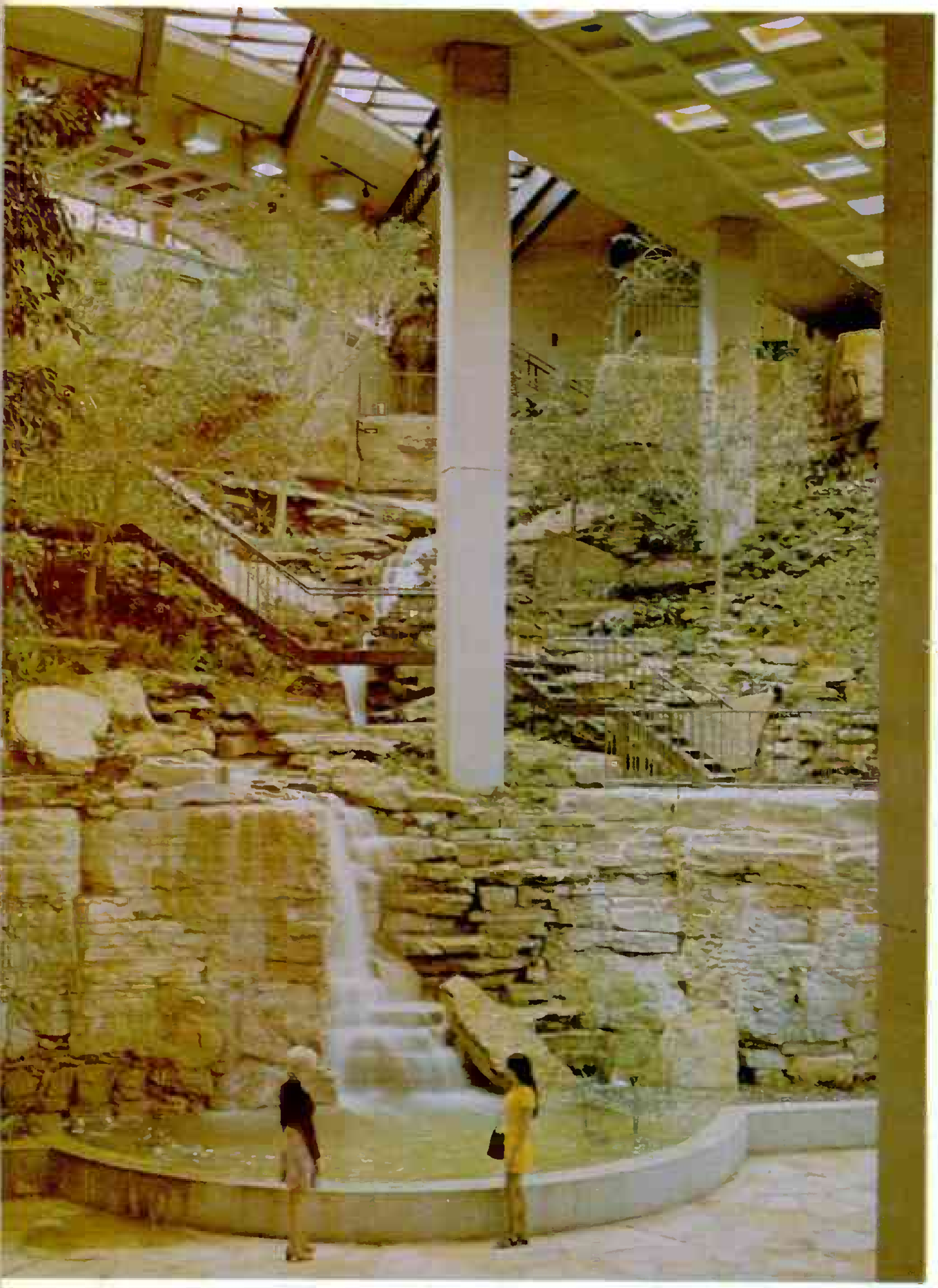
August, 1973 □ 75 cents

Electronic Servicing

A HOWARD W. SAMS PUBLICATION



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Servicing solid-state AGC

Agenda of the NEA/NATESA convention

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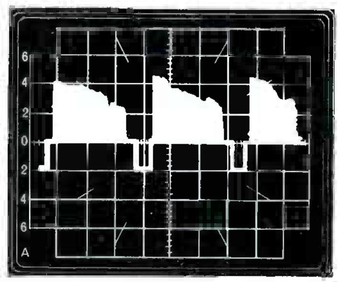
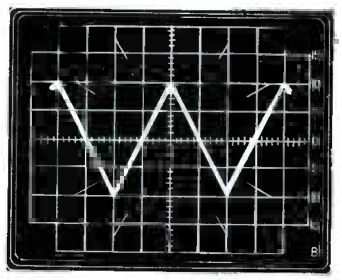


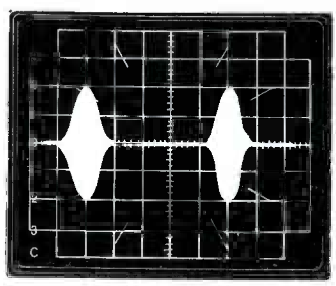
- **"A" Scale**

For readings in multiples of 2, from 0 to 6 (+ and -) peak to peak.



- **"B" Scale**

For readings in multiples of 5, from 0 to 15 (+ and -) peak to peak.



- **"C" Scale**

For readings in multiples of 1, from 0 to 3 (+ and -) peak to peak.

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August 1973 ☐ Volume 23, No. 8

Electronic Servicing®

in this issue...

About The Cover

One of the most unique features of the Crown Center Hotel in Kansas City, site of 1973 Joint NEA/NATESA Convention, is this huge and beautiful waterfall located in the lobby.

DEPARTMENTS

Second class postage paid at Shawnee Mission, Kansas and additional mailing offices. Published monthly by INTERTEC PUBLISHING CORP., 1014 Wyandotte St., Kansas City, Mo. 64105. Vol. 23, No. 8. Subscription rate $6 per year in U.S., its possessions and Canada; other countries $7 per year.

ABP

ELECTRONIC SERVICING (with which is combined PF Reporter) is published monthly by Intertec Publishing Corp., 1014 Wyandotte Street, Kansas City, Missouri 64105.

Subscription Prices: 1 year — $6.00, 2 years — $10.00, 3 years — $13.00, in the U.S.A. its possessions and Canada.

All other foreign countries: 1 year — $7.00, 2 years — $12.00, 3 years — $16.00. Single copy 75c; back copies $1. Adjustment necessitated by subscription termination at single copy rate.

Robert E. Hertel, Publisher

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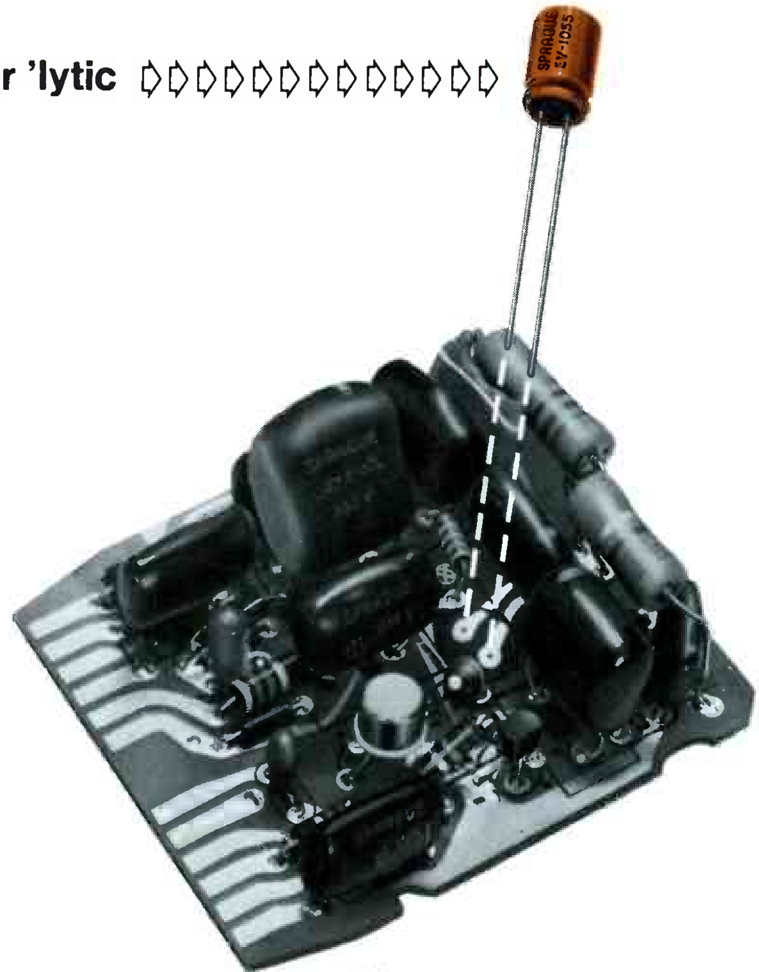
Type EV —
the space-saver 'lytic



board room

For space-saving 'lytic capacitor replacements on crowded printed wiring boards found in most of today's foreign and domestic consumer entertainment products, Sprague Type EV Verti-Lytic® Capacitors have the widest range of values . . . in the smallest case sizes . . . of any single-ended capacitors available anywhere!

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electronic scanner

news of the industry

The value of people over machines during emergency situations was emphasized recently by the in-space repairs to Skylab. Undoubtedly you know about the damaged power panel which reduced the amount of electrical power and threatened cancellation or curtailment of the $2.5 billion dollar mission. Not given in the newspaper accounts (but described in the **Wall Street Journal**), were details about how the two astronauts cut away a small piece of metal which was bent over and blocking deployment of the solar-cell panel. An off-the-shelf wire-cutting tool was used to make this repair, one which would have been very easy on earth. According to Edwin Mortimer, sales representative for the A. B. Chance Company of Centralia, Missouri, the cable cutter was their model C403-0689, which retails for $65.50. We must credit Astronauts Conrad and Kerwin with making the longest-distance electronics service call of all times!

A famous old name returns to the electronics marketplace this August when the Atwater Kent Radio Corporation makes the first deliveries of a new line of stereo-radio consoles. In the 1920's, one of the leading radio manufacturers was the original Atwater Kent Company, whose founder was A. Atwater Kent. The company ceased operation in the 1930's and many of the radios are in demand now as antiques.

Motorola is withdrawing from the manufacturing and marketing of home-audio products, according to **Radio & Television Weekly.** Not changed is the line of automotive products or the audio marketing programs in Canada. It is said this one line of products is being dropped to permit greater emphasis on color and b-w TV.

Zenith has announced an agreement to purchase the Philco-Ford color-television picture-tube plant located in Lansdale, Pennsylvania. Employment of the present staff will be offered by Zenith at the closing date, expected to be Friday, June 29. Zenith expects to expand the facility and add tooling and equipment required to produce Chromacolor TM picture tubes. Philco-Ford has agreed to purchase a substantial quantity of picture tubes during the next two years.

RCA has developed a system using a TV camera and a small computer for scoring bowling automatically and providing a read-out on paper. The system which has been approved by the American Bowling Congress, is in production by the RCA Electromagnetic and Aviation Systems Division of Van Nuys, California and will be marketed by Rapid Score, Inc.

A practical substitute for mechanical pin-tumbler door locks might be an electronic lock just announced by the Schlage Lock Company of San Francisco. As described in **Business Week**, there is no keyhole or card slot. Inside the door is a low-power radio-frequency oscillator, and inside a key-card (about the size of a credit card) is a tuned circuit. It is necessary only for the card to be held near the sensitive area of the door to accomplish unlocking. Approximately 10,000 key codes can be accommodated in the 4- to 16-MHz range.

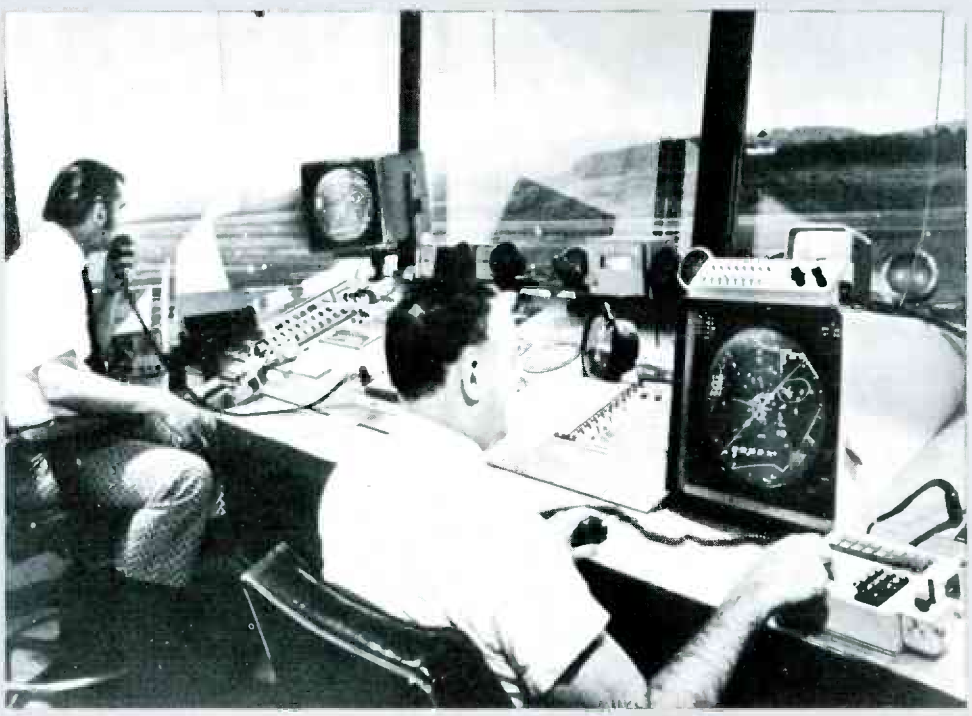
(Continued on page 6)

Dependable contacts without the use of gold plating have been achieved, according to **Business Week,** by specially-designed connectors manufactured by the Burndy Corporation of Norwalk, Connecticut. Prices of contacts used for computers and television receivers are said to be about one-third of those using gold to give low resistance and freedom from tarnishing which causes intermittents.

Jerrold announces their Tech School schedule for the remainder of 1973: September 5-6, Advanced MATV, Kansas City, Kansas; October 3-4, Basic MATV, Orlando,Florida; October 17-18, Basic MATV, Canton, Ohio; November 6-7, Advanced MATV, Houston, Texas; and November 28-29, Basic MATV, Charleston, West Virginia. There is no charge for these two-day schools. Contact your Jerrold representative, or Jerrold Electronics, P. O. Box 350, 220 Witmer Road, Horsham, Pennsylvania for additional information.

For the first time since 1963, RCA will supply merchandise to another manufacturer, according to an article in **Merchandising Week.** This fall, three models of console stereo are to be furnished to J. C. Penney. Console and portable Color-TV receivers are to follow in early 1974. A spokesman for the RCA Distributing Corporation said that no further expansion into private labels is contemplated, and that none of the Penny's machines will have direct counterparts in the regular RCA line.

Shown in the picture are air-traffic controllers evaluating under operational conditions a **newly-installed BRITE system.** Full name of the equipment, built by the ITT Aerospace/Optical Division of Fort Wayne, Indiana, is Bright Radar Indicator Tower Equipment. This is part of the overall automated system featuring a minicomputer and provided by Lockheed Electronics Company. Data about aircraft identity and altitude are provided automatically and shown on the scopes, thus increasing air-space safety. □



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- Attractive beige control cabinet blends with any decor.
- Improved heavy-duty precision worm gear drives antenna mast for strong turning force, and locks it in position to prevent "windmilling."
- No annoying "click-clack" sound. Operates quietly.
- Heavy-duty high-torque motor provides fast turning action . . . complete 360° rotation in less than a minute.
- Sturdy IMPAC® plastic control case.
- Electrical current used only during rotation.
- Quick-connect pressure terminals and pre-assembled mounting clamps (no protruding studs that can snag lead wire) mean fast, easy, money-saving installation.
- Plus all the usual top quality features you expect in an RCA rotator—lightweight aluminum drive unit housing, cushioned feet on control console, locking mast clamps with teeth, extended three year warranty (see warranty card for complete details).

RCA's Selecta-Channel antenna rotator passed continuous operation lab tests without burn out or over heating—tougher usage than the consumer will give it. It's your customers' best buy in rotators and that means it's your best buy too. See your RCA Rotator distributor today, or contact RCA Parts and Accessories, P.O. Box 100, Deptford, New Jersey 08096.

RCA

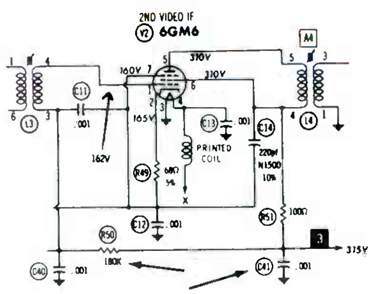
For More Details Circle (6) *on Reply Card*

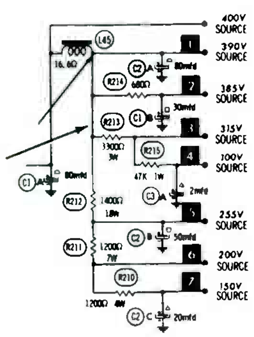
troubleshooting tips

Send in your helpful tips—we pay!

Low gain, reduced contrast RCA CTC16XL color chassis

There was very little snow off channel, and adjustment of the AGC control had little effect on the contrast. These two symptoms usually indicate low gain in the tuner or IF's. New tubes installed in these circuits gave no noticeable improvement in gain.





During DC voltage tests of the power sources, I found both the 315 and 100 volt supplies to be abnormally low. Resistance tests showed R213 had been hot and changed value because of leakage in C41. Also suspicious was R50, because the body of the resistor was cracked.

After these three components were replaced and the AGC control adjusted, gain and contrast were normal.

Stanley F. Gutt
Bayonne, New Jersey

No b-w video General Electric KD chassis

The symptoms were strong colors, retrace lines, but no b-w luminance signal. Visually, the picture was the same as when the picture tube has a heater-to-cathode short.

I tried an isolation transformer on the CRT, but the symptoms remained the same.

One of my techniques is to move various parts and notice any change of symptoms. When I got around to the service/normal switch, a slight movement would bring in the video.

I spray-cleaned the switch and it seemed to operate okay,but two weeks later there was a call-back for the same complaint.

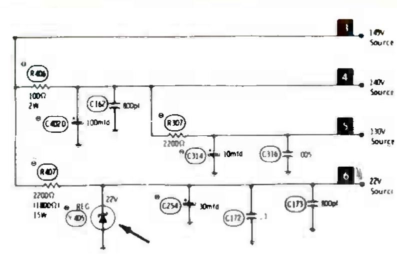
After that experience, I recommend you replace those slider-type switches instead of cleaning them.

J. E. Strenk, CET
Co-op TV
Rhinebeck, New York

No high voltage, output tube runs red General Electric C-2/L-2 color chassis

The first test was for drive voltage at the control grid of the horizontal output tube. There was none. Neither was any drive voltage present at the base of the horizontal discharge transistor (Q504).

Collector voltage of the horizontal oscillator (Q503) was +4 volts instead of the normal +19 volts. When I shorted the base to emitter, the collector voltage stayed the same, indicating that excessive Q503 current was not responsible.



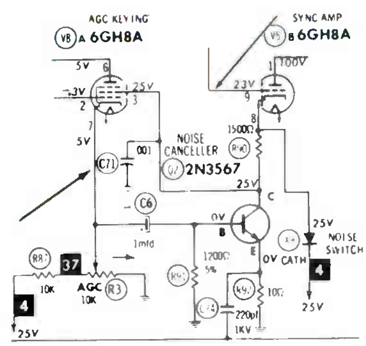
The collector voltage for Q503 comes from the 22-volt source, and it also checked +4 volts. However, the +150-volt source was normal. All loads were disconnected from the 22-volt source, but the voltage was still low.

R407, the 1.7K 22-watt dropping resistor, was checked and found to be within tolerance. Nothing remained to be tested except the 22-volt zener diode. When I replaced it, the voltages returned to normal, and the receiver had high voltage.

Roger D. Redden
Beaver, West Virginia

Audio distortion and poor AGC Penncrest 2631-48A

The main complaint was distortion in the audio,and it was some time before I realized the sync and AGC also were not normal. I decided to concentrate on the AGC symptoms.



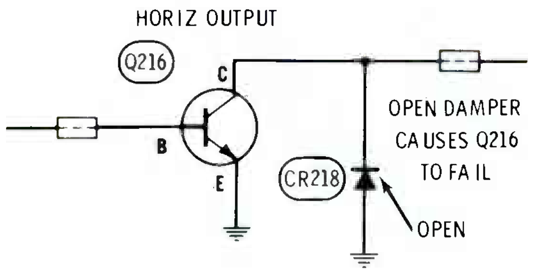
DC voltage analysis showed nothing very unusual about the AGC keying circuit, but there was too much video waveform at the screen grid (pin 3). Paralleling C71 with another .001 cured all three of the symptoms, and installation of a new one completed the job.

Yuban D. Chitta
Corpus Christi, Texas □

symcure

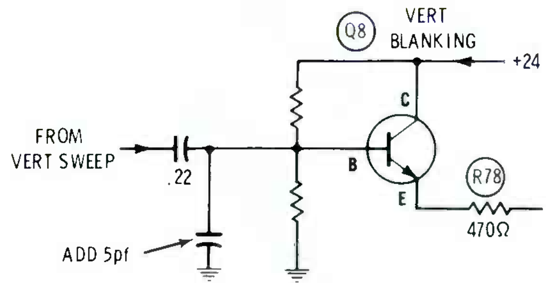
Symptoms and cures compiled from field reports of recurring troubles

Chassis-Zenith 25DC56
PHOTOFACT-1312-3



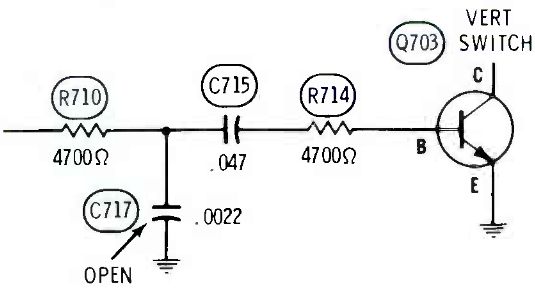
Symptom-Horizontal-output transistor hot, fails in few minutes
Cure-Check the damper diode, and replace if it is open

Chassis-Zenith 19DC12
PHOTOFACT-1311-3



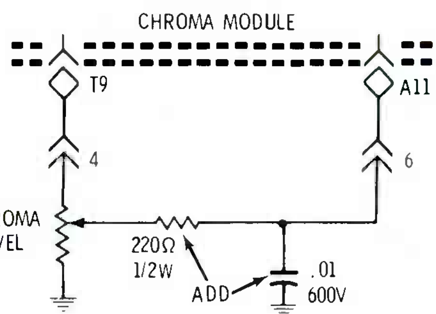
Symptom-Buzz in the sound on UHF
Cure-If Q8 replacement doesn't cure, add 5 pf capacitor as shown

Chassis-Zenith 25DC56
PHOTOFACT-1312-3



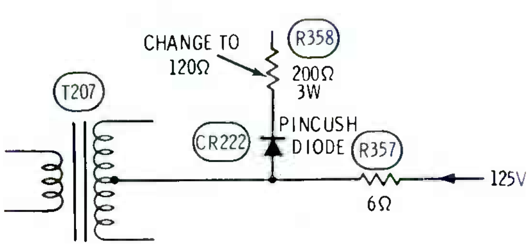
Symptom-Vertical jitter and poor interlace
Cure-Check C717, and replace if it is open

Chassis-Zenith 19CC19 (also 4B25C19)
PHOTOFACT-1215-3 (1166-3)



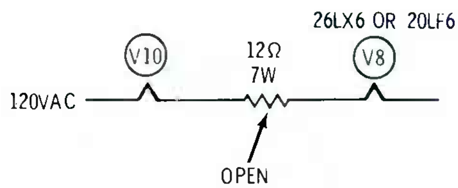
Symptom-Failure of IC2 in early-production sets
Cure-Add a resistor and capacitor, as shown

Chassis-Zenith 25DC56
PHOTOFACT-1312-3



Symptom-Picture is too far to the left
Cure-Reduce the value of R358 to 120 ohms

Chassis-Zenith 14DC15 & 16
PHOTOFACT-1304-3



NOTE: RESISTOR IS SHORTED
BY INTERNAL JUMPER OF 26LX6,
BUT NOT BY 20LF6

Symptom-A good 21LF6 won't work, but 26LX6 will
Cure-Check the 12-ohm resistor, which is shorted out when a 26LX6 is used

reader's exchange

Need a not-available schematic? Need an obsolete part? Have an unusual service problem and want help? Send information and full mailing address to ELECTRONIC SERVICING. Other ES readers should send replies with their offer of help direct to the writer. We reserve the right to edit and print all letters sent to this column. **Let us help one another.**

Needed: *Mailing address of Kenneth J. Englert who sent in two short articles. His address evidently was thrown out with the envelope.*
Carl Babcoke
Managing Editor

Needed: *A loctal-type FM 1000 tube. Gladly pay price and shipping.*
F. Barth
Barth Radio & TV
2910 South 17th Street
Tacoma, Washington 98405

Needed: *Schematic for a Model 20 Eveready battery receiver. The radio was manufactured by Union Carbide in the 1920's.*
Edward Bertram
Route 4, Box 161
Falmouth, Kentucky 41040

Needed: *Schematic diagram for a Cadaux Model 9086 transistor portable radio, manufactured in Hong Kong.*
John C. Holman
418 West Pine Street
Washburn, Wisconsin 54891

Available: *Service data for most antique radios $1 per page. Send brand and model number for estimate.*
J. A. Oden
710 Lakebird Drive
Sunnyvale, California 94086

Needed: *Copy of manual or tube chart setup used with model 85 tube tester. Manufactured by Superior Instrument Company.*
Ted Lammerse
928 Wolverine
Monroe, Michigan 48161

(Continued on page 14)

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TEL. 301, 565-0025

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Reader's Exchange

(Continued from page 12)

Needed: *Present address of Jackson Electrical Instrument Company, [old address 16-18 South Patterson Blvd.], Dayton, Ohio, or name of another company which could supply current roll chart for Jackson's model number 49 tube tester.*

Robert H. Henry
2085 Tustin Avenue
Costa Mesa, California 92627

Needed: *Schematic and operating instructions for a Jackson oscilloscope model CRO-1.*

Paul J. Cavallaro
7834 West Higgins Road
Chicago, Illinois 60631

Needed: *Schematic diagrams and manuals for an Elmac transistor radio model AF-67, serial number 402, and for a power supply, M-1070, serial number 2284, also from Elmac.*

Alan G. Scott
Route 3, Box 295
Appleton, Wisconsin 54911

Needed: *Power transformer for B&K Model 440 picture tube rejuvenator-tester. Also need socket adapters.*

Bert Kuschner
Route 1, Box 982
West Eau Gallie, Florida 32935

Needed: *Operating information on a Solar Exam-eter [capacitor checker] model CF.*

Ralph J. Hoge
3814 Feidler Drive
Erie, Pennsylvania 16506

Needed: *Schematic for Waterman scope model OS 51/USM24C built for U.S. Navy.*

J. Shukal
3915 Centinella Avenue
Los Angeles, California 90066

Needed: *Extra or unwanted schematics, service information, TV repair films, training aids or old TV sets for use in radio-TV repair class, a rehabilitation effort of Division of Corrections of the state of Florida.*

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c/o Buford Tyre, Radio TV Repair Instructor
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Raiford, Florida 32083 □

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Pershing Road at Main Street
Kansas City, Missouri

August is simultaneous convention time for NATESA and NEA, and this year the convention is held in Kansas City, Missouri, Electronic Servicing's home town. We of the ES staff want to extend you a personal welcome. Call us at 888-4664, if we can help you during the convention.

