
A bulletin describes a compact, interchangeable, hollow-shaft nutdriver set that features a drilled handle. Included is an illustration that shows how a screwdriver blade can be passed through the drilled handle and hollow nutdriver shaft to speed adjustments found on rheostats and similar controls.

SEMICONDUCTORS . . .

continued from page 53

The varicap manufacturer substituted its diode in place of the tuning capacitor in a portable AM radio. Using tuning circuits similar to those shown in Fig. 12, the capacitances in the antenna and oscillator circuits vary with the applied voltage as indicated by the curves in Fig. 15.

Tests were made in accordance with IEEE Standard 186 before and after this receiver was converted to electronic tuning. The results of these tests are shown in Table 1.

The curve in Fig. 15 indicates small capacitive changes as the bias voltage is varied between 7 and 10v, and we noted that the last station at the higher-frequency end of the dial covered a much larger portion of the tuning dial than the other stations. Since the potentiometer rotates a greater number of degrees than the mechanical tuning capacitor, the stations were more widely spaced across the dial of the converted radio.

Electronic Technician's Teklab has also converted one of a pair of AM portable radios (Fig. 13 and 14) for comparative studies. After the conversion was made, both radios could tune in all local stations, which in this city are spread nearly the entire broadcast band. The reception sounded as clear on one receiver as on the other.

We found that the capacitors connected in series with the varicaps had to be ceramic types since slight capacitor leakage detuned the radio, and sometimes a pair of stations would be alternately tuned "in" and "out" without moving the dial. It was also necessary to use a separate battery for the tuning bias supply since varying audio signals could load down a common battery and provide distortion by changing the tuning. A voltage-regulator circuit could have been included to eliminate this problem and permit single battery operation.

The converted tuning circuit did require a little additional space, and even more space would have been required if a voltage regulation circuit was included. There was no saving in component cost when constructing the varicap circuit. Then why a varicap tuning circuit?

Varicap tuning circuits permit the construction of all electronic automatic-search-tuning circuits, eliminating the need for complicated mechanical automatic-search-tuning systems that require relays, motors or solenoids. An oscillator step-counter circuit is used in place of the mechanical components. In this circuit, an oscillator produces a signal that slowly changes the varicap bias in steps so small they seem nearly continuous. These steps in bias potential continue to change the varicap capacitance until a station is received and its audio signal blocks the oscillator circuit. The step-count circuit then maintains a constant potential across the varicap, keeping the receiver tuned to the station received. When reactivated, the varicap bias is again changed by the oscillator step-count circuit until another station is received.

Remote tuning is another advantage of varicap tuned circuits. A varicap tuned receiver can be con-
For CB Antennas
Specify MOSLEY

1 DEMON
A short mobile antenna measuring 17" long on performance. Center loaded. Stainless steel whip. SWR 1.5/1 or better. Screw on and off. Antenna complete with coax, chrome plated spring and hardware. Weight 1.5 lbs.
MODEL DA-27

2 DEPUTY
Similar to DA-27, but base loaded and longer. Measures 43 3/4".
MODEL DP-27

1 CADET TWINS
About the most versatile CB antenna on the market today. Suction cup mount for temporary use on cars, trailers, boats etc. Use on all smooth surfaces - wood and fiberglass included. No ground. Length 3'. Center loaded. No hole drilling. Installs in seconds. Wr. 1 lb.
MODEL SUC-1

4 PER-1
A permanent version of the SUC-1.
MODEL PER-1

3 SILVER DOLPHIN
Performance proven marine antenna, dependable even in out-of-the-way coves! Height 8' 5 1/2". Loading through salt-resistant, weather-proof transformer. SWR 1.5/1 over 23 channels. No ground required. Fold over base hinge. Weight 3.6 lbs. Accessories available for angle mounting and clamping antenna to window ledge.
MODEL D-27

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To nearly double the effective power of the transmitter, stacking beams is recommended. Results in extra reliable point-to-point communications. Mosley Stack'it beam kits include everything needed for the stacking job. From two well-known Mosley performance proven beams, coax yoke, hardware, guy rope, boom, to concise assembly instructions. Feed with 52 ohm coax (not included). 80 MPH wind survival. Average assembled weight 42 pounds. Three models available:
MODEL SKT-3
MODEL SKT-4
MODEL SKT-5

DEVANT '1'
A performance proven vertical antenna popular with CB'ers. Gain 3.4 db. compared to quarter wave ground plane at 5.9 db. over isotropic source. Rugged and built to last. Aluminum ends tapered to reduce wind load and vibrations causing metal fatigue. So lightweight...