Convention registration fee is $25 per person (Included are Friday, Saturday and Sunday meals, plus the Trade Show and Hall of Fame presentations.)

Tuesday, August 21, 1973
8:00 AM
JESUP Technician-Training School
All technicians are invited to this session of the national JESUP program. The training consists of two days of TV-troubleshooting theory, and hands-on experience with major brands of television receivers. The fee, which includes luncheons, coffee breaks and literature, is $20.

Wednesday, August 22, 1973
10:00 AM to 3:00 PM
Electronic Service Open Golf Tournament

2:00 PM
Tour of Hallmark Card printing plant—sponsored by Electronic Servicing Magazine

Thursday, August 23, 1973
NATIONAL ELECTRONIC SERVICE CONFERENCE (NESC fee $5)
8:00 AM
Continental Breakfast (courtesy of Radio-Electronics Magazine)
9:00 AM
Get-acquainted period
9:30 AM
Service Conference Assignments
12:00 Noon
Luncheon (included in fee)
1:00 PM
NESC resumes

9:00 AM
"Profitable Service Management" School (sponsored by NEA). Registration fee $20.
12:00 Noon
Luncheon (included in registration fee)

1:00 PM
Service Management School resumes. Some of the featured speakers are: Miles Sterling, CET, Electro TV of Garden Grove, California; Carl Babcoke, editor, Electronic Servicing Magazine, Kansas City, Missouri, and a representative of Winegard Antenna Co., Burlington, Iowa.
6:00 PM
Cookout—Kansas City Steak Fry (optional), or Dinner-dance aboard the "Denver Zephyr" (a train trip through the Missouri countryside along the banks of the Missouri River)
10:00 PM
NEA Executive Committee Meeting
NATESA Executive Council Meeting

HOSPITALITY ROOMS OPEN
Friday, August 24, 1973
8:00 AM
Breakfast
9:00 AM
"Profitable Service Management" School, final session until noon, featuring Salesmanship, Management and Motivation by former US Senator Somers White, Phoenix, Arizona.

Trade Show Displays open all day Friday and Saturday

NATESA annual meeting
12:00 Noon
Luncheon

1:00 PM
NATESA Annual Meeting
3:00 PM
NEA State Presidents' Meeting
4:00 PM
CET Examinations
6:00 PM
Dinner (sponsored by Zenith Radio Corporation)
7:30 PM
Hall Of Fame Presentation
8:30 PM
ISCET Annual Meeting opens

Saturday, August 25, 1973
8:00 AM
Breakfast
9:00 AM
NEA Annual Meeting
NATESA Annual Meeting
12:00 Noon
Luncheon (sponsored by General Electric)
1:30 PM
NEA Annual Meeting—Elections
NATESA Annual Meeting—Elections
ISCET Technical Workshop
4:30 PM
Final Tour of Displays
5:30 PM
Cocktail Hour (courtesy of Howard W. Sams & Co.)

6:30 PM
Banquet
8:00 PM
Dance

Sunday, August 26, 1973
9:00 AM
ISCET Breakfast
10:00 AM
NEA Board Meeting
ISCET Board Meeting
Display Tear-Down
12:00 Noon
Officer's Orientation Meeting. All National officers are urged to attend this special leadership workshop, West Correll, Chairman.
3:00 PM
Convention Adjourns □

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1014 Wyandotte St., Kansas City, Mo. 64105

News from the

SERVICE ASSOCIATIONS

NATESA/NEA Merger Committee Meeting

Following the combined merger-committees meetings in St. Louis May 18-20, a guardedly-optimistic release was given by the chairman, Morris L. Finneburgh, Sr., E. H. F.

After thorough discussions and studies, a preliminary finalization of the "Articles of Agreement" was reached, and tentative bylaws approved. Altogether, there was agreement on 60 separate items.

Decisions were reached on important subjects, such as:

- procedures,
- name for the new association (National Electronics Service Associations),
- membership classifications and dues,
- governing body—the Board of Representatives,
- Constitution, and Articles of Incorporation,
- officer's classifications, and executive committee,
- chiefs of the executive staffs, and executive offices,
- emblem, logo and voting system,
- articles of arbitration, and preliminary Bylaws;
- Hawaiian Convention, and the Merger Celebration.

According to the release: "Merger at this time is NOT a positive conclusion, but with the anticipated and understanding cooperation between the officers, Executive Vice President, Executive Director, and the Joint Merger Committees, the ultimate goal is in view."

One more meeting of the Joint Merger Committees might be necessary. Or it is possible a last-minute meeting in Kansas City will suffice to clear up the remaining details before the convention.

TESA Wisconsin, in annual convention June 9-10 at Waukesha, by unanimous vote erased a historical mandate requiring all TESA Wisconsin members to belong to NATESA. A further amendment to the by-laws provided that the vote of each annual convention would determine which national organization would receive their affiliation. Their news release says, "TESA Wisconsin firmly believes in, and strongly endorses, the implementation of the NATESA/NEA merger, and hopefully anticipates the realization of this goal."

An article in **Merchandising Week** says the National Appliance & Radio-TV Dealers Association (NARDA) has changed the dues structure in an apparent attempt to enlarge their membership at the expense of NEA and NATESA. Service firms, or those dealerships deriving most of their income from service, are offered membership for $50 instead of the regular $75 yearly dues. NARDA President Jim Renier is quoted as saying, "there are still too many merchants, of all categories, who would sooner go broke or be forced out of business rather than admit that their only hope for survival is one strong national association." □

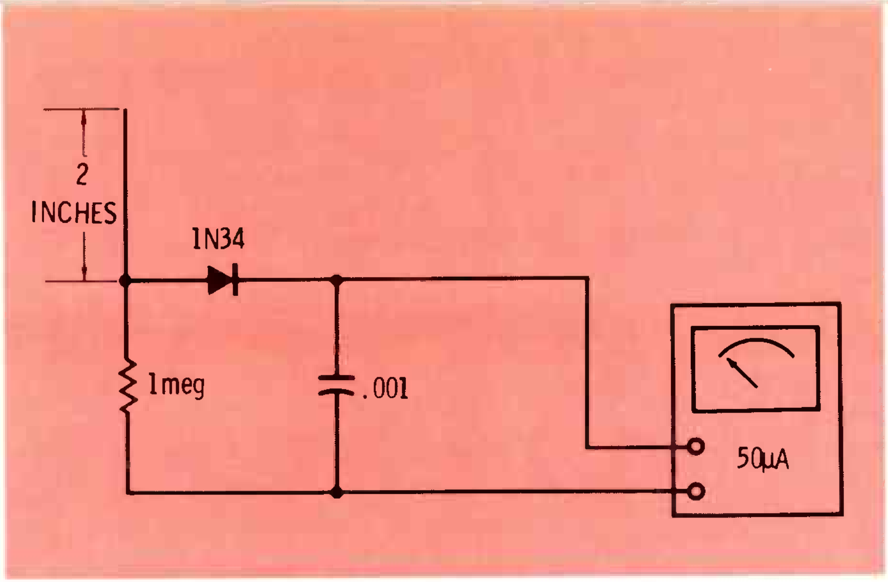


Fig. 1 A simple method of reading relative signal strength of microwave alarm carriers uses a tiny monopole, a few parts and a VOM.

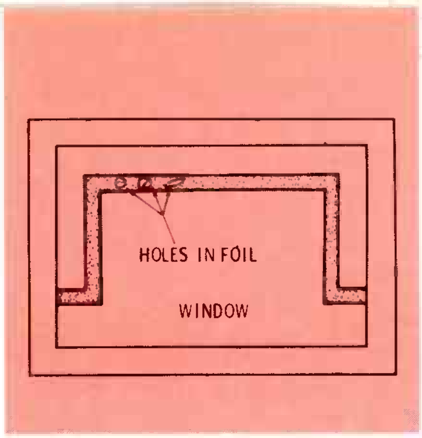


Fig. 2 Avoid perforating or damaging the foil applied to windows. Such damage can result in intermittent operation, or failure at a later date.

Installing and servicing security systems

By John E. Cunningham

Here's more information about a field that could be very profitable for you.

Burglary is a big business today, and as a result, so is the selling of systems designed to frustrate burglars. Intrusion alarms are being sold at the rate of about 300-million dollars a year. Each of these alarms must be properly installed and serviced. Many of them are serviced on a regular basis under a contract.

The alert technician who takes the trouble to become familiar with security systems can get his share of this lucrative business. The requirements are more demanding than those of servicing entertainment equipment. For example, it is not at all unusual for a technician to be called out in the middle of the night. On the other hand, the rates that can be charged for this type of service are much higher.

The circuits used in security systems are often somewhat unique, but the basic principles are the same as those underlying all types of electronic systems and the details of security systems are easily mastered.

As a rule, security systems use comparatively simple circuits. They must be reliable, and the fewer components used, the less likelihood of failure. Even the most sophisticated security system uses fewer components and has less complex circuits than a color TV set.

Getting Diagrams

Probably the hardest part of repairing an intrusion alarm is finding out just what is in it,and how it is supposed to work. The business is growing rapidly and many fly-by-night outfits have marketed alarms and then dropped out of existence. Trying to locate the diagram of a unit of this type is often a lost cause.

Even reputable manufacturers are reluctant to send diagrams and service information on their alarms. Sometimes, this is because they want to keep the service business, but more frequently it is because they do not wish the diagram of their product to fall into the hands of someone who intends to frustrate it.

When contacting manufacturers for information, it is always helpful to include a copy of a letter of reference from the local police chief.

Operating Frequencies Of Microwave Alarms

915	MHz
2450	MHz
5800	MHz
10,525	MHz
22,125	MHz

Note: field-disturbance sensors can be operated on any frequency, if the field strength does not exceed 14 microvolts per meter at a distance in feet of 157 divided by the frequency in megahertz.

Test Equipment

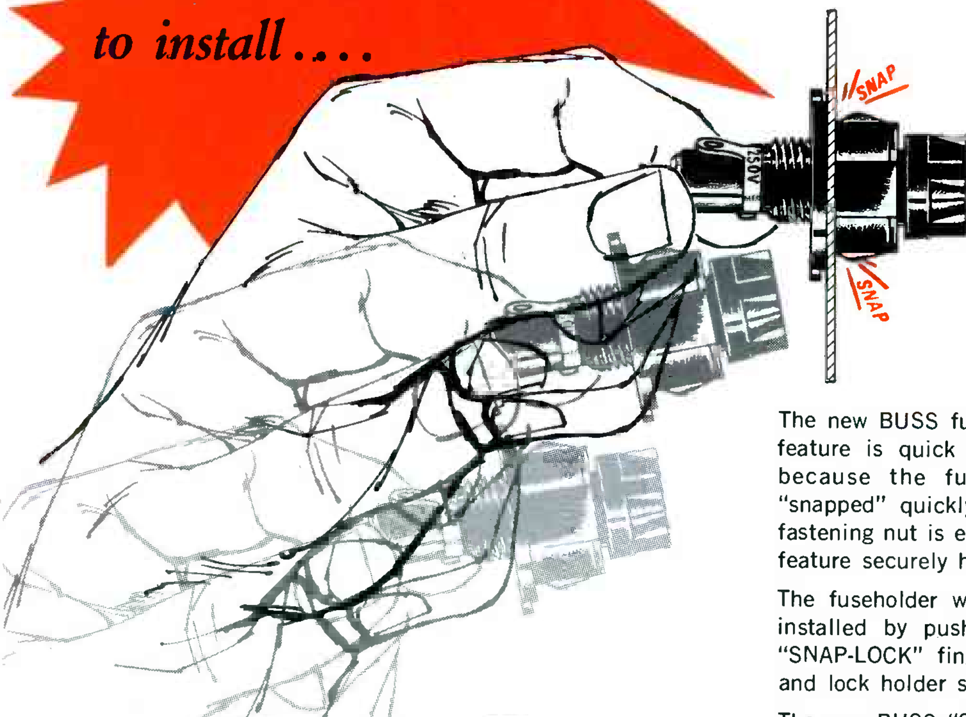
In general, little test equipment is required to service and maintain intrusion alarms. A good FET voltmeter will be used more than any other item. It should preferably have a low-power ohms range that

the New BUSS® SNAP-LOCK

Rear Panel Mounted FUSEHOLDERS

It's a "SNAP" to install....

Easy... Quick... Time Saving...



The new BUSS fuseholder with special "SNAP-LOCK" feature is quick and easy to install. It saves time because the fuseholder can be **pre-wired** and "snapped" quickly into place from rear of panel. A fastening nut is eliminated because the "SNAP-LOCK" feature securely holds the fuseholder in place.

The fuseholder with "SNAP-LOCK" feature is simply installed by pushing it into panel from rear side. "SNAP-LOCK" fingers engage edge of hole in panel and lock holder securely in place.

The new BUSS "SNAP-LOCK" fuseholder can be used in panels .025 to .085 inch thick. (See recommended mounting hole in dimensions below).

The BUSS "SNAP-LOCK" feature is available on the following BUSS fuseholders:

to take ¼x1¼ inch fuses:

Symbol HTA-00, Space Saver, extends just 1 in. behind panel.

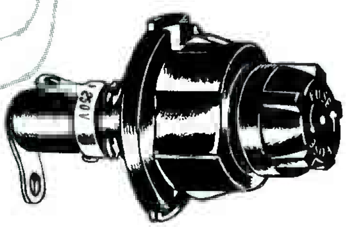
Symbol HLD-00, Visual Indicating Fuseholder.

Symbol HKP-00, Standard Fuseholder.

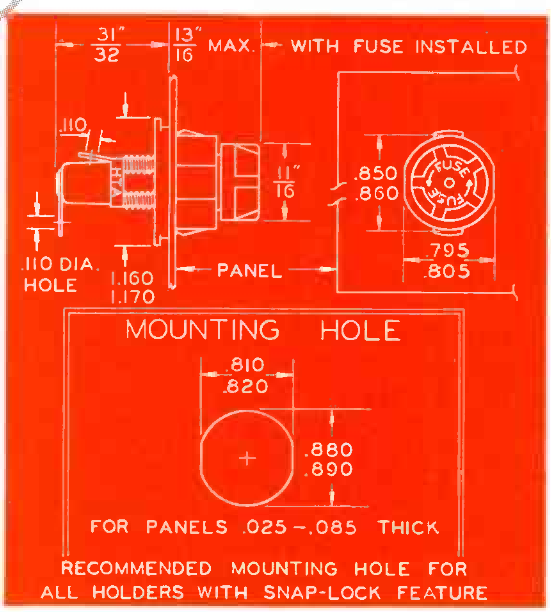
to take ¼x1 inch fuses:

Symbol HJM-00, Standard Fuseholder.

All are available with quick connect terminals, if so desired.



HTA-00 Fuseholder-actual size



Dimensions of HTA-00 holder.
When tooling up for mounting get latest blueprint.

Also fits ½ in. knock-out in electrical boxes

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FUSES

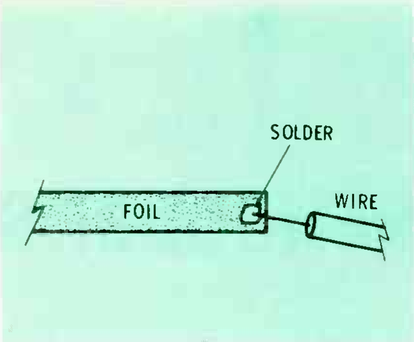

Fig. 3 Don't solder the wire to the foil as shown here, but use approved-type connectors, otherwise breakage can occur.

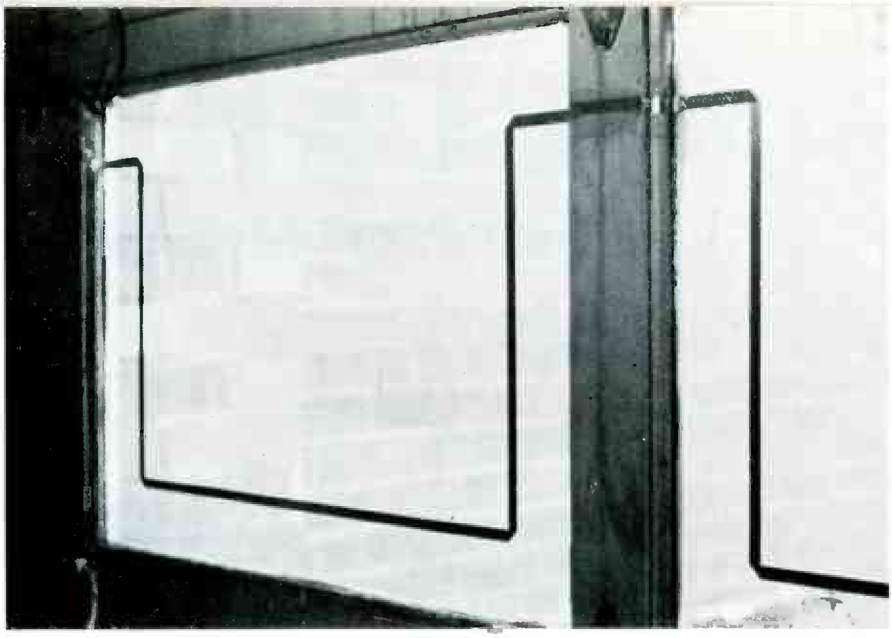

Fig. 4 An example of correct installation of foil. Connectors with flexible wires are used to connect together the segments of the door.

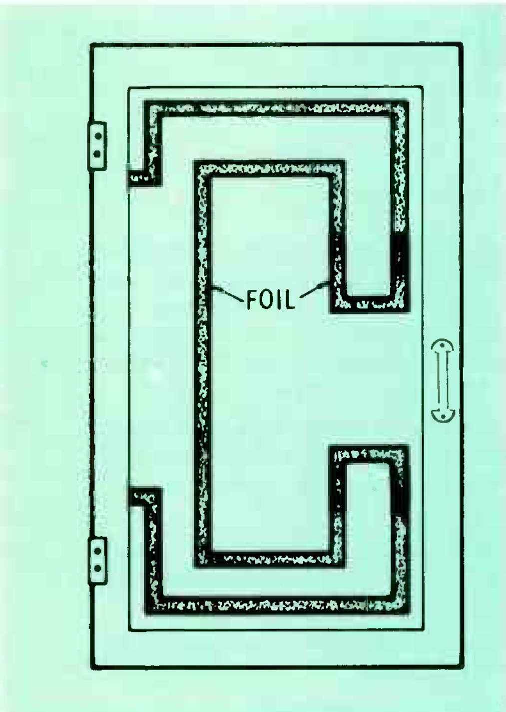

Fig. 5 Don't install window foil near handles or locks where it can become worn or damaged.

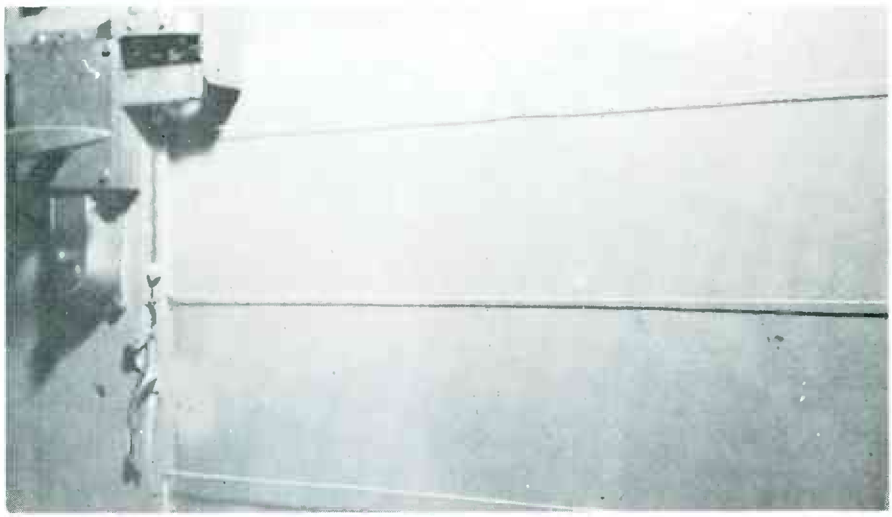

Fig. 6 Small-diameter insulated wire can be strung around the panels of a door for protection against forced entry. However, the wires can be damaged when left exposed.

will apply a very small voltage to the circuit under test. This will permit resistance and continuity tests in solid-state circuits without causing transistors to conduct. A good transistor tester is also very helpful.

When you're working on audio and ultrasonic systems, an oscilloscope is very helpful. The requirements for such a scope are not severe and a scope that is satisfactory for TV servicing is more than adequate in most cases.

Microwave systems sometimes require the use of a field-strength meter, but it needn't be anything elaborate. A simple field-strength detector can be built with a diode and a 20,000 ohms per volt VOM. Such a circuit is shown in Figure 1. The frequencies used by microwave systems—the FCC calls them Field Disturbance Sensors—are given in Table 1.

False Alarms

By far the most common complaint with intrusion systems is the false alarm; and the most common cause of a false alarm is a poorly installed or maintained system. The false alarm is the most common complaint because it very loudly calls attention to itself. When a businessman is called out in the night to shut off a noisy alarm, he is anxious to have the trouble corrected as soon as possible.

Another reason for false alarms is that most intrusion alarms are designed to "fail safe". That is, when something goes wrong the preferred result is that a false alarm will occur rather than leave the premises unprotected.

Still another reason that false alarms are more common is that many people simply do not check their alarm systems.

As stated before, the most common cause of false alarms is poor installation or maintenance. In fact, it might be said that the difference between a reliable alarm system and a troublesome one is money. If a business is willing to pay the

Fig. 7 Plywood or pressed wood should be installed over the wires on a door to protect against damage to the wires.

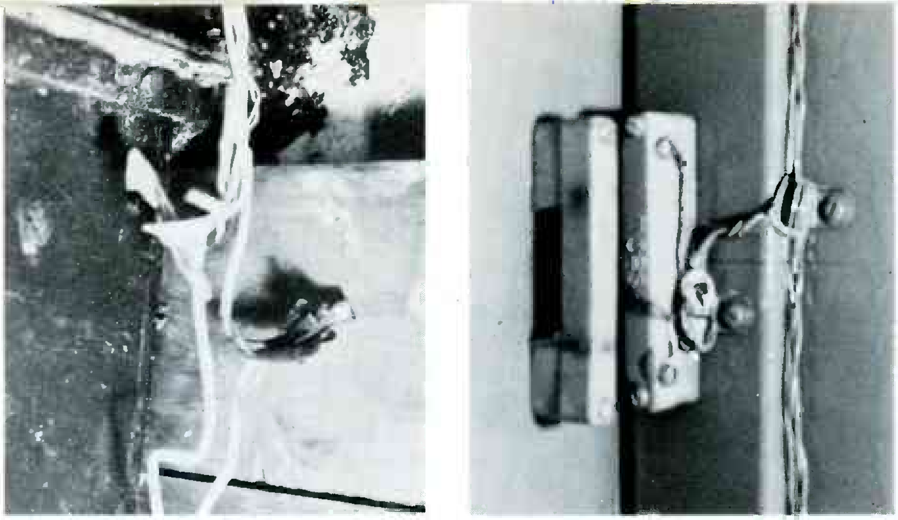

Fig. 8 Neat wiring is usually dependable wiring. **Left,** "Rats-nests" like this should be avoided, because they can cause erratic operation. **Right,** one example of good wiring.

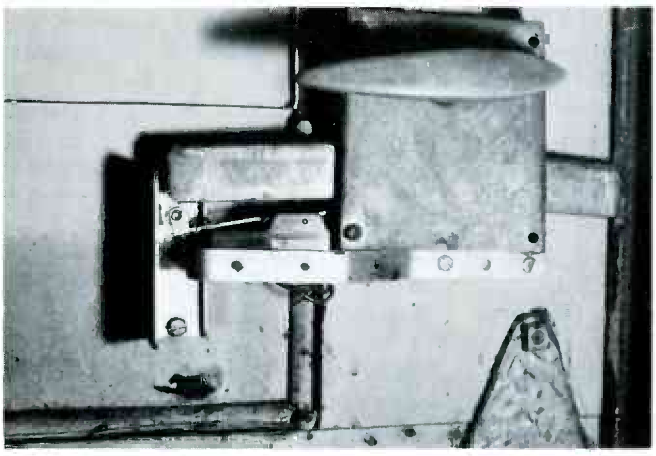

Fig. 9 Because it had been disconnected and the wires shorted together, this micro-switch failed to give an alarm when the door was forced.

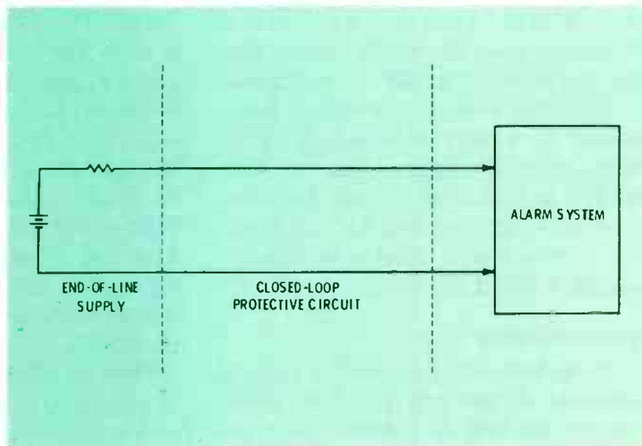

Fig. 10 By placing the power supply at the end-of-the-line, both shorts and opens in the system trigger the alarm.

price, they can get a reliable alarm that will detect intruders without causing unnecessary annoyance.

Probably the most common type of alarm is one that uses conductive foil on windows. This foil is very thin and delicate and if improperly applied, will inevitably cause trouble. A window foil installation with holes in the foil will soon lead to failure (Figure 2).

Before foil is applied, the glass surface must be clean. Secondly, the manufacturer's instructions as to the type of adhesive and method of application must be followed closely. The next principle that should be followed in the use of foil is to use the proper connectors. Very frequently to save money, the foil is soldered directly to a wire as in Figure 3. This is almost always a potential trouble spot. Figure 4 shows foil properly applied with connectors designed specifically for the purpose.

The location of foil also is important. It must not be applied where it normally will be rubbed against by people entering and leaving a building. Foil should not be applied near to a door handle, but should be routed where a broken glass would be likely to cut the foil (Figure 5).

Wooden or metal doors are usually protected by stringing a small wire along the inner surface of the door as pictured in Figure 6. This arrangement easily can result in accidentally broken wires. The wires should be protected by a piece of plywood or wallboard (Figure 7).

The wiring of the system should be properly installed. Figure 8 shows a "rats-nest" of wiring that was found in a system notorious for false alarms. To make the system reliable, the entire mess was pulled out and replaced with neat, firmly anchored wiring as shown also in Figure 8.

More-sophisticated systems are subject to more-sophisticated causes of false alarms. Ultrasonic alarms may be triggered by sounds from ventilators, air conditioners and heaters. Microwave systems frequently are triggered by moving metal objects such as fan blades, or venetian blinds.

Whenever a false alarm is not caused by one of the more obvious conditions described above, it must be tracked down. The first step is to know as much as possible about the conditions that prevailed when the false alarm occured. These conditions include weather, inside temperature, line voltage and any unusual condition in the immediate vicinity.

Knowledge of the weather conditions will help rule out noise from thunder, or surges from lightning. Temperature may also give a clue to the cause of a false alarm. Leakage in solid-state components is aggravated by high temperatures, and alarm systems are often mounted out of reach near the ceiling where the air is warmest.

High line voltage can cause false alarms in a very subtle way. The alarm may not trigger when the line voltage is high, but it may become unusually sensitive and be triggered by something that normally wouldn't affect it.

Troubleshooting

Troubleshooting an alarm system basically is not any different than troubleshooting any other piece of electronic equipment. Perhaps the greatest difference is that in most cases the difficulty is not in the electronics, but in the associated wiring, switches and circuits. Figure 9 shows a magnetic door switch located on a door that was forced open without triggering the alarm. The trouble is obvious. At sometime the switch, which was mounted on a metal door, must have given trouble, because it was actually shorted out of the circuit as shown.

Checking the wiring of an intrusion alarm is largely a matter of continuity checking. Many systems use an end-of-line supply (Figure 10) so that the alarm will be triggered if the wiring of the protective circuit is either opened or shorted. An alarm of this type is checked easily by shorting the protective circuit at various points along the system.

Although not as common, there are obviously cases where the trouble is in the alarm itself and not in the wiring. To locate trouble in such a unit, the schematic diagram should be available. With the diagram, the circuit can be checked, one component at a time. As pointed out before, the circuits usually have few components and for this reason, it doesn't usually take much time to check all of them. The additional effort usually pays off in a reliable system.

Automatic Telephone Dialers

A very popular form of alarm device is the automatic telephone dialer. This device will automatically dial the police department and play a recorded message in the event of an intrusion. One reason for their popularity probably is because many businesses are located where a local alarm (such as a bell) would not be heard by anyone. The use of leased private lines is expensive, but with an automatic dialer, regular telephone lines can be used.

Next to window foil, the automatic dialer is probably the most common cause of false alarms. In one large city, the police department recently reported that 98% of the calls they received from automatic dialers were false alarms. In another city a popular-type dialer triggered a false alarm when power was restored after a power outage. On one such occasion, after a general power failure, several of these dialers started calling the police department at the same time, completely paralyzing the police department's telephone switchboard.

Because of cases similar to this, many cities have passed ordinances governing the use of automatic dialers. Most of these require that the dialer must be an approved type, and that a separate block of telephone numbers is set aside for use with dialers. Thus, if several dialers went wild at the same time, only the special telephone numbers would be jammed. The regular police lines would not be affected.

The two best friends of the technician servicing automatic dialers are the local police department and the telephone company who has tariffs governing their use. Next comes the manufacturer who is not anxious to have his product outlawed in any particular locality.

With the manufacturer's data available, servicing usually presents few difficult problems.

Checking the System

The real test of an intrusion alarm is whether or not it will catch an intruder. Regardless of the principle on which it operates, the alarm **must** sound if an intruder enters the premises.

Most common is the so-called "walk through" test. Here the technician stealthily tries to enter the protected area in the way that a burglar might. He walks through all parts of the building, trying things like crawling under or scaling the protected areas.

Once it is established that the presence of an intruder most probably will trip the alarm, it must be proved that nothing else is likely to do so. Every appliance and machine that might operate when the alarm is in service must be turned on and any influence noted.

The owner of an intrusion alarm must be convinced that the reliability of his system depends upon proper installation and periodic checking. □

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For More Details Circle (14) on Reply Card

Servicing SCR-deflection systems part 3

By Bruce Anderson

Using general-replacement capacitors can speed repairs...but when the circuit is SCR deflection, this practice often adds more problems to the original ones.

Beginning with the RCA CTC48 chassis, an important change of the pincushion and horizontal linearity circuits was made. Earlier chassis had these components connected in series with the yoke. Later they were wired in parallel with the flyback transformer. Although there are several reasons for the change, the resulting improved reliability is the one of interest to us.

In part 1 of this series, the older circuit was shown, and it also was explained that opens in the yoke circuitry (which included the pincushion components) generally cause destruction of either the SCR's, or the diodes associated with them. Connection of the pincushion and linearity components in parallel with the flyback (Figure 1A) eliminated most of the possibilities for opens in the yoke circuit. Opens in the parallel path provided by the combined top/bottom and side pincushion transformer, T405, will not cause failures of the SCR's, since the yoke circuit is most of the load, and it remains intact.

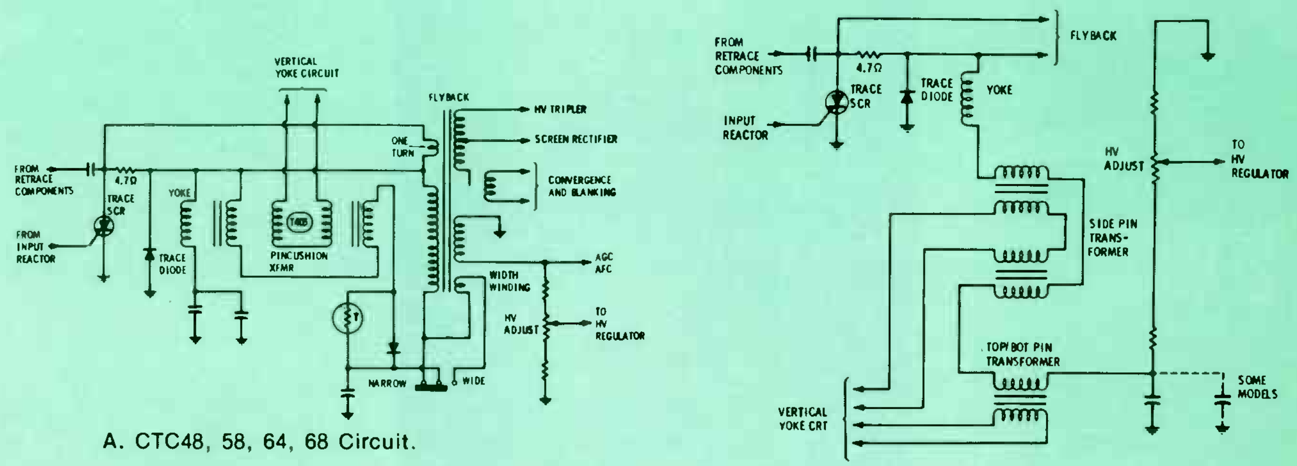
In servicing the system, it is convenient for us to eliminate the pincushion transformer and the linearity diode, CR406, simply by disconnecting them. In the earlier chassis, CTC40, 44, 46, 47, and 54, (Figure 1B) they can be eliminated by connecting a jumper across the circuit from the low end of the yoke to the top of the yoke-return capacitor. **Be careful not to confuse the procedures for the two groups of chassis.**

Circuit Operation

At first glance, it is hard to see how the parallel-connected pincushion transformer can do anything. Indeed, it could not function properly without the interaction of the regulator circuit. As we shall see, failure of the regulator causes loss of pincushion correction; however, there probably will be other symptoms.

Beginning with the CTC48, the regulator receives its sample voltage from the flyback transformer, rather than from the yoke. The regulator holds constant the **pulse voltage amplitude** by controlling the amount of power supplied to the deflection system (see Part 2, July issue).

Now consider what happens as the vertical-deflection current changes the impedance of the pincushion



A. CTC48, 58, 64, 68 Circuit.

B. Earlier chassis.

Fig. 1. Pincushion correction and regulator connections in SCR-deflection receivers.

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For More Details Circle (15) on Reply Card transformer. As the impedance of T405 increases, there is less shunt loading on the flyback, so the pulse amplitude to the regulator tends to increase. Immediately, the regulator reduces the input power to the system. Since there is less total power available under these new conditions, the yoke circuit is "starved" and the width is reduced. This, of course, provides the pincushion correction that is needed. In other words, the pincushion transformer and regulator components function by controlling the division of energy between the yoke and the flyback.

Width Control

These later chassis also are equipped with a width control of a different type. (In some runs of earlier chassis, a variable inductor was connected in series with the yoke to provide width control.) In the CTC48, the control consisted of a jumper wire which had to be unsoldered and moved to another stake to change the width. In the CTC58, 64, and 68, a switch is provided. (See Figure 1B.)

The width winding is a single turn on the flyback transformer, similar to the filament winding in tube-type receivers. First, assume the connections are made so this winding is out of the circuit. The regulator controls the input power to the system, providing nominal yoke current when the high voltage is adjusted to its design potential.

Now, suppose the single-turn winding is connected into the circuit so that it "bucks" the rest of the flyback primary windings. Without a regulator, this would decrease the flyback output, but the flyback output is returned to the original amplitude because the regulator allows more energy to enter the deflection system. The additional energy increases the yoke current, thereby increasing the width of the raster.

It is possible to make the raster more narrow than normal by reversing the leads from the single-turn flyback winding. This winding "boosts" the flyback output, causing the regulator to decrease the input energy and, ultimately, to reduce the yoke current. It is unlikely this modification will ever be necessary, and the possibility is mentioned here only to help explain the operation of the circuit. If excessive width is encountered, it is likely the regulator is not working correctly, and this should be investigated, rather than toying with the width-control circuit.

Caution

Another precaution about the width circuit is important. In the CTC48, soldering is required to change the width, so it is unlikely that anyone would make the adjustment with the set turned on. In the CTC58, 64, and 68, the switch **can** be moved with the set turned on, although the back must be removed for access to it. **DO NOT MANIPULATE THE SWITCH WITH THE SET TURNED ON**. This will momentarily open the flyback circuit, and it might cause extensive damage to the deflection components.

Pincushion Correction in Portables

The CTC49 and 59 portable receivers use 110°-deflection picture tubes, and they require considerably more side-pincushion correction than is available from a passive transformer. Again, the regulator circuit is called into action to provide this correction, as shown in Figure 2.

A sample of the vertical-deflection current is used to control conduction of the pincushion transistor, Q402. The collector current of this transistor drives the base of the regulator transistor, along with a current sample from the horizontal-yoke circuit. Therefore, the regulator is modulated by the vertical-deflection current.

The regulator in these chassis controls the amount of energy to the flyback and the yoke. This feature allows the vertical-deflection current to continuously vary the width of the raster, correcting pincushion distortion.

Miscellaneous Servicing Notes

Back in the "good old days" when television receivers were much less sophisticated, defective parts could usually be replaced satisfactorily with approximate-value substitutes. If a 52K resistor was needed, for example, and a 47K was the closest value at hand, it probably would do the job. Capacitors generally would substitute as long as the capacitance and voltage ratings were comparable to the original. **Those days are rapidly ending.**

Safety regulations and radiation limits have made it necessary to replace many components with exact replacement parts to maintain the integrity of the receiver. This, of course, increases our cost of doing business...a cost that must be passed on to the customer.

In many routine instances, the technician can save a lot of time otherwise spent in chasing parts by making a non-approved substitution, just to see if the mal-

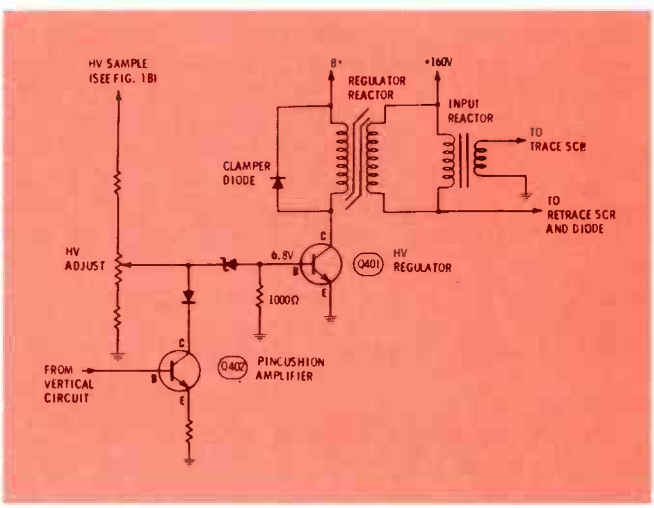


Fig. 2. Simplified side-pincushion circuit used with 110° CRT's.

function can be corrected. If it works, he can obtain the exact replacement and install it with confidence that no additional service is needed.

With the SCR-deflection system, this time-saving trick usually produces a lot of extra grief. In many cases, what appears to be a reasonable substitute simply won't work.

Hot capacitors

One of the most mystifying examples is the capacitor (C406) between the trace and retrace SCR's. Figure 3 shows its location in the circuit. However, the capacitance varies among the chassis. On the surface, it would seem that most any capacitor of the right value would do as a replacement...but hold on a second! It takes about 100 watts to power the yoke and high-voltage circuits of these color receivers, and all of that energy has to go through this one capacitor.

Ordinarily, we think of a capacitor as a reactive device which is incapable of absorbing power from the circuit. But, when the low-voltage and high-current power required to supply 100 watts is passed through this little "cap", its normally insignificant internal resistance becomes **very** important. Put a run-of-the-mill capacitor here and it will promptly overheat. As a matter of curiosity, we tried several off-the-shelf capacitors in this circuit and watched most of them overheat and short in as little as a couple of minutes. A few lasted for an hour or more. If we hadn't been expecting it to happen, we could have spent a lot of time trying to fix a fault which didn't exist at all.

The capacitors which return the yoke and the flyback to ground are less critical, but not by much. Here again, the currents are quite high, and most capacitors simply are not designed to have sufficiently-low resistance for these applications. The auxiliary capacitor, C407 of Figure 3, is another in the same category.

SCR's and diodes

The SCR's and diodes in Figure 3 also are of critical characteristics. It was mentioned before that they cannot be interchanged within a chassis, nor can it be assumed that a SCR or diode from one numbered chassis will work in another numbered chassis, even though the function is the same. A critical specification of the SCR's is their turn-off times. This is the time required for them to return to a stable "off" mode after conduction has stopped. Install the wrong SCR and it might go back into conduction even though the gate is turned off. A wrong diode might not have fast-enough turn-on time, making the circuit inoperative, and possibly causing more trouble.

Open filter

Another mysterious problem develops from poor filtering. Some additional ripple in the B+ isn't particularly harmful in itself, but if C104B of Figure 3 opens, we'll have an altogether new circuit. Without this capacitor (or with a large decrease of capacitance) the filter choke, L101, is effectively in series with the input reactor, T401. This changes the resonant frequency of the input circuit and makes the deflection system inoperable, no raster and no picture. Above-normal capacitance in C104B won't disturb normal operation, so it is OK to bridge it with another capacitor as a test.

Height

In the CTC62 only, voltage for the height control is obtained by rectification of pulses from the flyback transformer. This voltage is regulated to 27 volts by a zener diode. The circuit is simple, but the symptoms it can produce are not. An overload in the deflection system might load down the flyback so this voltage sags below the point of regulation, and causes a decrease in height. A short raster is a definite symptom, so it is easy to tackle this problem while ignoring the reduced high voltage. Save an hour or two by checking the horizontal system first.

Yokes

Impedances of the yokes used with all the SCR-deflection console chassis earlier than the CTC48 (CTC40, 44, 46, and 47) are approximately the same, and any yoke from this series may be used in a test jig to accommodate these chassis. (The socket adapters and convergence-board bypasses needed are specified in the service data for each chassis.) However, later chassis, CTC48, 58, 64, and 68, use a yoke having considerably lower impedance. If one of these later chassis is connected to an early-model yoke, the result is excessive scan and high voltage. Also, the increased high voltage may cause the hold-down circuit to operate, throwing the horizontal oscillator off frequency.

(Continued on page 37)

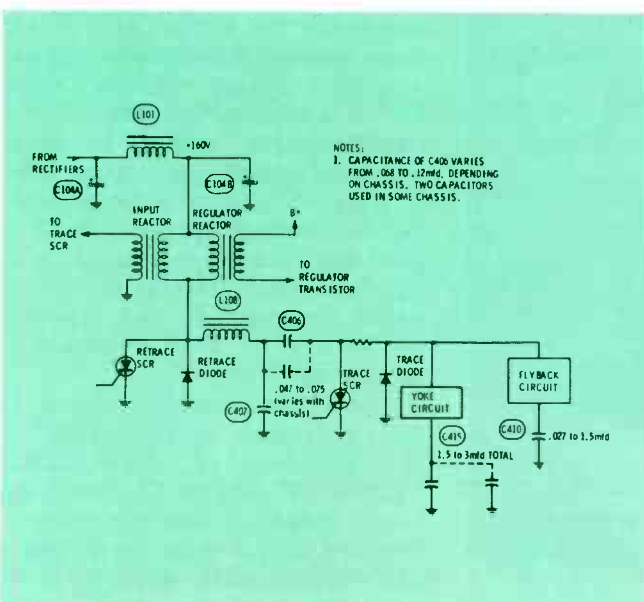


Fig. 3. Location of critical capacitors.

ADVANCED SERVICING FOR CB RADIO

part 3

By Forest H. Belt

Solving some receiver quirks, and suggestions for interconnecting instruments for quick testing wrap up this profit-oriented series.

Most technicians feel they understand receivers of just about any kind. They're justifiably frustrated when a seemingly simple CB receiver repair turns into an afternoon's fiasco. Difficulties like this fall into a few repetitive categories. They relate to sections of the set and to measurements with which the average technician is not familiar.

Here are some examples:

- the squelch circuit (particularly in a single-sideband receiver where there's no carrier to overcome the squelch);
- the sideband demodulator (there's a quick and simple way to test and adjust it); and
- the frequency synthesizer (there's also a quick trick to make sure it's right).

The noise blanker is easily misunderstood, and therefore is misadjusted again and again. You need to understand receiver sensitivity, squelch threshold, and audio power-output measurements to service CB quickly, successfully, and profitably.

So...let's dig into these receiver oddities. They are different from anything you encounter in TV or ordinary radio repairs.

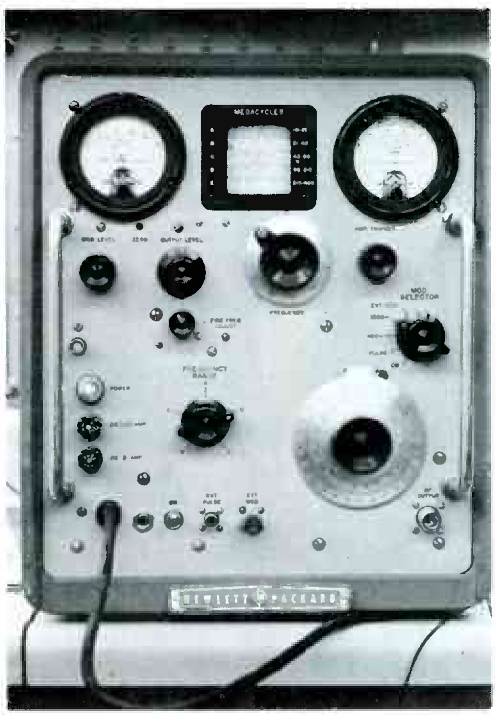


Fig. 1 Signal generators for profitable CB testing must be right on-frequency. An external counter can tell when the output frequency is correct, but only the inherent stability can keep it accurate. Inset shows calibrated microvolt dial needed for sensitivity tests.

Measuring Receiver Sensitivity

Right off the bat, this one measurement tells you many things about the overall operation of a communications receiver. That's because so many parts of the receiver are involved.

Start by setting the bench power supply for the correct DC or AC input voltage. If the transceiver has a variable voltage regulator, make sure it is adjusted properly. At the receiver output, connect an audio wattmeter. Many transceivers have a jack or terminal strip for connecting an external speaker; that's a good place for the wattmeter. In a pinch, use a voltmeter across an 8-ohm dummy load and calculate the watts ($P = E^2/R$); but this is not the quick way.

The signal generator (Figure 1) must be warmed up and stable. Set the frequency at 27.105 MHz, which is CB channel 12. Verify the output frequency with your counter. The test signal must be accurate and holding fairly close. (Periodically recheck and correct the signal generator frequency throughout any

Fig. 2 To find squelch sensitivity, you turn the Squelch control just past its threshold without signal. Then measure how much RF signal it takes to "crack" the squelch and let the audio through.

alignment procedure.)

Set the 1000-Hz modulation of the generator exactly for 30%. If you must, use your audio generator to supply the 1000-Hz modulating signal.

Turn the channel selector of the transceiver to 12. Attach the generator output lead to the transceiver antenna connector. Turn the receiver squelch control fully counterclockwise, and the volume control up slightly so you can hear receiver noise or the generator signal. Now turn the generator output control as low as possible, so no signal enters the receiver.

Adjust the receiver volume control for an audio power reading of 0.15 watt. Be sure no signal from the generator contributes to this receiver noise reading. Leave the volume control at that setting for the rest of this measurement.

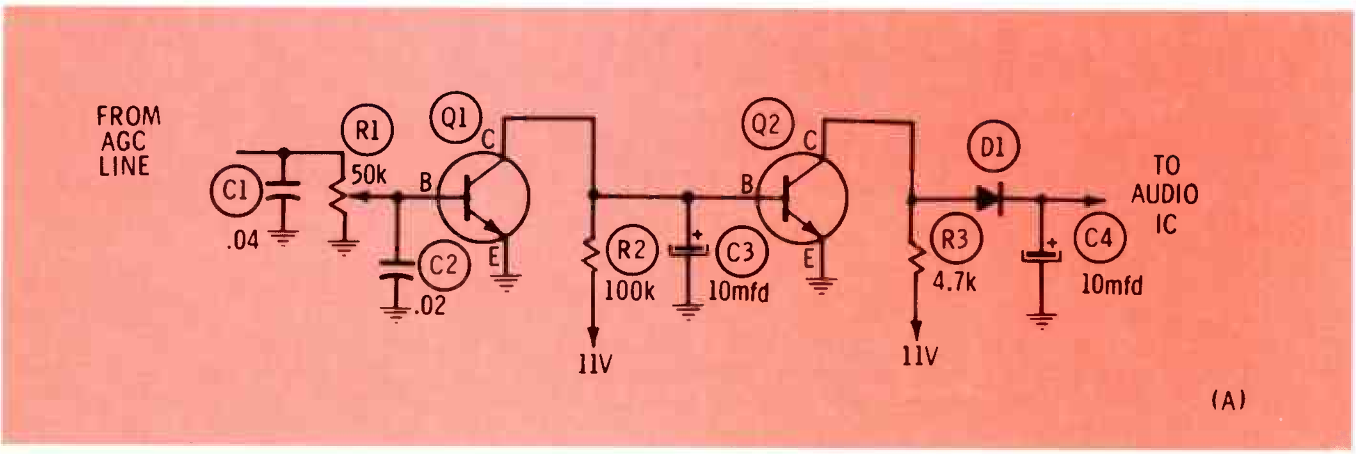
Advance the output control of the signal generator. You should hear the 1000-Hz sound if you've left the speaker connected. The wattmeter reading should begin rising. Turn up the generator control until the wattmeter indicates 1.5 watts of audio output. (Just for insurance, recheck the generator frequency with the counter.)

The first reading—0.15 watt—is a **noise** reading. The second—with the generator turned up—is a **signal-plus-noise** reading. You have deliberately advanced generator output just enough to cause a signal-plus-noise reading that is exactly 10 dB **over** the noise-alone reading. (A 10:1 power ratio equals 10 dB.)

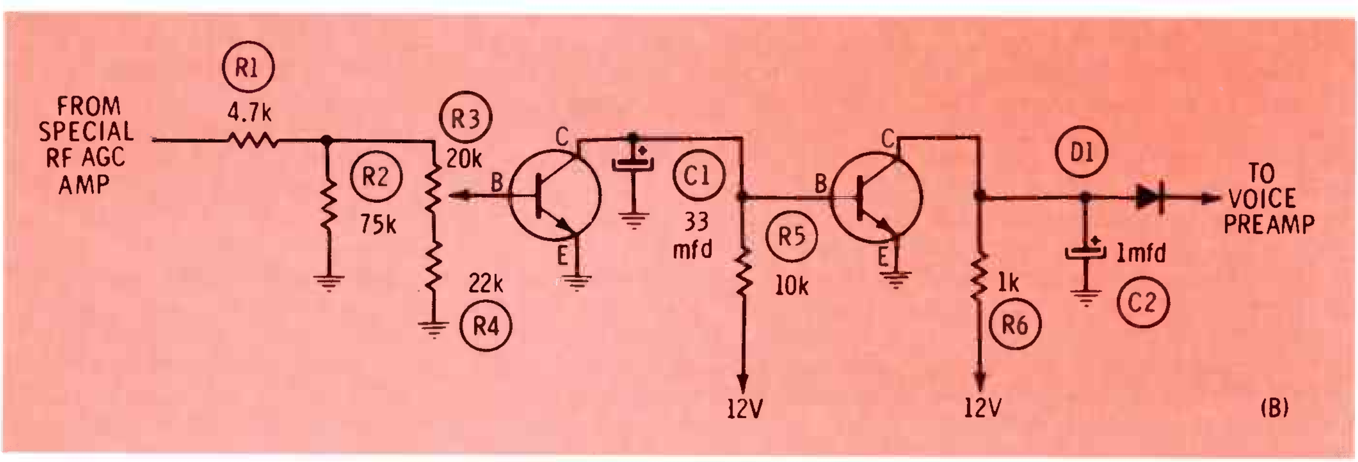
You can read the sensitivity of the receiver off the calibrated output attenuator of the signal generator (inset of Figure 1). If the attenuator dial reads 0.25 μV, that's the receiver sensitivity at the common AM-receiver reference of 10 dB S+N/N (read that "ten decibels signal-plus-noise over noise").