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4610 N. Lindbergh Blvd., Bridgewater, Missouri 63042

NEW SERIES OF ELECTRO POWER SUPPLIES

These new precision built power supplies are engineered to give extraordinary output per dollar...powerful new additions to the full ELECTRO line which includes a wide range of quality power supplies to meet your needs at sensible cost.

Send for complete specifications on these and other ELECTRO power supplies.

REGULATED
Hi-Power
PSR-500 SERIES
500 Watts
Continuous Variable Output

Delivers 500 watts of DC power continuously with output voltage regulated to less than 1% for both line and load changes. Maximum ripple less than 1%. All solid-state circuitry. Uses silicon rectifiers and SCR regulation. Fused input, circuit-breaker output protection.

Three models available with output voltage ranges: 2-32v, 2-55v, and 2-125v.

EXTRA
Hi-Power
PS-1000 SERIES
1000 Watts
Continuous Variable Output

Well filtered for Low Ripple

For continuous heavy-duty. Continuously variable output, 0-32 VDC for loads to 30 amps. Ripple: less than 0.75% at max. current. Filter circuit uses chokes and capacitors. Variable autoformer for smooth control. Bridge-type silicon rectifiers. Also available in a 0-55 VDC at 20 amps model.

HIGH CURRENT
PS-50, PS-30
12 Volts
Adjustable
Low Ripple at Max. Current

These new general purpose power supplies are heavy duty adjustable 12-volt units for servicing auto, aircraft and marine communications equipment. Useful in industrial and educational labs, thermo-electric cooling power source, etc. Maximum ripple is 1% at maximum current. Output voltage adjustment is 8-position tap switch. PS-50 delivers up to 50 amps, continuously; PS-30 rated up to 30 amps.

Sold through leading Electronic Distributors

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6125-V Howard Street, Chicago, Illinois 60648 • 312/647-8744

DECEMBER 1967
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ACCEPT NO IMITATIONS

NON-DRIFT COLOR TV TUNER CLEANER

- To clean better
- To be safe on plastics used in TV sets
- Non-flammable
- To cause no drifting

NEW! COLOR LUBE®
Safe For Plastics Inel ileugooll to R/1..1 1;

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NEW! PHONO AND TAPE RECORDER WHEELS, DRIVES, BELTS!

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Ancestors' Index

PHONO NEEDLES!

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ELECTRONIC TECHNICIAN
One out of every five professional servicemen has switched to Amperex TV replacement tubes

It takes a lot of quality to change the buying habits of 20% of the most knowledgeable technicians in the business. These servicemen are following the pattern set by the leading TV manufacturers, who are designing more and more of their quality lines around tubes originated by Amperex. The Amperex line of popular types is expanding all the time. Look for the green and yellow cartons at your distributor's or write: Amperex Electronic Corp., Hicksville, L.I., N.Y. 11802.
RCA'S NEW FIELD SERVICE GUIDE, ERT-200 helps you make all adjustments on all RCA color sets from 1955 to 1966 that can be performed in the home... including step-by-step procedure for replacing a color picture tube.

WHAT THIS GUIDE CONTAINS:
- Schematics on all RCA color sets from 1955 to 1966
- Field service adjustments (AGC, linearity, centering, etc.)
- Convergence, purity and black and white setup adjustments
- Parts lists
- Wave forms keyed to test points for majority of chassis
- Top and rear chassis views
- Photos of typical receivers
- Index of models from CTC2 through CTC20
- Separate section on tuner schematics
- Separate section on remote tuner schematics

Three part index lets you look up the set you are working on by model number, name or chassis number. You'll find the ERT-200 Field Service Guide indispensable. There's nothing like it on house calls for RCA color sets.

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