Most CB receivers have a sensitivity better than 1 μV at 10 dB S+N/N. The less signal it takes to produce the 10 dB change, the

Fig. 3 Squelch stages fall into two categories. Only the noise-operated kind is popular in single-sideband CB receivers. An audio-operated version (not shown) is used by one manufacturer.

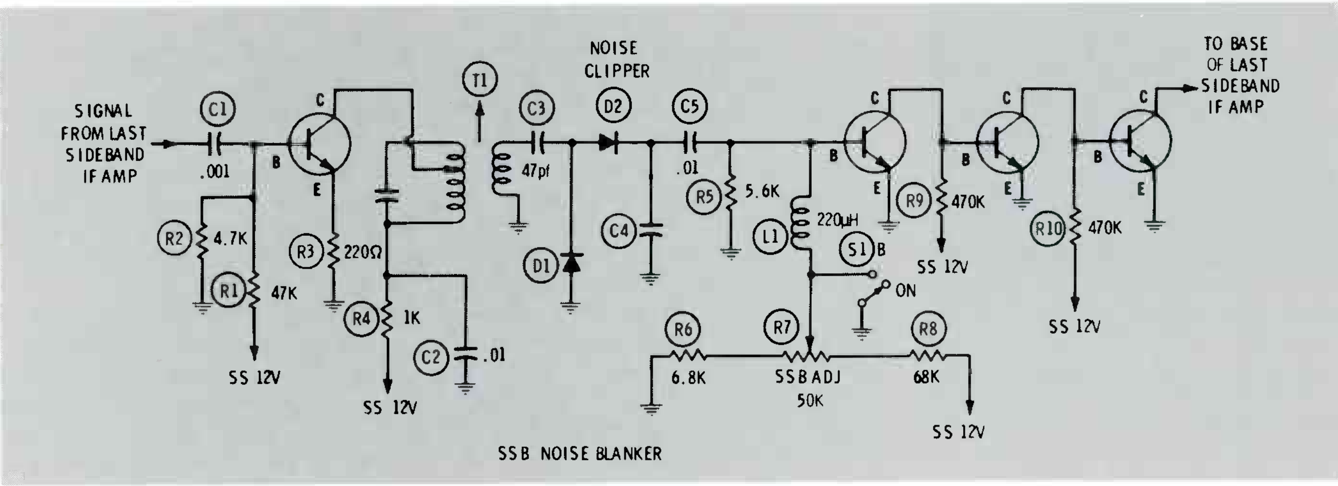


(A) Simplest squelch operates from AGC.

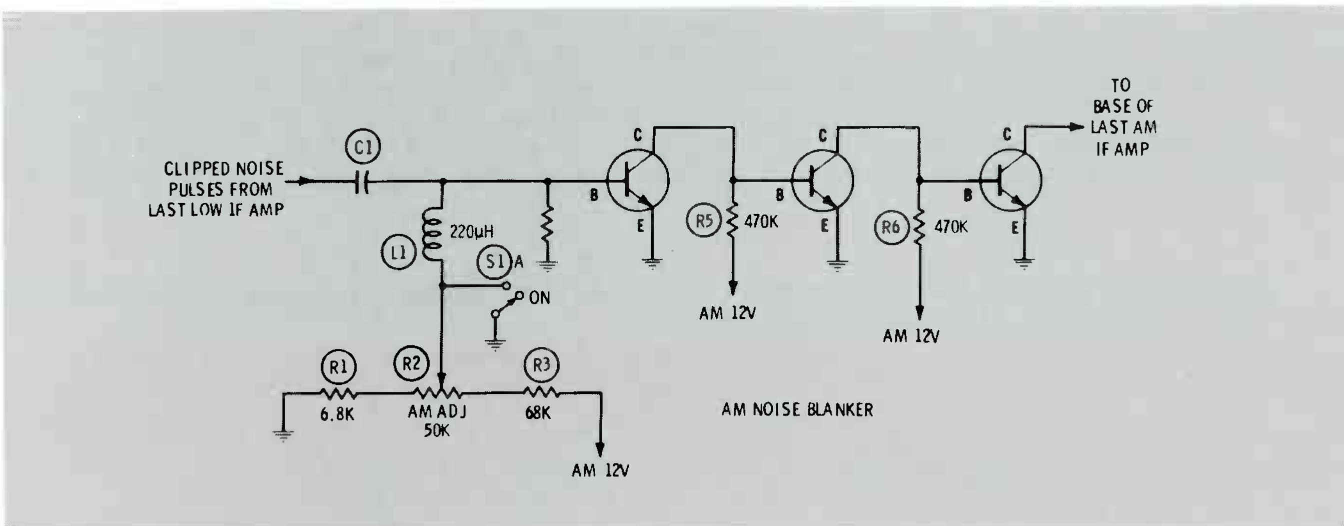


(B) DC from RF stages operates this squelch.

Fig. 4 Noise blanker system in most CB schematics is shown only as a "black box". These schematics show what's inside one type.



(A) For AM portion of receiver.



(B) For SSB portion of receiver.

greater the receiver sensitivity. (A few manufacturers use a 6 dB S+N/N evaluation, to make the sensitivity seem better in the sales literature.) If the required signal is more than a microvolt or so, the receiver needs alignment or other attention.

Audio Power Capability

While you're hooked up, you can measure the audio power output of the receiver. Advance the generator output control until the wattmeter reading stops rising. Then turn the receiver Volume knob wide open. The maximum wattmeter reading is the power capability of the audio system in this receiver.

If receiver sensitivity was poor, correct that before you make the audio output test. Most receivers can provide about 1.5 watts of audio power when the input signal has sine modulation of 30%. Some, designed for alternate use as a loudhailer, offer power output up to 5 watts. About 3 watts is common. Check the manufacturer's specification.

About Squelch Sensitivity

While you have the generator hooked up, you may as well check squelch operation. Turn the generator output control back to zero. Recheck to make sure the frequency is still accurate. Turn the volume control back down to a comfortable listening level.

Now rotate the receiver Squelch knob (Figure 2) slowly until the receiver noise is blocked off. Don't turn the knob any further. Then bring up generator output slowly, until the squelch breaks open and you can hear signal from the generator and noise. The generator output dial now indicates **squelch threshold sensitivity.**

Opening the squelch should take somewhat less generator signal than the 10 dB S+N/N measurement. If the regular sensitivity of a CB receiver is, say, 0.5 μV, then the squelch should open up somewhere in the vicinity of 0.3 μV. Extremely sensitive receivers may open squelch at 0.1 μV or less of signal. Any discrepancy in this relationship signifies trouble in the squelch system.

Two squelch systems (Figure 3) are common in CB radios. One operates off the main AGC. A DC amplifier cuts off the audio stage while the receiver is receiving nothing. When a signal comes in, the AGC voltage rises. That alters bias on the DC amplifier, which then allows the audio stage to work.

Single-sideband transmitters put out no carrier. They don't cause any significant change in AGC when the receiver picks up a SSB signal. A special kind of squelch takeoff operates from an RF-only AGC system in many single-sideband receivers.

If you compare Figure 3B with Figure 3A, you'll recognize almost no differences. Only the input source for activating the squelch system has changed. But you should take careful note of that change whenever you have to troubleshoot a squelch problem.

If more signal is required to open the squelch than to give the 10 dB S+N/N reading, the trouble is in the squelch system itself. The squelch DC amplifier might be operating off its normal curve, or you might have diode leakage.

Troubleshooting requires that you keep these base characteristics in mind: (1) It takes incoming voltage from the AGC system—whatever kind it is—to keep the audio stage squelched when you turn up the Squelch knob. So, inability to squelch the audio noise may come from not enough gain in the RF or IF system; squelch may seem "sloppy". It also can come from a fault in the squelch/audio interface. (2) If an incoming signal can't **unsquelch** the audio, or if too much RF signal is required, suspect first the squelch/audio interface. Then work your way back toward the start of the squelch section, to discover what's working overtime.

Fig. 5 "T" connector and feedthrough make connections between pulse generator and signal generator for testing effectiveness of noise blanker. Lacking a pulse generator, you can substitute the noise pickup from a piece of wire placed near the running engine of an auto.

Occasionally, you'll discover that DC from the AGC section isn't even reaching the squelch takeoff point.

How A Noise Blanker Works

Few CB manufacturers show on their schematic diagrams what the noise-blanking system contains. Usually, it's just a "black box" in the RF or IF system.

What the blanker does is simple enough to outline. When a sharp spike of noise accompanies the signal, such as with auto ignition, circuits inside the blanker issue a brief opposition signal. That, applied to the RF (or IF) bias arrangement, reduces gain of the amplifier(s) momentarily. Once the pulse has passed, the RF (or IF) section continues as usual to amplify the incoming signal. The fast-acting noise blanker does this job quite unobtrusively.

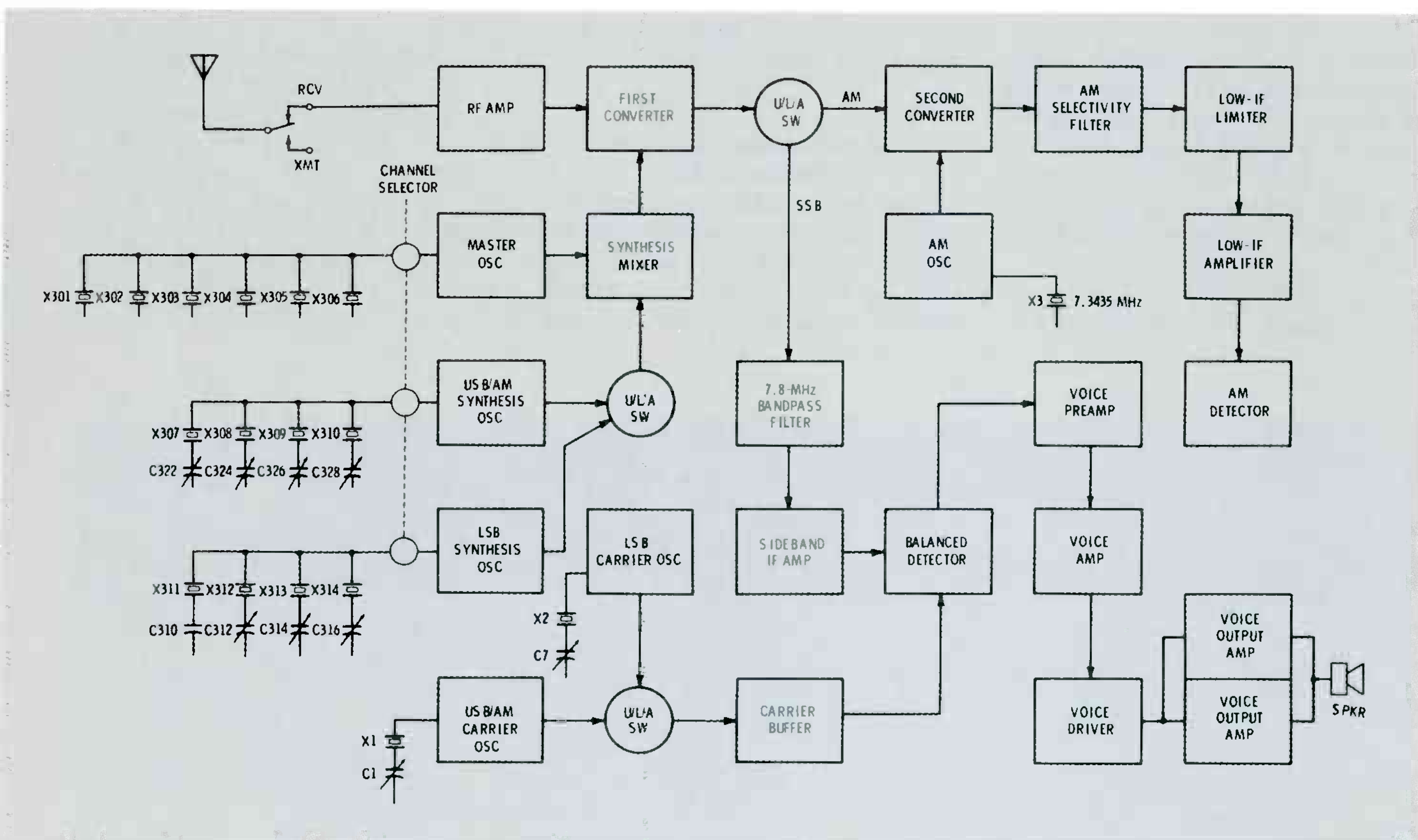


Fig. 6 Frequency synthesizer for reception is the same one used for transmission, and frequencies developed are the same. An extra crystal converts the high-IF signal to low IF (455 kHz) for AM reception. SSB is always single-conversion in CB sets.

Trouble arises when the blanker system itself becomes maladjusted for some reason. The symptom takes one of three forms. (1) The blanker just cuts off the RF or IF section, blocking all signals. (2) Gain of the section goes 'way down, giving a very poor (100 µV or more, sometimes) sensitivity measurement. (3) Noise doesn't trigger the blanker, and slips right on through. The last symptom is hardest to spot, because without noise the receiver seems to operate properly. Only after you've heard the noise-quieting effect of a correctly-operating noise blanker can you recognize when the "black box" is inoperative.

Setting the blanker in Figure 4 isn't difficult, but it is very critical. Start with the receiver set to pick up AM signals. Either short the antenna input jack to ground or at least attach your dummy load. The object is to have absolutely no RF signal entering the receiver.

Turn on the blanker switch (it isn't switchable in some transceivers). Find the AM blanker adjustment—usually a pot (R2 in Figure 4A). Keeping squelch open, and volume turned up enough to hear RF circuit noise, turn the AM Adjust until you notice a slight reduction of natural receiver noise. This is caused by the blanker trying to operate on circuit noise rather than on incoming noise. Back off the adjustment slightly. You don't want the blanker activated by anything but noise from outside the receiver.

You adjust SSB blanking separately (Figure 4B). Connect a DC voltmeter at the junction of the D2 and C4. Make sure the blanker switch is off. With an accurate signal fed into channel 12 of the receiver, adjust T1 for maximum DC voltage. Remove the meter.

Remove the signal from the generator. Turn the SSB Adjust pot until the receiver's natural noise just starts to be quieted. Then back off the control enough that there's no tendency for receiver noise to actuate the blanker.

Verifying noise-blanker operation on the bench requires a pulse generator with very sharp (short-duration) pulses and a slow repetition rate. Connect it and the RF signal generator in a mixing "T" such as illustrated in Figure 5. Feed both to the receiver.

Leave the blanker switch turned off. Turn up enough RF signal to quiet the receiver slightly. Then turn up the pulse generator till you begin to hear the impulse noise (it sounds something like ignition noise from an automobile). Turning on the blanker switch should kill the pulse noise altogether. (You can even see these spikes in the output, on your scope, if you set the time base and triggering to operate at the repetition rate of the pulse generator. They'll appear as spikes sticking up above the RF.)

Synthesizer and SSB Demodulator

Why group these together? Because they have one characteristic in common, when you're dealing with the receiver. It's this: Forget them, if you've already serviced and adjusted the transmitter. In all 23-channel transceivers that use frequency synthesis, the synthesizer operates the same for receiving as for transmitting. The only change for receiving involves rearrangement of other sections and the addition—for AM reception—of another crystal oscillator (to beat the high-IF signal down to 455 kHz).

In case you don't understand this, examine the block diagram in Figure 6. Several of the stages are identical with those in Figure 8 of the second installment in this series. The AM second oscillator has been added. For AM reception, the 7.3435-MHz signal mixes with the 7.7985-MHz double-sideband (AM) IF signal producing 455 kHz.

The other frequency-determining arrangements remain essentially the same. If the transmitter is on-frequency, so is the receiver. Merely verify that 7.3435-MHz crystal with your frequency counter.

And the sideband detector? Compare the diagram in Figure 7 with Figure 9 in the second installment. They are exactly the same stage, only operating in reverse. The stage diagramed here accepts (a) the single-sideband IF signal near 7.8 MHz, and (b) a CW signal at 7.8015 or 7.7985 MHz, depending on which sideband is to be demodulated. The output of this balanced demodulator is the original voice signal, with IF signals canceled.

No adjustment is required for receiving. When you balanced the stage for transmission, you also balanced it for reception. So, when servicing the receiver, forget this stage and the synthesizer.

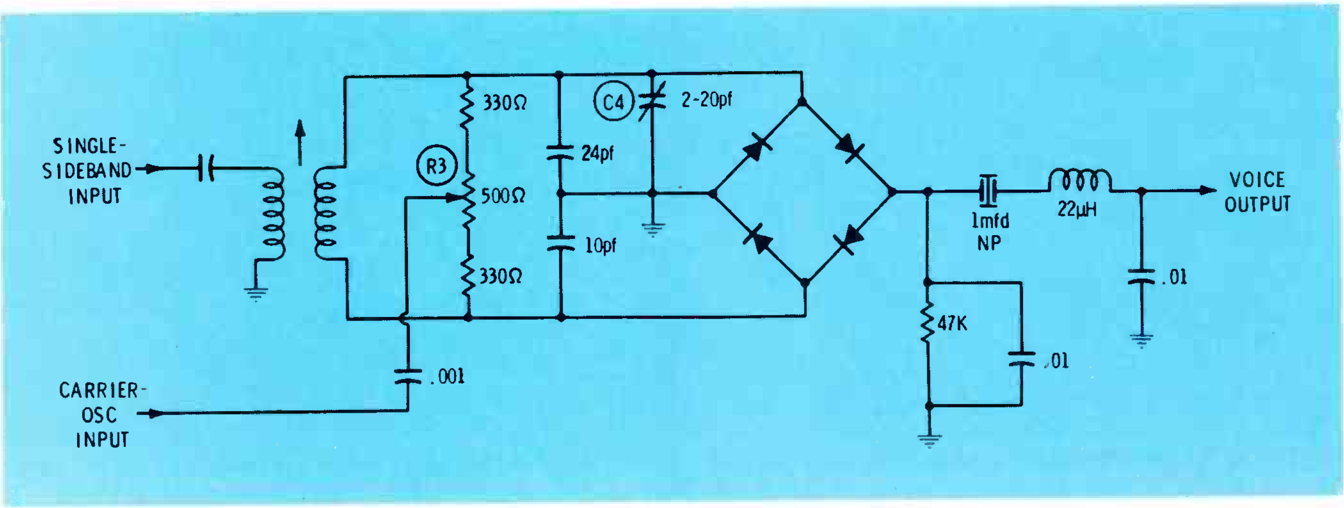


Fig. 7 Balanced demodulator is mirror hookup of balanced modulator.

Saving Time Makes Money

You may remember, I agreed to show you some professional bench tricks that save hours every day. You have a pretty good idea now what goes on inside a CB transceiver. You should, from what you've learned in this three-part series, know your way past the spots that give the average technician trouble. Your troubleshooting speed depends now on how well you arrange your service bench for CB repairs. I refer specifically to how you handle your instruments.

The diagram in Figure 8 illustrates how you can wire up your instruments to save lots of time. The trick lies in two six-position coaxial switches (a common configuration) and a few "T" connectors. You make just one connection to the transceiver. Turning the knob of coaxial Switch 1 lets you:

(1) Connect your homemade dummy load.
(2) Connect a high-power dummy load.
(3) Connect the RF signal generator.
(4) Connect the shop antenna.

Switch 2 chooses what signal goes to the frequency counter. This has multiple advantages. Let me explain them, by switch-position number:

(1) RF signal generator. While aligning a receiver you can continuously monitor the signal, assuring that you'll correct any drift immediately. Without this switchable connection, you're prone to overlook or neglect this important factor.
(2) Signal from a 455-kHz generator, if it's separate from your main signal generator. This is important to accurate receiver AM alignment, and for checking selectivity and sideband filters.
(3) Transmitter RF from high-power dummy load. A series resistor prevents overloading the counter input.
(4) Transmitter RF from the homemade dummy load. You can monitor frequency during any phase of transmitter alignment, while adjusting frequency, power, modulation, or whatever.

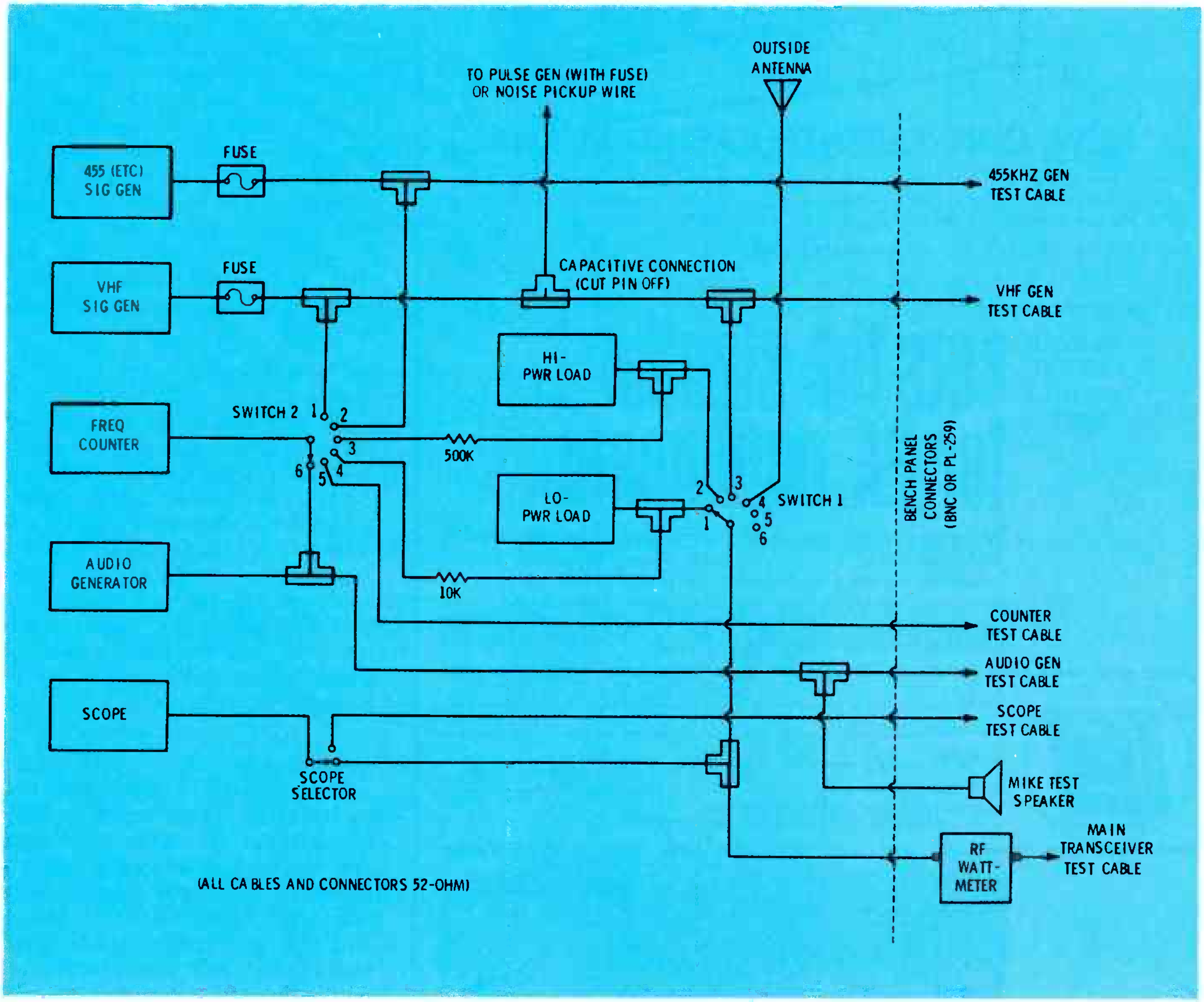


Fig. 8 Two coaxial switches can save hours of connecting and disconnecting instruments to CB transceiver. Handiest setup has switches mounted in panel of bench and the wiring all out of sight behind panel. Other switching systems can do the same job; design yours to fit your bench needs. The object is to save time by having everything already hooked up.

(5) A set of test leads connected to a shielded coaxial cable. This allows checking frequencies at test points inside a transceiver, such as in the synthesizer.

(6) Audio signal generator. You can adjust for a precise 1000-Hz signal to make SSB tests.

If you use an RF wattmeter that has its own dummy load, put it on one of the leftover positions of Switch 1. But a through-reading wattmeter, you should connect **between** the bench main coaxial connection and the transceiver, as the diagram shows. This lets you monitor RF watts throughout transmitter work without any switching. The wattmeter has no effect on signal from your RF generator, so it doesn't have to be disconnected during receiver testing.

The scope connects as shown, through a "T" connection just inside the bench connection. This gives you a constant monitor on transmitter output. As long as there's a dummy load (or the shop antenna) across the transmitter output, the scope's input capability isn't likely to be exceeded. You just vary the scope input attenuator to suit the transmitter's output. An extra two-position coaxial switch changes the scope input to a panel test cable.

Caution

There's danger of burning out the costly matching pad or output attenuator of your signal generator. To avoid that, a coaxial fuse holder is available (Hewlett-Packard has them). If you inadvertently key the transmitter with the generator switched in, the not-costly fuse opens. Of course the safest procedure is to keep the mike unplugged from the transmitter when you're servicing the receiver.

Advantages

You can see how much time this inexpensive setup can save. You can perform the majority of tests and adjustments without juggling a bunch of test leads and connections. Just attach DC or AC power and the bench coax. Individual leads from each instrument still permit special tests, but all the repetitive tests are handled through switching. This kind of planning and thinking are what lead to profits in CB radio servicing. □

Servicing SCR Deflection

(Continued from page 29)

If the receiver is being serviced for a problem completely unrelated to deflection, it might be possible to reduce the line voltage sufficiently to operate the chassis. This is likely to lead to other problems. A shunt inductor which can be connected across the old-style yoke is available from RCA. In an emergency, the primary of a flyback transformer from a CTC48 (or later) chassis can be connected across the early yoke. **Be extremely cautious, because the high-voltage winding will generate several thousand volts.**

Conclusion

The SCR-deflection system is radically different from either vacuum-tube or transistor-deflection systems, and requires basically different servicing techniques. A few of these essential differences are listed here.

1. Loss of oscillator drive does not damage components of the system, unlike loss of drive to a horizontal-output tube, which destroys the tube. In fact, removing drive to the retrace SCR by disconnecting its gate or by unplugging the horizontal module in modular chassis is a useful technique, since certain oscillator faults may cause the circuit breaker to trip.

2. An open in the yoke circuit of a vacuum-tube system is not likely to cause additional failures. In the SCR system, it will almost certainly cause further faults. In servicing, never attempt to operate the set with the yoke or any of the SCR's or diodes open or disconnected. **Always** check continuity of the yoke circuit if any of the SCR's or diodes have failed.

3. Shorts in the loads seldom cause additional damage (excluding the possibility of a "cooked" flyback transformer). Remember that the SCR system has much more reserve power capability than conventional systems. Because of this, leaky capacitors and shorted high-voltage rectifiers can get very hot. Fire-retardant components are used extensively; don't defeat their purpose by using substitutes that are not.

4. In many of the chassis, the width-control, pincushion, and linearity circuits work in conjunction with the regulator. Start by making sure the regulator is operating.

5. The high-voltage protection (or hold-down) circuits operate by driving the horizontal oscillator off frequency. If you defeat the hold-down circuit for testing, operate the instrument at less than 100 line volts to preclude generating excessive high voltage. Always restore the hold-down circuit before completing service.

6. Don't draw arcs from the high-voltage supply to see if it is working. Unshielded arcs often destroy solid-state devices.

Finally, respect the system, but don't be afraid of it. The symptoms and their causes which have been discussed here encompass a great number of common troubles, but there will always be new troubles to spring up in a TV set. That's what keeps us all in business. If the precautions which have been mentioned here are observed, there is little danger of introducing new problems. There aren't enough parts in the system to make servicing it very difficult. □

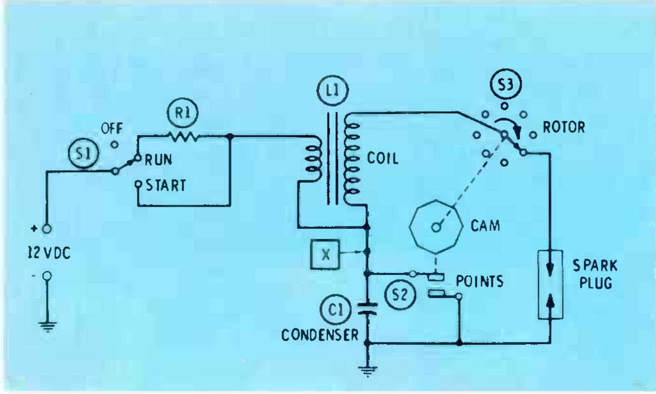


Fig. 1 Circuit of the Kettering-type inductance-discharge ignition system. Although it has some inherent weaknesses, it's still in use today.

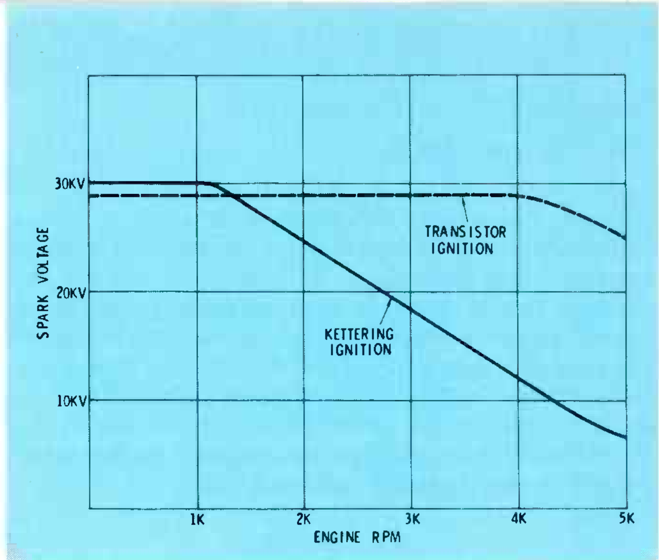


Fig. 2 Spark voltage versus engine RPM comparison between the standard Kettering ignition and a good electronic system.

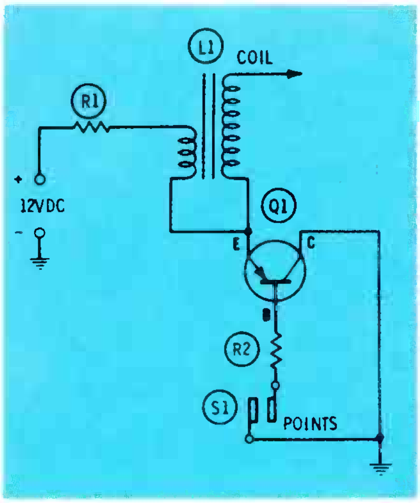


Fig. 3 Early designs of transistorized ignitions used transistors to supply the coil currents and retained the points to change the bias of the transistors. Current through the points is reduced from around 4 amperes to about .1 ampere, and the life of the points is extended accordingly.

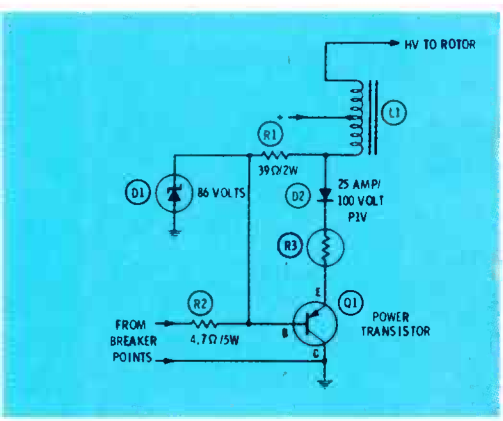


Fig. 4 A more-advanced circuit has an auto-former coil with a higher turns ratio to give lower inductance of the primary, diode protection of the transistor against transients, and a silicon power transistor for better temperature characteristics.

Understanding solid-state ignition systems

By Joseph J. Carr, CET

Solid-State auto ignition systems are quite sophisticated compared to the old "coil and condenser" types used for so long. This article is designed to help you understand and repair these new systems.

Kettering-Type Auto Ignition

Over 50 years ago, Charles F. Kettering, the famous General Motors automotive genius, patented the ignition system that bears his name. Even today the system, only slightly modified, is still used in many new cars. Although the operation has some definite shortcomings, we must admit the circuit has had the most extensive time-testing of any in history!

How it works

As shown in Figure 1, the circuit is simple and straightforward. Operation is based on the electronic effect that a steady DC current flowing through an inductance produces a large "kick-back" pulse of voltage when the current is interrupted suddenly. After this large pulse is stepped-up by a tapped transformer, the arc produced ignites the air/gasoline fuel mixture.

Geared to the crankshaft of the engine is a rotating shaft used for accurate timing of the spark. On top of the shaft, and inside the distributor, is the "rotor" part of a high-voltage switch which channels each voltage pulse to the correct spark plug. Part of this same cam shaft has a number of flat sides, one for each cylinder, that determine when the coil switch ("points") opens and closes.

When the breaker points are closed, current from the car battery flows through the primary of the tapped-transformer ("coil"). Then, when the points open (assume the "condenser" is not there), the magnetic field of the coil collapses by ringing of the inductance with internal capacitances of the winding and stray-capacitances of the wiring.

After it is boosted by the step-up ratio of the coil, the ringing voltage has sufficient amplitude to arc across the spark plugs.

Unfortunately, this simple system has several huge disadvantages. The ringing persists too long, the spark produced is not "hot", but is fuzzy like that from RF voltages, and the points become pitted because of excessive arcing across them.

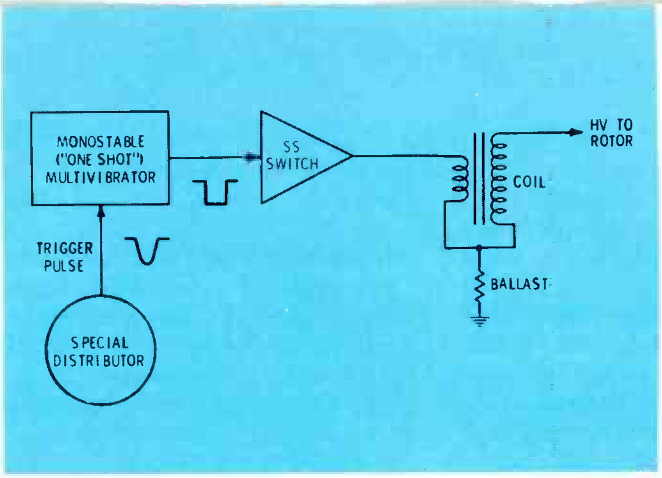


Fig. 5 A special distributor with a magnetic transducer (whose output triggers a one-shot multivibrator which turns on a transistor switch) is used to eliminate the points in some new designs.

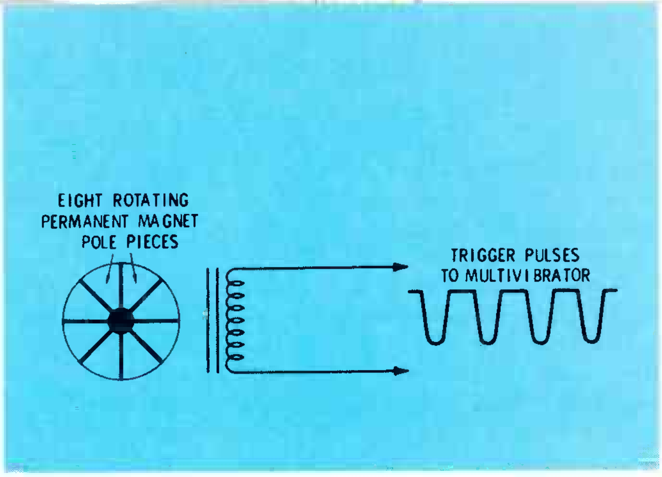


Fig. 6 The rotor assembly has one magnet for each cylinder of the engine. Movement of the magnets past the magnetic head induces a voltage in the head, and the output is sufficient to trigger a one-shot multivibrator.

All these problems are minimized enough to make the system practical by the addition of a "condenser", the capacitor which parallels the points. The spark action becomes more complex, because the condenser series-tunes the coil to a low frequency giving a large initial pulse of voltage followed by high-frequency ringing from the stray circuit capacitances. In addition, arcing across the points is minimized, which extends the useful lifetime of the points.

This rapid failure of the points when the condenser is open is one reason mechanics usually replace the condenser at the same time as the points; it's good preventive maintenance.

The capacitance value of the condenser is reasonably critical for longest point life and best ignition performance.

Shortcomings

For years, nothing except Kettering-type ignition systems were used in all autos. So, no one can deny the circuit works. But there are two deficiencies that have spurred the development of other types.

First of all, regular maintenance is required. Even in normal operation, arcing occurs across the points causing pitting and burning of the platinum surfaces. The points need to be large in area to minimize heating, but must be kept small to minimize bounce and float. So, trade-offs dictate that the points are only marginally adequate for the load.

Also, lead deposits build up on the electrodes of the spark plugs, requiring replacement to prevent shorting-out the spark. Very little loss of spark can be tolerated before the engine performance is noticeably affected.

The second problem is illustrated by the chart in Figure 2. As the engine speed is increased progressively above a fast idle, the spark voltage gradually decreases. Although the cylinder pressure is greater at low speeds and some fall-off of higher-speed voltage can be tolerated, the actual amount is too much. The result is poorer ignition at the higher engine speeds.

One cause of the decreased voltage is "breaker-point" float, which is the inability of the points to physically follow the more rapid movements.

A second reason is the amount of time necessary for the coil current to build up to the required maximum. If the points remain closed for too short a time, and the current doesn't reach maximum, the magnetic field of the coil will be insufficient in power, and the collapse will not generate enough kick-back voltage.

Electronic ignition systems eliminate some of these problems, and minimize others.

Transistorized Breaker Points

Some of the pioneering electronic ignition circuits used a transistor to turn off and on the coil current, but the traditional points were retained to key the forward bias of the transistor (Figure 3). Only base current flowed through the points, so the lifespan was greatly increased.

However, other problems appeared in the early designs. As you well know, transistors are heat sensitive. When germanium transistors (the only kind capable of carrying enough current at that time) were used in the furnace-like heat of summer operation, the resulting excessive collector/emitter leakage was enough to load down the circuit and impair the operation. Also, the transistors seemed to fail more often when the temperature was high.

At the other extreme, operation during cold weather was degraded because the transistors failed to pass enough current for normal ignition requirements.

One successful type

The circuit of Figure 4 solves most of these objections. Replacing the two-winding transformer is a more efficient auto-former which has a higher step-up ratio and a lower primary inductance to minimize voltage drop-off at higher speeds.

Heat effects are minimized by the use of a silicon-type transistor, and the addition of R3, which has a positive temperature coefficient. Also, series diode D2 and parallel zener diode D1 operate to remove most of the kick-back pulses from the transistor (to prevent transistor failures).

Ignition Without Points

During the mid-sixties there were

rumors that the Delco Division of General Motors had succeeded in eliminating the points in their new system. It was true.

A pickup coil (Figure 5) is placed inside a special distributor. Its output signal triggers a monostable (one-shot) multivibrator. You will remember from the Digital Logic series that a one-shot changes states, remains there for a time determined by a time constant and then reverts to the original condition. When this pulse from the one-shot energizes the switching transistor, a surge of current (always of the same duration) is applied to the coil. Of course, this helps keep the spark voltage the same regardless of speed.

Figure 6 illustrates how the magnets (one for each cylinder) are arranged to rotate past a fixed magnetic head. The output is a constant series of distorted sine waves which are changed to square-cornered pulses by the one-shot multivibrator. Unless the coil winding opens or shorts, no maintenance should ever be needed.

Light-Triggered Ignition

Another type of breakerless ignition uses chopped light as the control (Figure 7).

A system of rotating slots and light baffles allows the light of the internal bulb to shine through and illuminate the light-sensitive cell each time a plug is to be fired.

Capacitor-Discharge Ignition

Perhaps the type of electronic ignition giving the best performance (and costing the most, also) is the capacitor-discharge version. In the Kettering type, power for the operation is obtained from the coil current. That is, a constant coil current is suddenly stopped to produce a kick-back voltage.

Nearly the opposite is true of the C-D type. A capacitor is gradually charged, and then suddenly is discharged through the primary of the coil producting a "hot" spark. Performance at high speeds is good,

Electronic-ignition subchassis used in the 1972 Chrysler cars. The five-pronged plug is held in place with a screw.

Back side of the Chrysler electronic-ignition unit shows by the components embedded in epoxy that it is non-repairable.

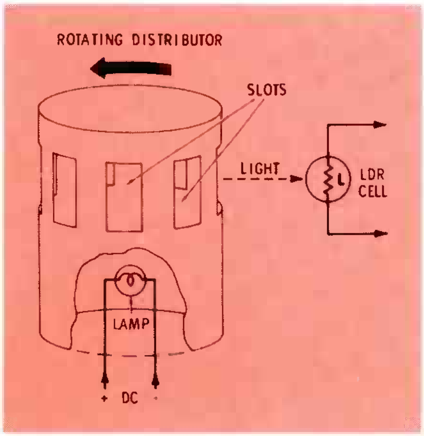


Fig. 7 Some ignition systems break a light beam to trigger a light-sensitive cell, which in turn biases-on a transistor or SCR.

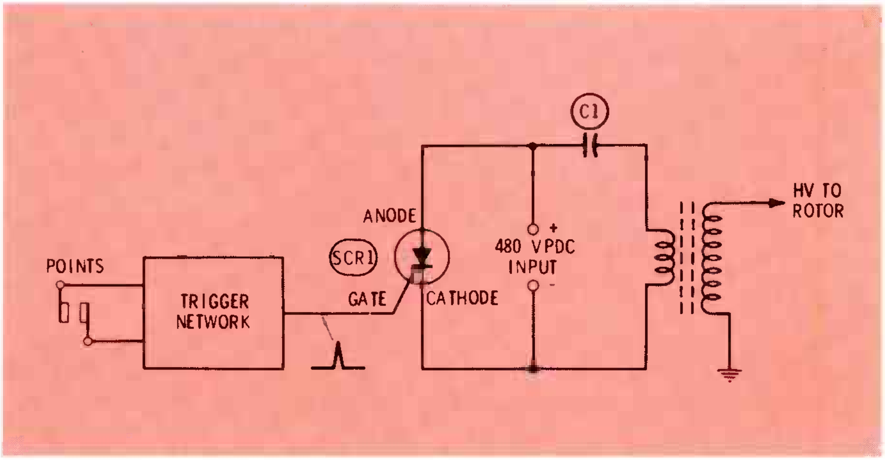


Fig. 8 In the capacitive-discharge system, power is stored in a capacitor, then discharged through the primary of the coil. Control of the discharge is by a SCR, which is even more efficient than a transistor.

because there's plenty of time for the capacitor to become fully charged each time.

Here's how the circuit of Figure 8 works. Start with the assumption it's time for the next spark. C1 has been charged from the pulsating (unfiltered) DC supply voltage (which is also connected to the anode of the SCR, now non-conducting). Next, the points and the triggering network apply a positive-going pulse to the gate of the SCR, making it conductive. The conduction grounds the B+ end of C1, sending its charge through the primary of the coil to produce a pulse of spark at one of the plugs.

There is a second action. SCR conduction also shorts out the power supply (which has a bridge rectifier and no filter capacitors). This short circuit loads down the power supply and stops the operation of the two power-oscillator transistors in the DC-to-DC power supply. The result is a loss of DC voltage, but without excessive overload of the supply.

It's necessary for this supply voltage to become zero to unlatch conduction of the SCR. In addition, ringing of C1 and the coil forces the SCR anode voltage to become slightly negative, thus insuring dependable unlatching.

When the SCR stops conducting and no longer loads the power supply, the transistors start oscillating, again producing pulsating DC which charges C1. Now the circuit is ready for another triggering pulse.

Using a SCR here instead of a transistor gives lower-resistance switching, producing less heat. And because SCR's are of rugged silicon construction, they can withstand the ringing pulses without excessive failures.

Servicing Electronic-Ignition Systems

Here are some servicing tips:

- check the power transistor or SCR first; they account for most failures;
- make certain you understand the basic circuit functions, else you will be forced to testing individual components instead of troubleshooting;
- use silicone grease between transistors and heat sinks, and on both sides of mica washers;
- after you have reinstalled any component, test for shorts using an ohmmeter; and
- make sure all soldered joints are strong mechanically and electrically.

Remember that the customer is more likely to blame you for any failures caused by your mistakes or poor workmanship than would be the case with TV's or stereo machines. Imagine what an intermittent soldering joint could mean on a freeway at 70 MPH, or what the car owner might think if the ignition were to go dead out in the boondocks! □

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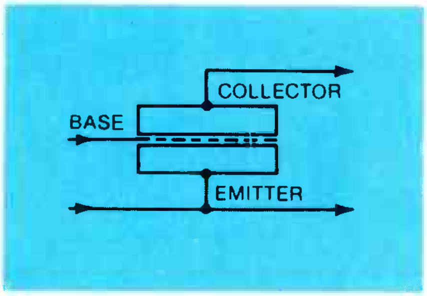
TROUBLESHOOTING SOLID-STATE AGC CIRCUITS

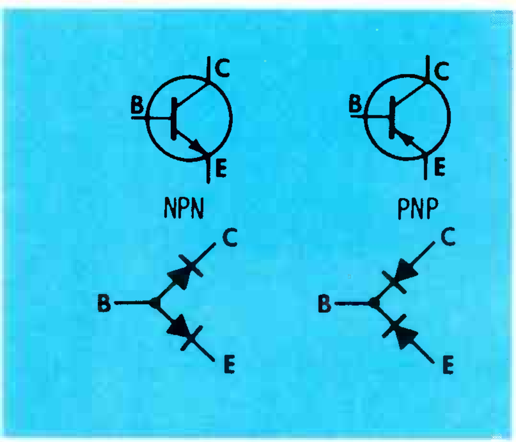
By Carl Babcoke

Should the solid-state AGC voltage rise or fall with increasing signal strength? How much voltage change should be expected? There is a simple method by which you can answer these questions for yourself, regardless of the model of receiver.

Fig. 1 Stripped to the basics, a transistor consists of two non-identical diodes built back-to-back.



(A) This is an approximation of a transistor. Most often the base is a very thin area of "P" or "N" material diffused to slabs of "N" or "P" material on either side. The base/emitter and base/collector junctions can be tested as diodes. A non-symmetrical transistor will also measure as a very inefficient diode from collector to emitter.



(B) For troubleshooting purposes, it's very helpful to memorize the diode equivalents of PNP and NPN transistors, as shown here.

Solid State AGC More Difficult

Servicing any kind of AGC system has its pitfalls. Because the circuit is a closed-loop type, an abnormal DC voltage anywhere in the loop usually causes corresponding changes in other branches of the circuit. This can lead to confusing symptoms.

Solid-state AGC systems have all the built-in hazards of tube designs, plus a few unique to transistors, such as these:

- transistors can be either polarity, depending on arrangement of the "N" and "P" sections during manufacture (Figure 1). This makes circuit analysis more difficult, for the polarity of the voltages to be expected depend on the type of transistor;
- because bi-polar transistors physically are two non-identical diodes formed back-to-back (see Figure 1), diode-type leakage paths through the transistors can cause effects not possible with tubes;
- two polarities of power supplies are used, as shown in Figure 2. Measured across the transistor the DC voltages might be the same, but when measured to chassis might appear to be entirely different;
- two different alloys of material are used during manufacture. Germanium types need about .2 volt, and silicon types about .6 volt of forward bias for Class-A stages. Bias is critical, so you must know first which type is in use before knowing whether or not the voltage is correct;
- all bi-polar transistors require both current and voltage for forward bias at the base/emitter junction. Solid-state AGC must supply power (not just voltage). That's the reason for the extra AGC-amplifier stages. Table 1 shows how the resistivity of the base/emitter junction changes with forward bias; and
- gain reduction takes place if the base/emitter forward bias is either increased or reduced from the amount giving optimum high gain (See Figure 3). There is no tube equivalent for this dual action. How can we know which type (cut-off or saturation) AGC is being used in any particular model?

Because this is such an imposing list of discouraging factors, it's obvious we need a dependable short-cut method to help raise our troubleshooting methods far above the tedious work of calculating the effects of more or less bias causing more or less current. **And there is such a method.**

Positive-Going And Negative-Going Signals

The secret of this effective method is determining whether the DC voltage at each point of the circuit is positive-going or negative-going with a stronger signal.

We'll show you how to do this for yourself. But first, let's make sure we all understand the ground rules. Only the DC voltages at bi-polar transistors are under consideration just now, and we are not concerned about phases in transformers or tuned circuits.

Transistor phases

Input signals can be applied either to the base or emitter of a

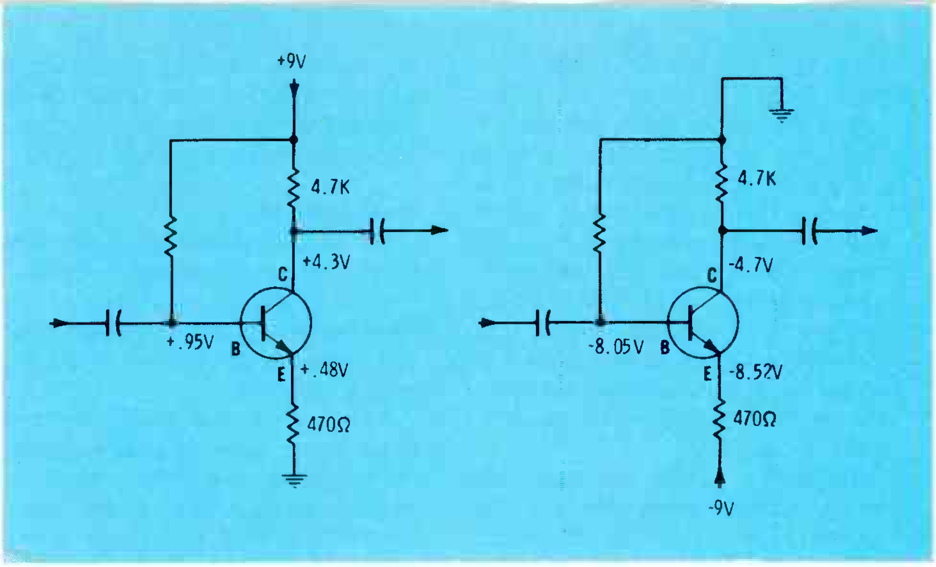


Fig. 2 Opposite polarities of power supply voltages will appear to produce completely different voltages at the transistor. These two transistors have exactly the same DC voltages applied to them. Measure base and collector voltages from the emitter to avoid confusing readings.

transistor. Also, the output can be taken either from the emitter or from the collector. All in all, there are three basic circuit configurations possible with transistors, and they are shown in Figure 4.

It can be very helpful in analyzing circuit actions if you memorize which of these circuits invert the phase. Actually, only the common-emitter type gives phase inversion, so it's not difficult to learn. The other two types differ greatly in impedances and gain, but do not invert.

Positive-Going And Negative-Going Permit Shortcuts

It's certainly possible to analyze circuit actions in tedious, minute detail, but it is also very time-consuming. For example, in analyzing the circuit of Figure 4A, we could say a more-positive input signal increases the forward bias, which forces the collector to draw more current. Increased collector/emitter current produces more voltage drop across the collector resistor and leaves less DC voltage from collector-to-emitter. Therefore, the collector becomes less positive.

But it's much easier to say a positive-going input signal produces a negative-going output signal.

Just remember that a DC positive voltage becoming more positive or a negative voltage becoming less negative are both positive-going signals. Also, a positive voltage becoming less positive or a negative voltage becoming more negative are both negative-going voltages. Rectifier and detector circuits with negative output DC voltages are negative-going, and those with positive output voltages are positive-going.

Also true of PNP's?

You might wonder if the previous rules about positive-going and negative-going voltages also apply to PNP-polarity transistors. After all, the previous examples were about NPN types. The facts of Figure 5 prove those rules apply equally to both NPN and PNP types.

Handy Rule For Diode Polarity

This helpful rule about diodes should be memorized: **DC voltages obtained from diode rectification will be negative if obtained from the anode, and positive if obtained from the cathode.**

Video-Detector Polarity

At the output of the video-detector is the first DC-oriented signal in a television receiver. Output from the anode of a detector diode will measure negative, and will become more negative with a stronger signal. That's a negative-going signal. Conversely, output voltage from the diode cathode will measure positive, and it will become more positive with a stronger signal. And that's positive-going.

Next, we follow this video-detector signal through the video and AGC stages noticing whether or not the polarity is inverted by the stage. By the time the AGC voltages are applied to the IF and RF transistors, we know whether it is positive-going (saturation biasing) or negative-going (cut-off biasing).

This system tells us in a hurry whether any particular DC voltage should be positive-going or negative-going. Later, we'll find out how to tell the amount of voltage change.

Why The Diode?

One more point should be cleared up before some typical circuits are analyzed to prove how the method works.

This item concerns the reason

BASE/EMITTER DC RESISTANCE

DC VOLTAGE	RESISTANCE
.40	80K
.45	16K
.50	4K
.55	1500 ohms
.60	600 ohms
.65	310 ohms
.70	190 ohms
.75	125 ohms
.80	90 ohms

why the diode is included in the collector circuit of Figure 6. Such a diode is found in every transistorized AGC keying stage, although none are used in the equivalent tube circuits.

In tube-equipped AGC-keyer circuits, positive-going horizontal pulses are fed to the plate of the tube through a coupling capacitor (a shunt-fed rectifier circuit). Efficiency of the rectification, which produces negative voltage at the plate, is reduced by the amount of the bias voltage. The effect of increasing the negative grid bias is the same as adding a resistance in series with the plate.

As is true of all shunt rectifiers, the plate is clamped by the diode action so it becomes only slightly positive at the tip of each horizontal pulse. During the remaining time, the signal at the plate will be negative.

It seems logical that it only would require replacing the tube with a silicon NPN transistor and the circuit would work just as well. No way!

Refer to Figure 1 and the diode equivalent of a NPN transistor. Imagine a **negative** voltage applied to the collector (cathode equivalent). There is a low-impedance path from collector-to-base that shorts out this negative voltage.

To sum up the action: without the "pulse gate" diode very little negative voltage (positive if a PNP and the pulse polarity is reversed) could remain at the collector. Therefore, the circuit would be too inefficient for practical use.

That also gives more than a hint about the symptoms when the diode shorts. The result is virtually no AGC action.

Of course at the other extreme, an open diode eliminates all AGC action. The situation is rather unique, because either a shorted or an open diode produces the same symptoms.

Which is the rectifier?

In the tube circuit, the tube was a rectifier; no mistake about that. But when a diode is added to the transistor AGC-keying stage, the transistor is **not** the rectifier. It's only a series control element which affects the rectification efficiency of the "pulse gate" diode. All of the rectification is done by the diode. Therefore, the polarities of DC voltages at each end of the diode are determined by the polarity of the diode, and nothing else. Positive will be measured at the cathode and negative at the anode of the diode. Keep this in mind.

Phase inversion

Do AGC-keying stages follow the same rules about polarity inversion? Yes, they do, if we consider the diode as part of the transistor stage and measure the output at the far end of the diode.

And that's a very useful shortcut. If the input signal is positive-going, output from the diode must be negative-going. Also, if the input signal to a PNP is negative-going, output from the diode must be positive-going.

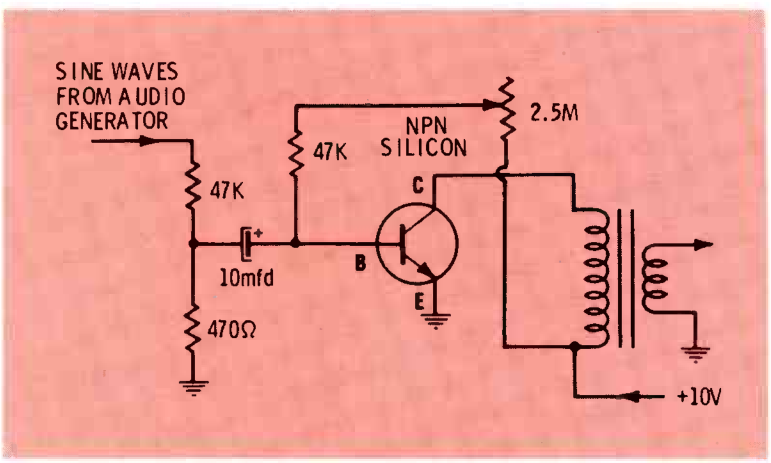
In this way, the concept of positive-going and negative-going signals can be followed through all the circuits.

How Packard Bell AGC Operates

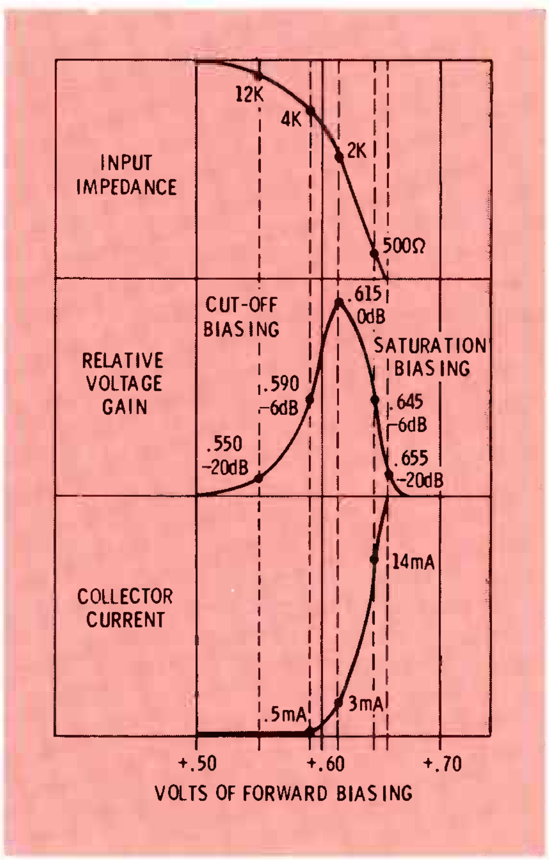
Figure 7 shows the simplified schematic of the Packard Bell CR424 chassis (Photofact 971-1) AGC circuit.

Output from the video detector is taken from the cathode of the diode, so the output is positive-going. Output of Q5 is from the

Fig. 3 The effects on gain, input impedance and collector current when the forward bias is varied.

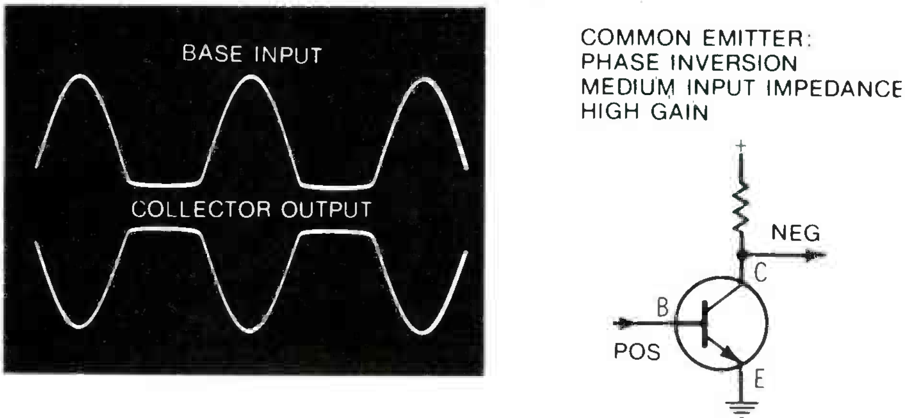


(A) Schematic of a simple audio amplifier with adjustable base voltage. Maximum gain was very high, nearly 2000.

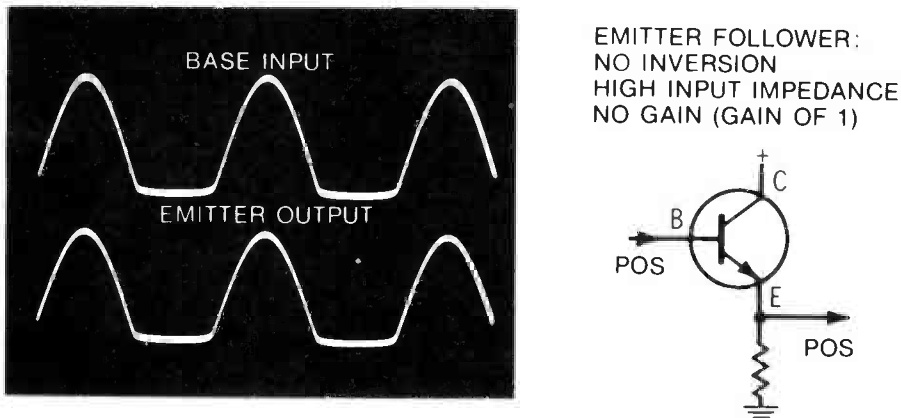


(B) Input impedance decreased at a parabolic rate as the forward bias was increased, showing that the input impedance is determined mainly by forward bias. Gain increased at a predictable rate up to a certain bias point (the exact point depended somewhat on temperature). Above that voltage, the gain decreased. The gain reduction was very rapid above .65 volt. Collector current did not follow the gain curve, but steadily increased with the increase of forward bias.

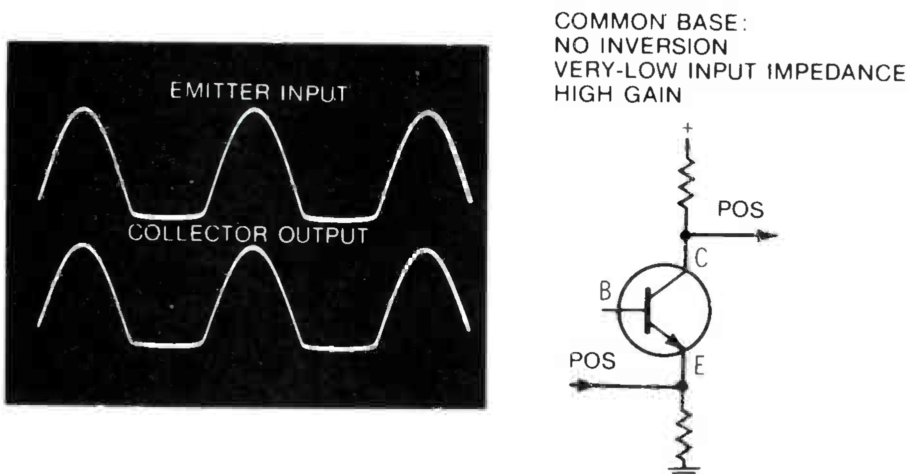
Fig. 4 Whether or not a transistor stage inverts the phase depends on where the input signal is applied, and from which point the output signal is taken. We advise you to memorize the following resume.



(A) This common emitter is the most-often-used circuit. Input impedance ranges from 500 ohms to about 3K, and the output impedance is around 50K. If the input is positive-going, the output is negative-going, and vice versa. There is phase inversion.



(B) Emitter followers have output voltages the same as the input voltages, but at lower impedance. This gives a power gain, and such stages are very useful as impedance-matchers. Typical input impedances might be 50K, and output impedances of around 100 ohms. There is no phase inversion. They are also called "common collector" types.



(C) Common-base (grounded base) types are not encountered very often. There is no phase inversion, and the input impedance to the emitter is extremely low.

emitter (emitter follower) and the signal there is still positive-going. This is the correct polarity for the base of Q13, the AGC keyer, and the rectified signal at the output of X12 is negative-going.

After it is filtered, part of the rectified negative voltage is fed to the base of Q14. At the collector, because the stage is a common emitter, the signal is positive-going. This output is the saturation AGC for the first three video-IF stages.

The positive-going AGC voltage at the base of Q1 (1st IF) becomes a negative-going DC signal at the collector. Part of that voltage is applied to the base of Q12, the PNP RF-AGC amplifier transistor. Because the stage is a common-emitter type, output at the collector is positive-going, so the RF gain reduction is by saturation. Notice that Q1 acts as a DC AGC amplifier, in addition to being the first IF amplifier.

Delayed application of AGC to the RF amplifier is necessary, regardless of whether tubes or transistors are used, in order to minimize snow on medium-strength signals.

In this case, the delay is accomplished by the action of diode X11. When the signal strength is weak, the collector of Q12 is nearly zero volts, but the other end of X11 has a positive voltage. The diode is reversed biased, and is virtually an open circuit. Positive voltage sufficient for maximum RF transistor gain is supplied by the voltage divider, consisting of the 120K and 22K resistors.

If the signal strength increases, Q12 conducts part of the positive voltage present at its emitter to the collector. This forward biases X11 and supplies the higher voltage to reduce the gain of the RF transistor.

All of this takes much longer to read about than it does to follow from the schematic. After some practice, you should be able to do a similar analysis very rapidly for any chassis.

How much change?

At this point of the analysis, we know for certain at which points the signal is positive-going and where it is negative-going, and whether the AGC voltage reduces the gain by cut-off (less forward bias) or by saturation (excessive forward bias).

But, how **much** should we expect these various voltages to change? Accurate troubleshooting is impossible without knowing the approximate answer.

Check The Value Of The Emitter Resistor

The larger the value of the emitter resistor, the more change should be expected of the base voltage. That's because the emitter "follows" closely behind any changes of the base voltage. The larger the emitter resistor, the more closely the emitter voltage tracks with the base voltage.

Some approximate AGC voltage variations are shown in Figure 8. The figures given are for the **change** of the base supply voltage between operation without a signal, and normal operation with a very strong signal. We will use those figures as guides in analyzing the following circuits.

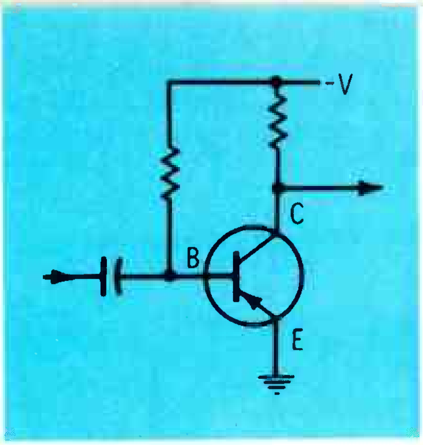


Fig. 5 This example using a PNP-type transistor proves the action of positive-going and negative-going is the same as it is for NPN's. Assume a negative-going input signal which acts as increased forward bias. Collector current is increased by the greater bias and more voltage is dropped across the collector resistor, leaving less negative voltage from collector to ground. Therefore, the output signal is positive-going. The stage has inverted the phase, exactly as a NPN would.

RCA CTC38 Chassis

The CTC38 chassis (Photofact 1092-3) is a hybrid using both tubes and transistors in the AGC circuit (Figure 9).

Output of the video detector is positive-going (unusual with tubes), and the signal passes through two common-cathode (inverting) video amplifiers before it's applied to the AGC-keying tube. Therefore, the signal at the grid of the AGC keyer, V2B, is the normal positive-going. Inversion occurs in the keyer, with negative voltage produced at the plate during operation with medium and strong signals.

Part of this negative voltage is cancelled by a fixed amount of positive voltage and the resulting delayed AGC voltage sent on to the Nuvistor-type RF-amplifier tube. Except for the positive-going detector and two video stages, the operation so far is typical of tube circuits.

A very small portion of the negative-going signal at the plate of the AGC keyer is fed to the base of Q6, the IF-AGC transistor. Also at the base circuit, is connected the IF-AGC control that determines how much effect the negative-going signal will have on the IF AGC.

Two points should be emphasized here. Notice that the AGC control determines the bias of the sync/AGC amplifier tube, and a wrong adjustment can cause contrast problems. Secondly, the IF-AGC control varies the amount of IF, AGC, but the ultimate effect is to determine how much AGC is applied to the RF tube.

Look at it this way. The AGC circuit operates to reduce the gain in two circuits; both the RF and IF stages. And it's always done with two separate branches of the AGC circuit. If the operation of one of these branches becomes abnormal, the other branch attempts to correct for any change of gain. The result is overcorrection in the normal channel.

In this case, the IF-AGC control can reduce the amount of AGC applied to the IF. When that happens, more negative voltage is supplied to the RF stage, and can cause snow. Therefore, the symptom of wrong adjustment of the IF-AGC control is to cause snow, if adjusted too far.

IF AGC

The negative-going voltage at the base of Q6 still appears at the emitter as negative-going, because the stage is an emitter follower. How much should the voltage change between no signal and strong signal? According to the rule, quite a bit, perhaps 15 volts or more since the emitter resistance is so high. Through the 3300-ohm emitter resistor, part of this voltage change is transferred to the emitter of Q1, the 1st-IF amplifier.

Now, here comes the part that's hard to understand. The emitter voltage of Q1 measures about +40 volts with no signal. With a strong signal applied to a normal receiver, the voltage continues to measure approximately +40 volts. What happened to the rule that the higher the value of the emitter resistor the more voltage change?

There's nothing wrong with the rule. It just doesn't apply here. Under the rule, if a varying voltage is applied to the base, and the emitter circuit has a large value of resistance, both base and emitter voltages should be expected to vary several volts during AGC operation. However, in this circuit, the base voltage is fixed and the emitter is varied for AGC purposes. Therefore, the emitter voltage should be expected to change no more than a few hundredths of a volt, because this represents true bias change.

In practice, both the base and emitter voltages swing about half a volt. But, relative to 40 volts, a half-volt change can hardly be measured with any accuracy. If we were to measure the bias between emitter and base, we would find the change to be about .05 volts.

Perhaps you can see from these critical voltages that you would **not** apply a bias box to the emitter of Q1 as a test of the AGC. The best way is to connect a bias box to the base of Q6 and vary it around +55 volts to find the effect of different AGC voltages.

Sylvania D12

Completely different is the AGC circuit of the Sylvania D12 chassis (Figure 10, taken from Photofact 1045-2).

Output of the video detector is negative-going, and the signal remains negative-going at the output of emitter-follower Q4, which supplies the base of Q11, the AGC keyer.

Now, most sets at this point have a positive-going base signal to a NPN having positive-going pulses at the collector. But, the Sylvania is just the opposite, the base is negative-going, the transistor is a PNP and the pulses to the diode are negative-going.

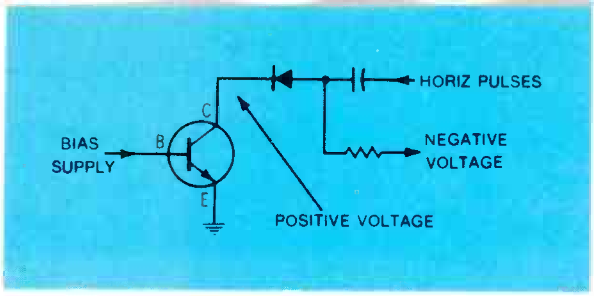


Fig. 6 Transistorized-AGC circuits need the diode; tube circuits don't. See text for the reason.

In addition, the pulses are supplied by a winding of the flyback, and the DC voltage from the rectification is found at the other end of the winding.

The AGC-keying transistor is operated as a common-emitter type, so the output from X17 is positive-going DC. After filtering by the 1.5-mfd capacitor, the voltage is applied to the base of Q10, the AGC amplifier. Output from the emitter is postive-going, and is the AGC voltage for the RF-amplifier transistor.

When no signal is being received, Q10 has no base voltage and does not conduct. However, there is a DC voltage at the emitter which supplies the maximum-gain bias for the RF amplifier. This voltage comes from the emitter of Q1 through the diode X9 (which is forward biased).

Emitter voltage for Q1 is developed from two parallel paths. One is through the 15K and 47K emitter resistors (these alone would bias Q1 nearly to cutoff), but this path is paralleled by the 1000-ohm emitter resistor of Q10 and the series resistance of X9. Refer to Table 1 for the approximate resistance of diodes at different forward biases.

During reception of a strong signal, the base voltage of Q10 becomes more positive than its emitter, and Q10 conducts. This raises the emitter voltage above the anode voltage of X9 so X9 is cutoff. Now a higher positive voltage is applied to the RF transistor reducing its gain by the saturation effect. Also, the open X9 increases the resistance of the emitter path of Q1 up to 62K. Q1 has very little gain because of the cutoff effect of the higher emitter voltage.

When the receiver is supplied with signal strengths in between these two extremes, X9 acts as a variable resistance; the stronger the signal, the higher the resistance.

Philco Hybrid AGC

Many Philco models, including

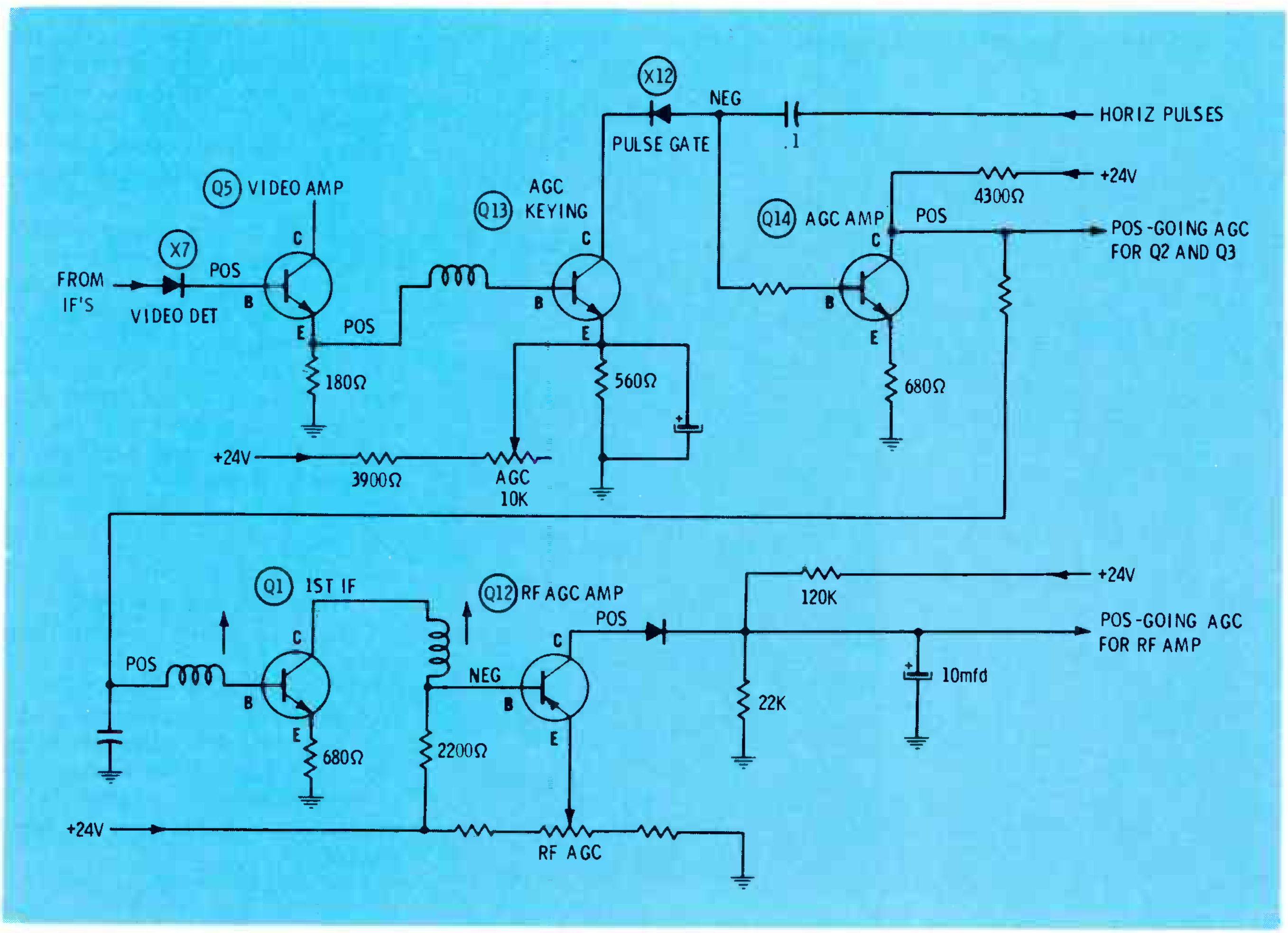


Fig. 7 Simplified schematic of the Packard Bell CR424 chassis AGC including the important positive-going and negative-going points. Both the IF and RF amplifiers have their gain reduced by saturation (increased forward bias), and the 1st IF transistor also acts as a DC amplifier for the RF-AGC amplifier signal.

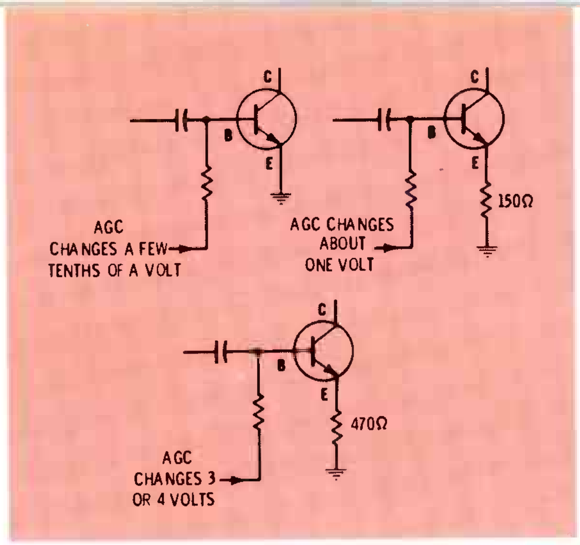


Fig. 8 How much the AGC voltage at the base of a transistor changes between no signal and strong signals is determined by the value of the emitter resistor. The higher the value, the more the voltage changes at both the base and emitter.

16QT85 (Photofact 827-2), use the hybrid circuit of Figure 11. It is different in principle from those previously described.

Output of the video detector is negative-going, the signal is inverted in the tube, and is positive-going at the base of the NPN AGC-keying transistor. The collector circuit of X5 keyer has a diode X 16, and the pulses are supplied by a winding of the flyback transformer.

DC outputs from the anode of X16 and the other end of the flyback winding both are negative-going. However, that doesn't matter in this circuit.

The DC output voltage from the keyer is not used. Instead, the AC signal from the rectification of pulses is dropped across the 6.8K resistor, whose other end is bypassed to AC. This voltage drop is coupled through the .0022 capacitor and shunt rectified by X15. Positive voltage is produced (because the DC voltage is taken from the cathode of X15). After filtering by the 310K resistor and the 4 mfd capacitor, the positive-going voltage is applied to the base of X6, the AGC amplifier transistor.

When the receiver operates without a signal, X6 has no forward bias at its base. At that time, the forward bias necessary for maximum gain of the IF transistor is supplied by a voltage divider consisting of the 8200-ohm and 1500-ohm resistors and the 3K IF-AGC control. In addition, there is a paralleling path through the 4700-ohm and 2200-ohm resistors to ground.

Forward bias for the RF transistor comes from the 18K and 1500-ohm resistors, with the zener, X14, and the 2200-ohm emitter resistors paralleling the 1500-ohm resistor.

Reception of a strong signal increases the forward bias at the base of X6, causing an increased emitter voltage. Part of this voltage, through the 4700-ohm resistor is applied to the IF transistor where it decreases gain by the saturation effect.

When the emitter voltage exceeds the avalanche point of the zener, X14, plus the RF AGC voltage, the zener conducts to supply saturation AGC voltage to the RF-amplifier transistor, reducing its gain. In other words, the zener action prevents any gain reduction of the RF stage until the signal strength is moderately strong, thus preventing snow.

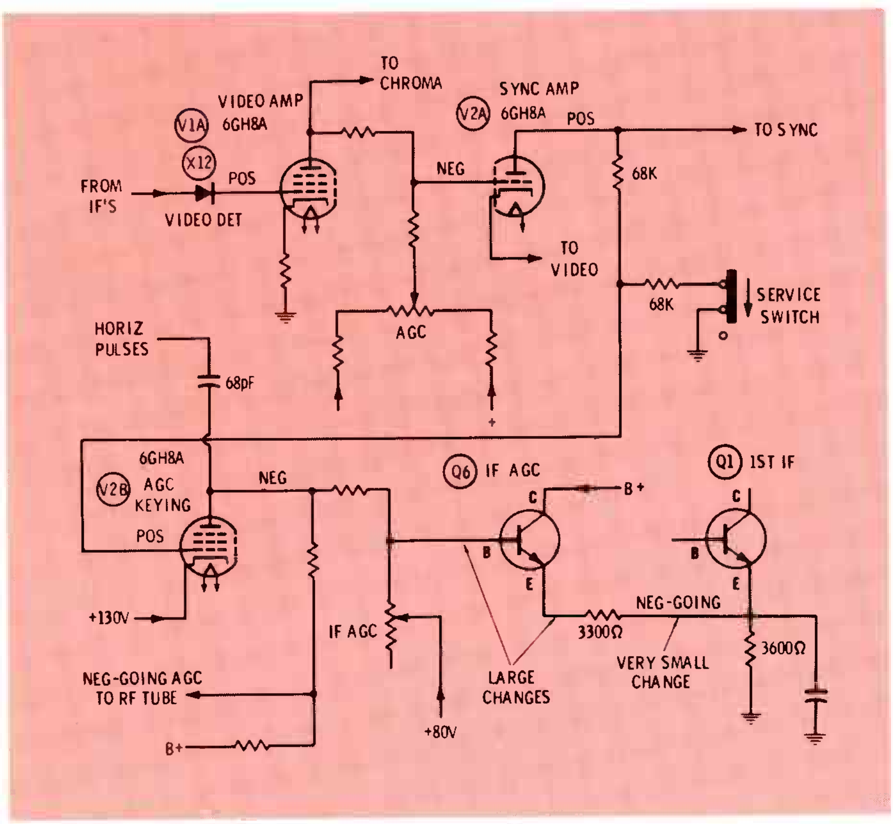


Fig. 9 Simplified schematic of the AGC circuit in the RCA CTC38 hybrid color chassis. The RF stage is a Nuvistor tube using cutoff AGC, while the gain of the IF transistor is reduced by saturation. Unique is the IF AGC which changes the IF-emitter voltage by a few tenths of a volt.

RCA Solid-State AGC

Figure 12 shows a simplified schematic of the AGC circuit used in the RCA CTC40 chassis (Photofact 1030-2). Unusual is the dual-gate MOSFET RF amplifier which requires AGC voltages very similar to those needed for tubes. Also unique is the omission of an AGC control.

The video detector is positive-going, and the signal remains positive-going at the output of the NPN emitter-follower, Q4. Input to Q11, the AGC-keying transistor, also is positive-going, with the output at X11 negative-going. Nothing unusual so far.

Service switch

The connection with the service switch reminds us of a deliberate use for one of the symptoms of a malfunctioning AGC: loss of the picture because of excessive AGC. In this case, the anode of X10 is grounded in the normal position, and the diode does not conduct because of its positive cathode voltage. So, normal action of the AGC is not affected.

When the service switch is slid to "raster" position, positive voltage comes in through the resistor, through X10, and to the base of Q11. This affects Q11 the same as a huge input signal, producing an excessive amount of AGC, and in turn eliminating all stations.

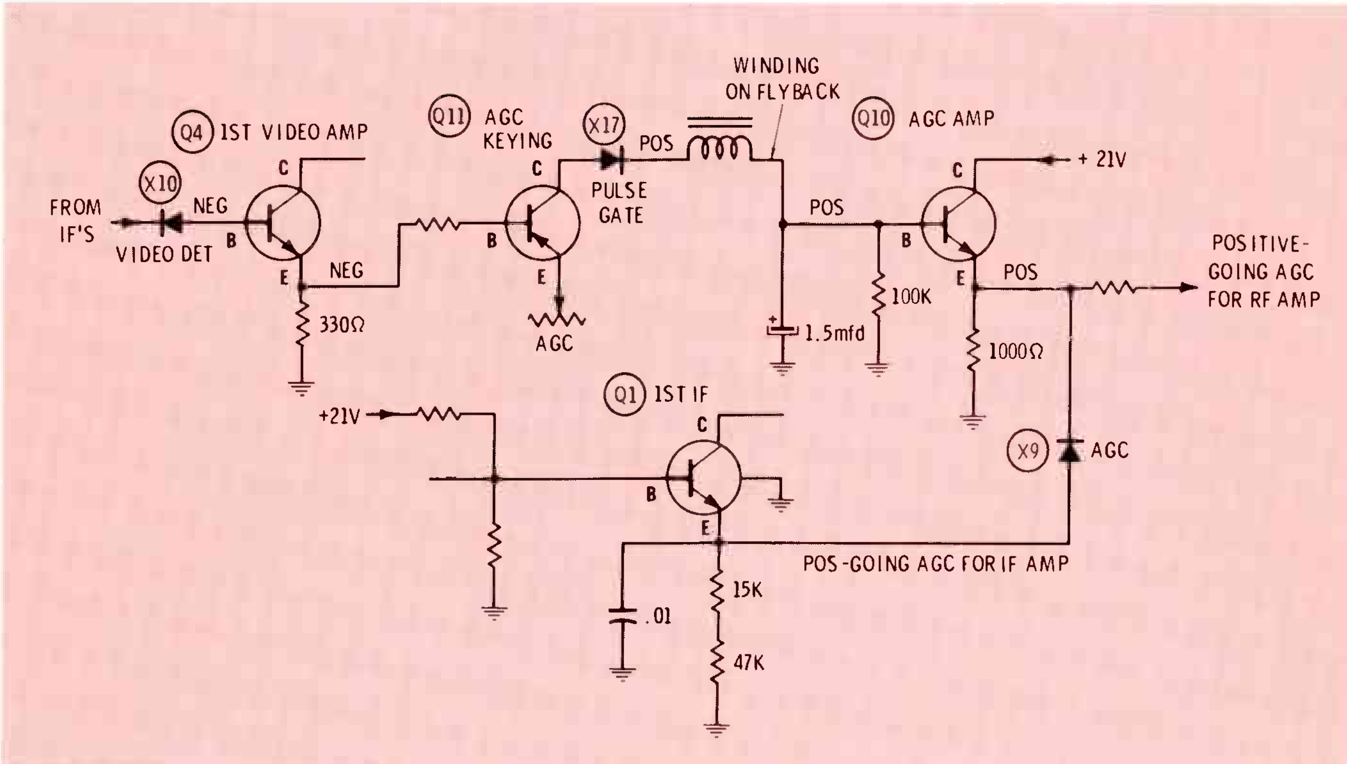


Fig. 10 Simplified schematic of the AGC circuit of the D12 Sylvania. The AGC-keying transistor is a PNP type with horizontal pulses supplied from a flyback winding. IF AGC is cutoff type applied to an emitter.

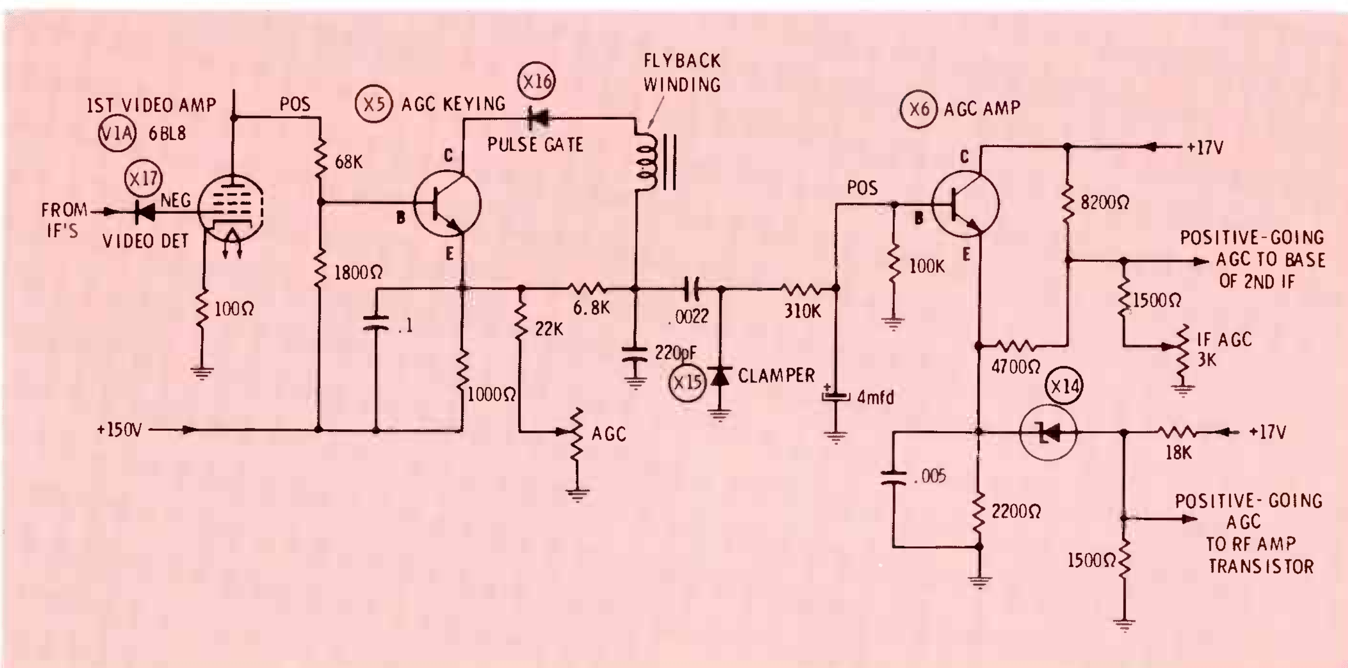


Fig. 11 Not the DC but the AC keying signal is used to control the AGC in this Philco 16QT85 color chassis. Gain of both RF and IF is controlled by saturation biasing.

Always suspect an overactive AGC if there is a snow-free raster with no picture.

AGC for the MOSFET

Negative AGC for the MOSFET RF amplifier is obtained from the anode of X11. Voltage delay is provided by positive voltage from the resistor connecting to B+.

A different use is made of transistor Q41, a NPN-silicon type. Actually, the base/emitter junction only is used to obtain the inherent zener effect of such transistors. Conduction in both directions limits both the maximum negative and maximum positive voltages that can be applied to the gates of the MOSFET. This is done to prevent possible damage to the gates.

Assume operation without a signal. The base of Q41 becomes positive from the voltage brought by the resistor connecting to B+. However, if the voltage tries to exceed about +7 volts, the base/emitter junction conducts in the forward-bias mode and prevents the voltage from rising more than .7 volts above the emitter.

Now, suppose an extremely strong signal is received, or the service switch is changed to "raster" and the RF AGC voltage tries to become very negative. The transistor has a zener rating of about 11 volts, but there is +6.5 volts already at the emitter. Therefore, when the base voltage tries to exceed -4.5, zener conduction takes place and clamps the AGC voltage there.

Incidentally, RF-amplifier AGC in excess of about -2 volts usually produces snow. Use this data during troubleshooting.

IF AGC

Q12 is the IF-AGC transistor of common-emitter type, whose input in negative-going and whose output is positive-going. Because there is no emitter resistor, the base voltage is only around.+.6 volt and changes very little with signal.

Part of the Q12 collector signal (positive-going) supplies saturation AGC bias directly to the base of Q2, the 2nd IF transistor. A common cathode resistor shared with Q1 supplies some indirect AGC action also to Q1.

Because the emitter resistance of Q2 is 600 ohms, the base voltage can be expected to change 3 or 4 volts between no signal and strong signals.

Other Tips

Shorted transistors, open or shorted diodes, and open or shorted electrolytic capacitors account for most of the component failures in solid-state AGC systems.

Borderline operation of AGC is just as difficult to pinpoint as it is in tube circuits. Just remember an AGC voltage that is expected to become 5 volts more positive when a strong signal is received, yet only becomes 2 volts more positive, is exactly the same as tube AGC which should be -10 volts and only measures -4. Both readings are insufficient.

Open bypass capacitors often produce the same symptoms (only often more severe) as a similar defect in tube circuits. These symptoms include:

- loss of vertical locking;
- one side of the picture darker than the other; and
- picture bending which resembles sync separator trouble.

Practice analyzing AGC circuits by using the negative-going and positive-going shortcuts and we are sure you will encounter fewer tough AGC problems. □

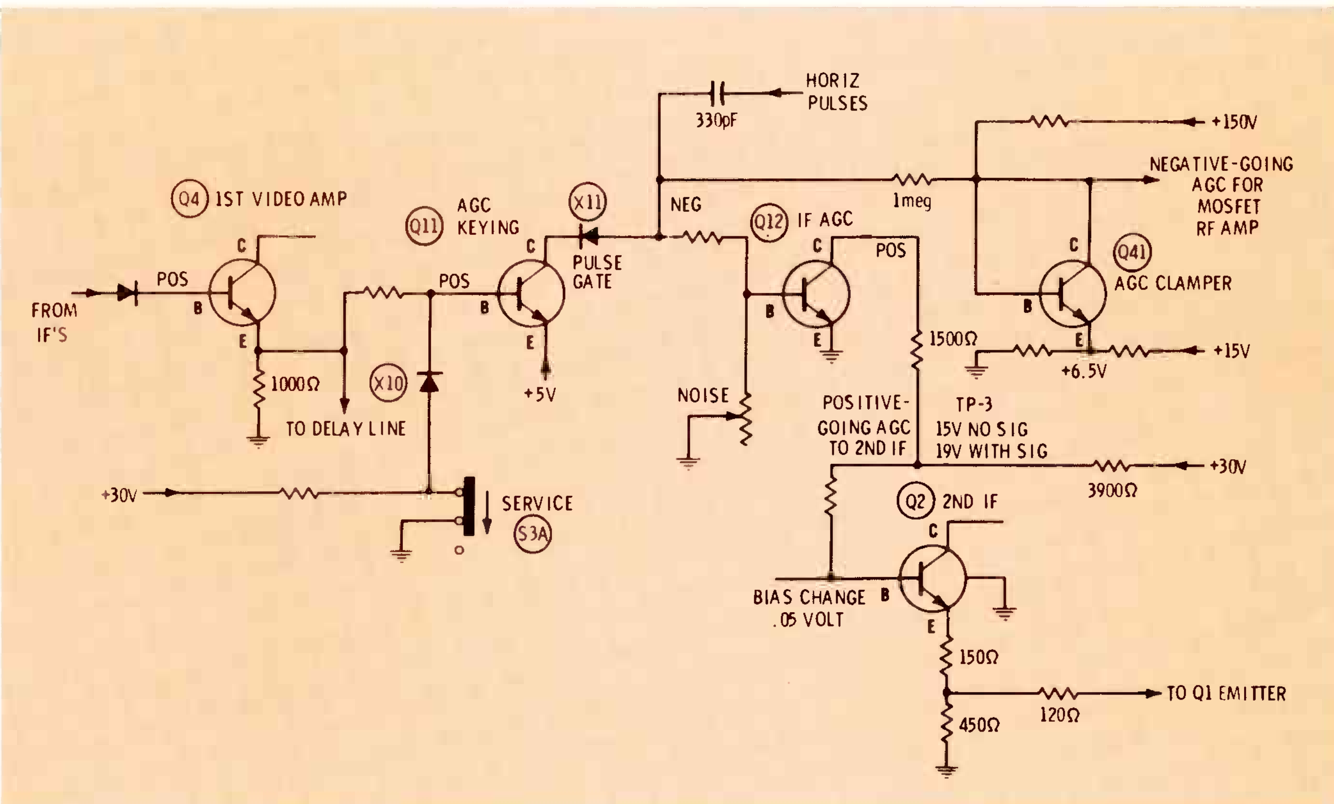
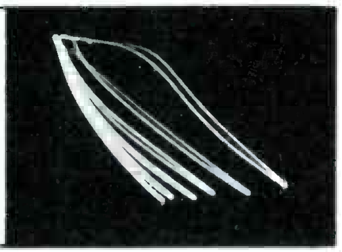
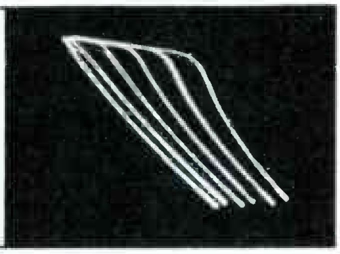
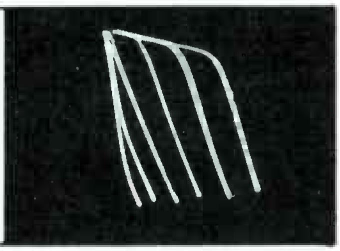
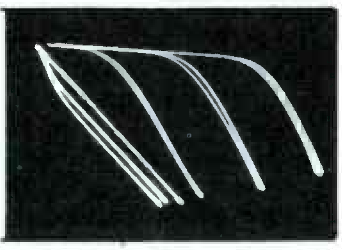
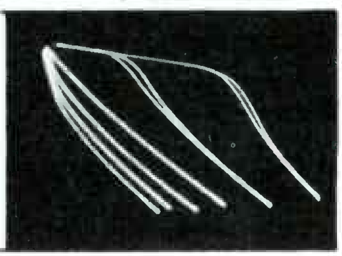


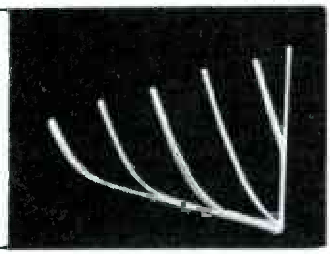
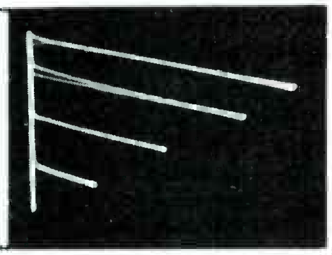
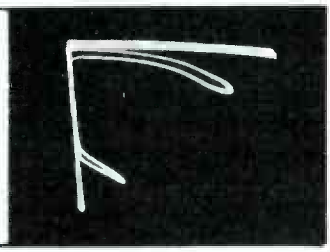
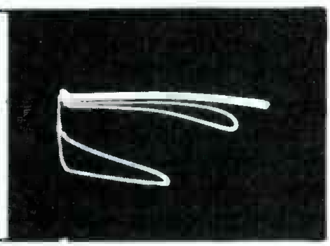
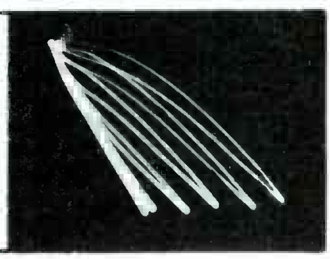
Fig. 12 Simplified schematic of the AGC circuit of the RCA CTC40 solid-state chassis. No AGC control is used, and the RF stage has a dual-gate MOSFET with voltage protection by a zener. IF AGC is by saturation effect.

SIGNATURE PATTERNS

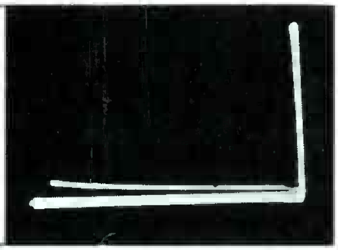
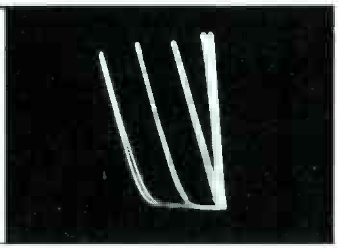
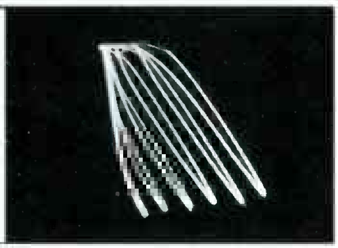
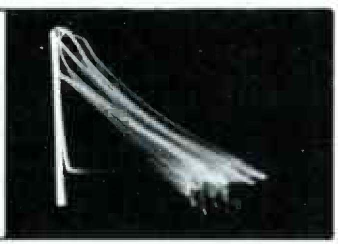
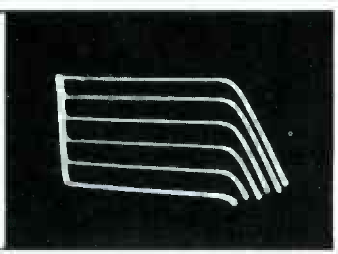
Made On Jud Williams Model A Curve Tracer

ADMIRAL CHASSIS 2K20

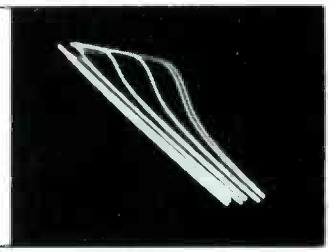
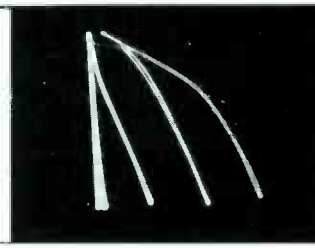
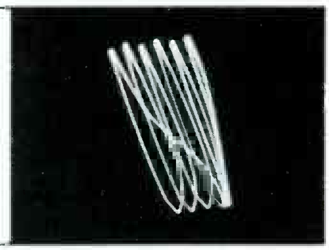
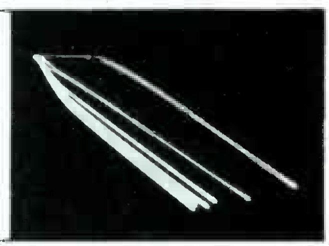
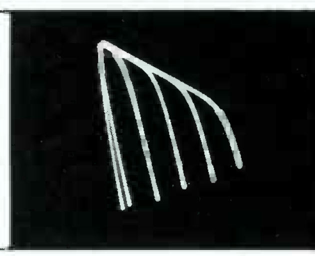
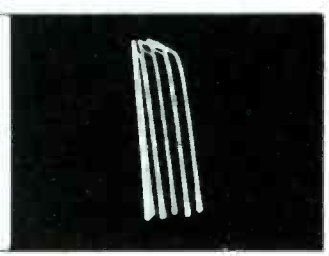
MANUFACTURER ADMIRAL	MODEL OR CHASSIS 2K20
TRANSISTOR IDENTIFICATION & CURVE TRACER SETTINGS	**SIGNATURE PATTERNS**
Q301 1st IF **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 20uA	
Q302 2nd IF **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 200uA	
Q303 3rd IF **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 200uA	
Q304 1st VIDEO **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 50uA	
Q401 AFC AMP **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 200uA	

MANUFACTURER ADMIRAL	MODEL OR CHASSIS 2K20
TRANSISTOR IDENTIFICATION & CURVE TRACER SETTINGS	**SIGNATURE PATTERNS**
Q501 SYNC AMP **POLARITY** PNP **SWEEP VOLTAGE** 30V **BASE CURRENT** 200 uA	
Q502 SYNC. SEP. **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 10uA	
Q503 NOISE GATE **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 50uA	
Q504 AGC GATE **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 50uA	
Q505 AGC AMP **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 10uA	

MANUFACTURER	MODEL OR CHASSIS
ADMIRAL	2K20

TRANSISTOR IDENTIFICATION & CURVE TRACER SETTINGS	SIGNATURE PATTERNS
Q506 AGC DELAY POLARITY PNP SWEEP VOLTAGE 30V BASE CURRENT 500uA	
Q601 CHROMA AMP POLARITY PNP SWEEP VOLTAGE 30V BASE CURRENT 10uA	
Q602 YEL GATE POLARITY NPN SWEEP VOLTAGE 30V BASE CURRENT 20uA	
Q603 RED GATE POLARITY NPN SWEEP VOLTAGE 30V BASE CURRENT 100uA	
Q604 3.58 SWITCH POLARITY NPN SWEEP VOLTAGE 30V BASE CURRENT 20uA	
Q605 EMITTER FOLLOWER POLARITY NPN SWEEP VOLTAGE 30V BASE CURRENT 50uA	

MANUFACTURER	MODEL OR CHASSIS
ADMIRAL	2K20

TRANSISTOR IDENTIFICATION & CURVE TRACER SETTINGS	SIGNATURE PATTERNS
Q701 1st BANDPASS POLARITY NPN SWEEP VOLTAGE 30V BASE CURRENT 200uA	
Q702 2nd BANDPASS POLARITY NPN SWEEP VOLTAGE 30V BASE CURRENT 50uA	
Q703 BURST AMP POLARITY PNP SWEEP VOLTAGE 30V BASE CURRENT 20uA	
Q704 3.58 OSC. POLARITY NPN SWEEP VOLTAGE 30V BASE CURRENT 20uA	
Q705 DRIVER POLARITY NPN SWEEP VOLTAGE 30V BASE CURRENT 50uA	
Q706 BUFFER POLARITY NPN SWEEP VOLTAGE 30V BASE CURRENT 200uA	

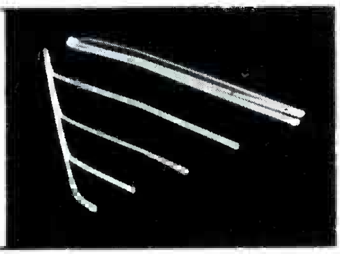
MANUFACTURER	MODEL OR CHASSIS
ADMIRAL	2K20
TRANSISTOR IDENTIFICATION & CURVE TRACER SETTINGS	SIGNATURE PATTERNS

Q707 KILLER DET

POLARITY NPN

SWEEP VOLTAGE 30V

BASE CURRENT 10uA

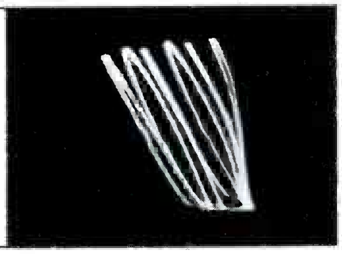


Q708 KILLER AMP

POLARITY PNP

SWEEP VOLTAGE 30V

BASE CURRENT 20uA



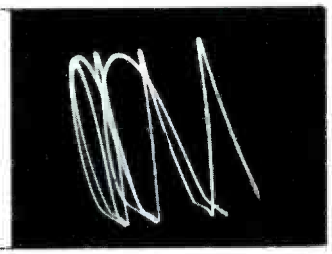
MANUFACTURER	MODEL OR CHASSIS
ADMIRAL	2K20
TRANSISTOR IDENTIFICATION & CURVE TRACER SETTINGS	SIGNATURE PATTERNS

Q709 ACC AMP

POLARITY PNP

SWEEP VOLTAGE 30V

BASE CURRENT 20uA

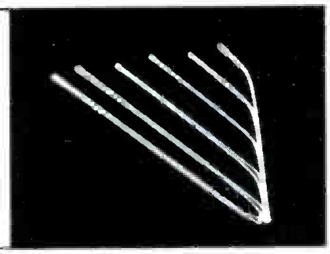


Q710 BLANKER

POLARITY PNP

SWEEP VOLTAGE 30V

BASE CURRENT 20uA



Retention and protection of

Here are some tips to help you decide which business records to keep, how long to keep them, and how to protect them.

By Robert G. Amick

Keep business records! Be accurate and thorough! Keep complete records! That's always been our advice. If you have taken those warnings seriously, you'll have acquired quite a supply of paper.

And that raises an important double question: "How long do I keep those records? How do I protect them?"

Part of the answer depends on the nature of the records. Some are permanent records: deeds, leases, mortgages, and certain insurance policies; anything that has an indefinite or long life.

Then there are those of moderate life spans, such as: chattel mortgages on your truck, store fixtures, or other equipment. These should be retained for some time past their pay-off dates.

Finally, there are short-life records, and these might be papers having a useful life of two months up to a year.

Determining Useful Life

Here are some of the factors about records that determine the necessary period of retention:

Legal requirements

Federal, state or local laws might require you to keep available certain records for specified periods of time. In addition, other laws set forth how long after an event happens that legal action can be taken against you. Check with your lawyer to be certain.

Business requirements

Records intended to facilitate your operation should be kept until they lose their usefulness.

Administrative discretion

If you plan to analyze a certain type of record to improve some system (inventory controls, for example), then obviously you must retain all records relating to this part of your business. Or, if the same information is preserved in two sets of records, you must decide which to retain and which to discard.

As you can see, disposing of records systematically is an individual question. It will differ in your business even from other similar businesses.

And yet, planned disposal of records is vital. It takes equipment, space, and valuable time to store and handle them.

Let's look at some typical classifications of records and their normal period of retention, as they might apply to your business.

Real Estate

Deeds, rights-of-way, and easements are held permanently. Or, at least as long as you own the affected property. Keep leases for four to six years after expiration (according to the statute of limitations). A lease which is automatically renewed, unless one of the parties acts to terminate it at renewal time, is kept this way. While short-term leases which you renew on the same terms year-by-year need only be held for a year after expiration.

Tax Records

Records on purchase and use-tax returns are held for three years because a city or state must announce its intentions to act on these returns within this time limit. State and federal income tax returns are normally held for six years, sometimes permanently.

Legal Records

A trade-mark, patent or copyright, state registration of a business name, or state assignment of a tax-record number is a permanent record. Contracts usually are kept for six years after expiration. Those renewed annually are kept like annually-renewed leases.

Formal records on lawsuits are usually held for six to ten years after the settlement, although the worksheets and notes connected with a lawsuit or contract can be cleaned out as soon as the matter is settled or the contract signed.

Payroll

Payroll records must be kept, according to law, for specific periods. Earnings records for four years, payroll records for three years, wage-and-hour records for four years. Pension records are kept permanently, and sometimes serve as records of earnings or payroll as well.

Shipping And Delivery Records

The only requirement here is that order, shipping, and billing records should be retained for two years. These records frequently duplicate each other. In that case, you can discard one or more covering the same transactions. One record satisfies the law.

Insurance Records

If there's any possibility of a claim against one of your insurance policies, retain that policy, even after expiration. Of course, the insurance company will have their records, but it's still a good idea to have your own. Keep these policies until the statute of limitations (usually four to six years) says no action can be brought.

Attach to the policy any notes of minor accidents with the truck, or the incident when a customer tripped on your loose floorboard, even though no action was required at the time. This will remind you not to discard the policy the minute it expires.

As you can see, some of these records are held to meet legal requirements. Others are held to protect yourself. Your own analysis must tell you what records to keep for how long.

Correspondence and sales tickets fall into this discretionary group.

records

Letters covering orders, adjustments and similar subjects usually needn't be kept for more than 60 to 90 days after the matter is concluded.

Sales and job tickets certainly should be held as long as your guarantee on the work is in effect, plus a precautionary period. Watch your local consumer-protection laws on this.

Protecting Records

Obviously, it is important to have vital records protected against loss and destruction. And yet it might be equally important for you to be able to get to them during the business day. Often the answer is to have duplicates made.

In legal matters, the original document takes precedent over copies. But, in your daily work, the information you need is just as valuable when taken from a photocopy.

Therefore, a copy can be kept in your active files, while the original is protected is a safe place, such as a safe-deposit box. Also, safe-deposit boxes are ideal for storing deeds, leases, contracts and insurance policies because they don't require much storage space.

Others of your daily business records grow constantly, requiring much space, and yet they are important enough to need protection. Records of what you own, what you owe, and what is owed you are irreplaceable. If they were wiped out by fire, flood, or other disaster, their loss might prevent complete recovery under your insurance coverage (inventory records), or delay settlement of money from those who owe you.

Unfortunately, these are the very records you need constantly, so locking them in a vault is no help.

Some shop managers keep the original records in the stores and duplicates stored in their homes. However, such duplicates must be in order. Make copies promptly and keep the filing up to date.

Well-kept records properly protected will prevent many costly and embarrassing incidents and losses. □

test equipment report

Features and/or specifications listed are obtained from manufacturers reports. For more information about any product listed, circle the associated number on the reader service card in this issue.

Solid-state Oscilloscope

Product: B&K Model 1403 3-inch "Mini-Scope" by Dynascan Corporation.

Features: A general-purpose unit, this oscilloscope is lightweight, compact and rugged, suited for field-service work, production lines and schools. The 1403 has a bandwidth of DC to 2.0 MHz, and has direct-deflection terminals for viewing waveforms to 150 MHz. It's solid state, has DC amplifiers on both horizontal and vertical axes. A wide-angle CRT is used to reduce case depth, making the 1403 compact and portable.

Size: Dimensions are 5-1/4 x 7-3/8 x 11-1/4 inches. The weight is 8.5 pounds.

Price: B&K Model 1403 scope sells for $179.95.

For More Details Circle (50) on Reply Card

Frequency Counter and Multimeter

Product: Hickok 3420 Multimeter/Counter from Hickok Electrical Company.

Features: Hickok 3420 combines a 4-digit multimeter (which measures AC voltages, DC voltages, and resistances) with a 5-digit 20-MHz counter in one compact instrument.

Size: Dimensions are 3-1/2 X 8-3/8 X 13 inches. It weighs 10 pounds.

For More Details Circle (51) on Reply Card

Industrial VOM

Product: Model 265 VOM from Simpson Electric Company.

Features: High AC- and DC-current ranges, and the ability to almost simultaneously take AC-voltage and AC-amperage readings are two features making the meter suitable for industrial work. Appearance is similar to the familiar Model 260, with a rotary switch to select the ranges, a handle which doubles as a meter stand, and a protective carrying case. Accessories include a spring-loaded retractable probe, 5KV AC and DC probes and a 30KV DC high-voltage probe for TV use. The VOM is supplied with test leads, batteries and operator's manual.

For More Details Circle (52) on Reply Card

Four-Function Pocket Calculator Kit

Product: Heathkit IC-2009, four-function pocket calculator kit by the Heath Company.

Features: A battery-powered, self-contained calculator, Heathkit IC-2009 offers 8-digit LED display with a full-floating decimal. A Constant key permits chain calculations, while a Clear Entry key allows removal of an entry from the display window without disturbing prior calculations. Plug-in keyboard and display boards, plus a complete troubleshooting section in the instruction manual make self-service easy and economical. Assembly time of the calculator is two or three evenings.
Price: Heathkit IC-2009 sells for $92.50.

For More Details Circle (53) *on Reply Card*

TV Marker-Signalyst

Product: RCA WR-525A Marker-Signalyst from Electronic Components of RCA Corporation.
Features: WR-525A is designed for aligning TV receivers with sweep-

alignment generators to check TV-tuners and RF/IF receiver alignment on all VHF channels and many UHF channels. Calibrated for fundamental signal output on picture-carrier frequencies, WR-525A will provide dual picture and sound sweep-alignment markers when modulated with 4.5-MHz signal.
Size: Dimensions are 4-1/2 X 3-1/2 X 3 inches. Power is provided by a single 9-volt battery.
Price: WR-525A sells for $46.50.

For More Details Circle (54) *on Reply Card*

Vest-Pocket Multitester

Product: Model 51-150 vest-pocket multitester by Weltron Company.
Features: Model 51-150 has a sensitivity of 1,000 ohms-per-volt. Ranges: AC volts 15V, 150V, 1000V; DC volts 15V, 150V, 1000V; DC current 1MA, 150MA: resistance 0 to 100K ohms. Accuracy is ±3% of full-scale value on DC ranges, ±4% of full-scale value on AC ranges, and ±10% of indication on ohms.
Size: 2-2/8 X 3-9/16 X 1-3/16 inches: weight is .37 pounds including test leads and packaging.
Price: The Weltron Model 51-150 Multitester sells at retail for $41.55.

For More Details Circle (55) *on Reply Card*

Substitution Unit

Product: The "Substitutor" model RC167 from Sencore, Inc.
Features: Model RC167, replacing the company's model RC146, is intended for solid-state work. A full range of carbon resistors, wire-wound power resistors, capacitors, universal rectifiers and conventional electrolytic capacitors are provided for substitution tests. The addition of large, low-voltage capacitors such as 1000- and 2000-microfarad electrolytics at 75 volts, now provides the service technician, experimenter or engineer with a full range of values. Because of the lower voltages of these large, solid-state electrolytics, extra protection is provided by the surge-protector switch. The instrument has a reversible parts drawer, and can be mounted upside down or on a wall.
Price: Model RC167 is listed for $90.00. □

For More Details Circle (56) *on Reply Card*

product report

for further information on any of the following items, circle the associated number on the reader service card.

Solid-state Rectifiers

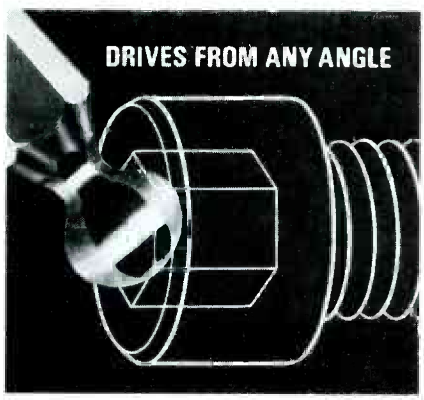
Product: ECG508/R-3A3, ECG509/R-3AT2, ECG510/R-3DB3, high-voltage rectifiers; ECG511/R-2AV2 focus rectifier; ECG512/R-DW4 damper diode; ECG513, 45 kilovolt stick rectifier; by GTE Sylvania Incorporated.

Features: The rectifiers directly replace electron tubes in certain television applications, and have been added to the ECG replacement semiconductor line offered by GTE. The devices are packaged individually with a data sheet giving mechanical and electrical ratings and a list of tube types they replace. ECG semiconductors and a complete cross-reference guide are available through Sylvania's electronic component distributors.

For More Details Circle (57) on Reply Card

Screwdrivers and Blades

Product: Allen hex-type screwdrivers and interchangeable blades by Xcelite Incorporated.

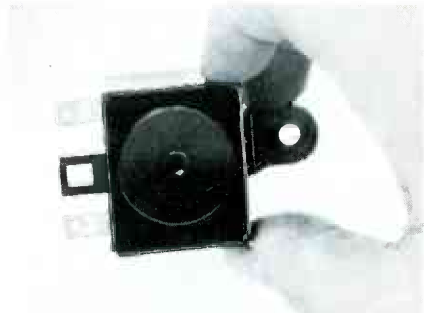


Features: A "ballpoint" tip design increases speed and ease in engaging and turning. The tools are said to work at any angle, and thus handle hex socket screws which, because of obstructions, cannot be reached straight-on. Nine sizes, from .050 inches through 3/16 inches, are available. Fixed-handle types are packed singly, or complete sets in roll kits with extra pockets for associated tools are offered.

For More Details Circle (58) on Reply Card

DC Buzzer

Product: DC buzzer from Littlefuse, Inc.



Features: Designed for low-voltage applications requiring an audible alarm, the buzzer can be used in heat-sensing fire alarms and burglary prevention systems. Automotive applications include unfastened seat-belt, ignition-key-in, headlights-on, door-ajar, and excessive-speed warnings. Rated for operation at 12 volts DC, the buzzer has an output of 75dB minimum in the range of 150-300 Hz. The low-current-drain (200 Milliamps) device is sealed in a molded housing that protects the vital functioning components. The unit is supplied with two ¼-inch wide quick-connect terminals which can accommodate standard solder-type connections. It has a .28 X .22 inch molded plastic pin for mounting purposes.

Size: Dimensions are 1.68 X 2.15 X .69 inches.

For More Details Circle (59) on Reply Card

Fuseholders

Product: "Snap-Lock" feature for mounting panel-mounted fuseholders announced by Bussman Manufacturing Division.

Features: Mounting is done easier and more quickly because of the elimination of the conventional fastening nut and washer. The fuseholder can be pre-wired and snapped into place from the rear of the panel. Fingers on the Snap-Lock feature engage the edge of the panel hole and lock the holder securely in place. It can be used in panels .025 to .085 inch thick. The Snap-Lock feature is available on Buss fuseholders, HTA, HLD, and HKP to take 1/4 X 1-1/4 inch fuses and the HJM fuseholder to take 1/4 X 1 inch fuses. □

For More Details Circle (60) on Reply Card

catalogs literature

Circle appropriate number on Reader Service Card.

100. Dukane Corporation—has released a brochure entitled "Sound Systems" which offers the reader basic data for the design of sound-reinforcement systems. Path of the signal is traced from the source through components in systems that range from the elementary to the complex. System organization is depicted by flow diagrams with line drawings of actual components. Two tables assist the reader in selecting appropriate volume controls and determining correct power requirements.

102. Eder Instrument Co.—announces release of a four-page catalog illustrating and describing the new Eder-Lite, a full line of miniature inspection lamps and accessories. The Eder-Lite has long been used for the inspection of electronic equipment, appliances, and precision instrumentation, because it permits viewing of inner surfaces and hard-to-get-at places.

103. General Electric Co.—has available a bulletin, GEA-8429A, describing the type AK-4 hook-on volt-ammeters for testing alternating current circuitry.

104. JSH Electronics, Inc.—is distributing a price list for communication tubes which includes special purpose tubes, cathode ray tubes, receiving tubes and solid-state tube replacements. It covers major brands and is eight pages long.

105. Mallory Distributor Products Co.—has released a brochure concerning security products which include smoke/fire alarms, car alarms, closed-circuit alarms, personal alarms and ultrasonic alarms. This brochure, 9-654, covers over 45 security products and accessories.

106. Motorola's HEP—offers a catalog in which 43,000 semi-conductor devices are cross-referenced to 472 HEP replacements. Included in the catalog (HMA-07) are 1N, 2N, 3N, JEDEC, manufacturers' regular and special "house" numbers and many international devices. All Motorola HEP devices are listed by type numbers and case style with a packaging index, device dimension drawings and selection guide information.

107. Mountain West Alarm Supply Company—has in stock M-73, an 80-page catalog which describes 400 intrusion and fire-alarm products, many of which are UL listed. It features 8 pages of "application notes" for alarm equipment with some information on general alarm systems.

108. Multicore Solders—introduces a 6-page brochure describing and illustrating in full-color photographs typical soldering problems, and the company's full line of solders, fluxes and chemicals. Among the problems illustrated are icycling, bridging, dewetting, blowholes, contamination, insufficient and excess solder. Each is an actual photograph showing the problem related to the circuitry and solder of joints of PC boards and terminals.

109. Nortronics—offers a new edition of their Recorder Care Manual, a 32-page manual published for users of reel-to-reel, 8-track cartridge and cassette recorders and players. The new publication illustrates how regular maintenance of recording equipment insures continued optimum performance and longest possible recorder life. It provides detailed information of the principles of magnetic recording, magnetic heads and important maintenance operations.

110. Pomona Electronics—announces publication of its 1973 catalog of electronic test accessories. Featured new products include a do-it-yourself "Grabber" (a version of the mini-test clip) and two molded breakout test cables. The catalog provides illustrations and complete engineering information on all products, including dimension drawings, schematics, specifications, features, and operating ranges.

111. Sprague Products Co.—has released an 8-page short-form resistor catalog which contains 5980 catalog items with 616 different resistance values (from 0.1 ohm to 250,000 ohms) and 15 wattage ratings (from 1 to 120 watts). The catalog has basic descriptions and physical sizes, giving buyers and specifiers the data they need for fast, easy selection of resistors. Also given are complete listings of Sprague's family of wire-wound resistors.

112. TDK Electronics Corporation—has a 48-page booklet, "The TDK Guide to Cassettes", which contains useful information on home tape recording methods and equipment. The booklet offers facts and tips for those who want to learn more about tape recording techniques and how to get more rewarding results. It contains a short course in tape recording terminology and technology for the layman, including an explanation of the various types of tape formats, their merits and applications.

113. Vaco Products Company—has available a 16-page publication illustrating a selection of screw-holding drivers, nut drivers, reversible drivers, offset drivers and many more. This brochure of tools and "fixin" things is numbered SD-168.

114. Watts Business Forms, Inc.—has a revised 1973 edition of the Watts Stock Business and Tax Forms catalog. It features newly designed forms with B-color custom-look printing at stock-form prices, custom-design letterheads, business cards and forms for every industry and use.

115. Xcelite Incorporated—has released Bulletin/Price List No. 273L which describes a new line of Allen hex type screwdrivers with "ball-point" tip design. An illustration demonstrates how the tools can be used at an angle to drive socket screws which, because of obstructions, cannot be engaged straight-on. □

audio systems report

Features and/or specifications listed are obtained from manufacturers reports. For more information about any product listed, circle the associated number on the reader service card in this issue.

Tone Arm

Product: Shure-SME Model 3009 Series II improved tone arm by Shure Brothers Incorporated.

Features: Model 3009 Series II features reduction in the effective tone arm mass and improved antiskating control. Other improvements include less overhang of the counterweight, making the arm suitable for use with most turntables, and easier balance adjustment incorporating a rotating counterweight at the rear of the tone arm. Shure-SME Series II accepts cartridges weighing four to nine grams and allows tracking force adjustments in 1/4 gram increments from 0 to 1-1/2 grams.

Price: Model 3009 is priced at $135.

For More Details Circle (61) *on Reply Card*

Automatic HI-FI Analyzer

Product: Model BKF10 Automatic Distortion Analyzer from The London Company.

Features: Model BKF10 incorporates a distortion meter, a sweepable AF oscillator, an amplitude-response meter, and a frequency indicator, all of which operate automatically. This equipment simultaneously determines both distortion factor and frequency response, while the input signal is swept through the four frequency decades. Internal harmonic distortion is maintained at less than 0.01%. Dynamic range of the oscillator signal level exceeds 60 dB, from less than lmV to more than 1 volt RMS. As a distortion meter the BKF10 measurements extend from 0.02% to 10%. The distortion meter section can be converted into a signal-to-noise meter by pushing a button. The direct reading presentation then displays noise levels from -80 dB to -20 dB.

For More Details Circle (62) *on Reply Card*

Radio Headset

Product: Model RH-01 radio headset from The Mura Corporation.

Features: Model RH-01 has six transistors and two three-inch transducers for hi-fidelity sound. Equipped with all standard features, the headset is available in four colors. A nine-volt transistor battery is shipped with each unit.
Price. Model RH-01 is priced at $24.95.

For More Details Circle (63) *on Reply Card*

Do-it-yourself Speaker Kits

Product: Models CK10-2, CK20-2, CK20-3, speaker kits from National Tel-Tronics.

Features: All the models utilize National Tel-Tronics "fold-together" cabinet design that enables the purchaser to assemble the walnut-finished enclosure in about 25 minutes. The units are supplied with Peerless Speakers which provide special cone treatments, aluminum voice-coil formers, extra-fine magnet wire, heavy-duty Alnico V magnets.
Price: Prices of these models range from $34.95 to $119.95 per pair.

For More Details Circle (64) *on Reply Card*

Amplifiers

Product: Series CHS-A solid-state public-address amplifiers from the Bogen Division of Lear Siegler, Inc.
Features: All models in the series incorporate an electronic compressor, and the four amplifiers have facilities for connecting a reverberation unit or acoustic equalizer unit. Models CHS-20A, CHS-35A, CHS-60A, and CHS-100A are rated at 20, 35, 60, and 100 watts, respectively; Model CHS-M is the preamplifier-mixer. CHS series accessories include rack mounting kits, a locking cover for the control panel, a phonograph top that mounts on the amplifier, and a carrying case for use in portable systems.

For More Details Circle (65) *on Reply Card*

photofact bulletin

Photofact Bulletin lists new **Photofact** coverage issued during the last month for new TV chassis.

ADMIRAL
Chassis 7K1885-1, 8K1886-1/-2/-3, 8K1887-1/-2/-3/-5, 12K1879-3, 12K1881-3 1335-1

ADMIRAL
Chassis M2001-2, M2004-2 1328-1

CURTIS MATHES
5E10 (Ch. C-52, CMC-52) 1330-1

DUMONT
16DP02W 1334-2

EMERSON
Chassis 5K1673-34, 5K1675-4, 11K1663-43, 11K1670-2 1336-2

EMERSON
25CC93S (Ch. 30M20) 1339-2

EMERSON
Chassis 6K2000-1 1335-3

GENERAL ELECTRIC
Chassis 10JA 1339-3

GENERAL ELECTRIC
Chassis 16JA 1335-2

GENERAL ELECTRIC
Chassis 19JA 1328-2

HITACHI
CU-100 1337-1

MAGNAVOX
Chassis T979-01-BA thru T979-06-BA, T979-02-AA thru T979-05-AA 1329-1

MOTOROLA
Chassis H9TS-460 1337-2

MOTOROLA
Chassis 14TS-929, E/F/YE16TS-929, J/YF/YJ18TS-929 1327-1

MOTOROLA
Chassis 16TS-/C16TS-/YC16TS-/ZVC16TS-597/T, 19TS-/C19TS-/D19TS-/K19TS-/Q19TS-/YD19TS-/YQ19TS-/ZDC19TS-/ZDQ19TS-/ZV19TS-/ZVL19TS-/ZWQ19TS-597/T 1324-2

OLYMPIC
CT-513 1329-2

OLYMPIC
9P96, 9P97 1326-1

PHILCO-FORD
Chassis 3BH15, 3BH15A, 3BH16, 3BH16A 1334-3

PHILCO-FORD
Chassis 3CY80 1331-1

RCA
AS15W(Ch. KCS168XF) 1338-2

RCA
Chassis CTC51E/K/XAB/XU/XW, CTC52C/D/F/XAB/XAC/XAE/XAF/XN 1332-2

RCA
Chassis CTC60A/B 1330-2

RCA
Chassis KCS168XD/XE 1326-3

RCA
Chassis KCS172L/M/M 1333-3

RCA
Chassis KCS191A 1323-2

SEARS SILVERTONE
528.50160200/201/202 1327-3

SEARS
564.40620200/201, 564.40630200 1336-3

SHARP
3S-26R, 3S-26W, 3S-27R, 3S-27W 1331-3

SYLVANIA
D14-1 thru D14-5 1335-3

SYLVANIA
Chassis D16-10/-11/-12/-15/-16/-17 1325-2

SYLVANIA
Chassis D18-1 thru D18-4 1322-3

SYLVANIA
Chassis E02-1, E02-2 1324-3

WARDS AIRLINE
GAI-1125A/B 1325-3

□

The MARKETPLACE

This classified section is available to electronic technicians and owners or managers of service shops who have for sale surplus supplies and equipment or who are seeking employment or recruiting employees.

Advertising Rates in the Classified Section are:

- 25 cents per word (minimum $3.00)
- "Blind" ads $2.00 additional
- All letters capitalized 35 cents per word

Each ad insertion must be accompanied by a check for the full cost of the ad.

Deadline for acceptance is 30 days prior to the date of the issue in which the ad is to be published.

This classified section is not open to the regular paid product advertising of manufacturers.

FOR SALE

TV & RADIO TUBES 36c EA!! Free color catalog. Cornell, 4221 University, San Diego, California 92105 4-73-tf

FOR SALE CONT.

FOR SALE: B&K 1460 DC-10MHZ TRIG. SCOPE B&K 415 SWEEP/MARKER GENERATOR NEW $275 EACH. I PAY SHIPPING. ROLESON T.V. R2 BOX 77 BROOKVILLE, INDIANA 47012 8-73-1t

T.V. TEST EQUIPMENT 415 B&K Sweep Marker 1077 B&K T.V. Analylst, 1465 B&K Oscilloscope (Equipment Never used). $1000.00. Donaldson Selectronics, 42220 52nd St. West, Quartz Hill, Ca. 93534 8-73-1t

USE YOUR SCOPE (any model, no rewiring) to test transistors in/out circuit. Simple instructions $1.00. Schek Technical Services, 8101 Schrider St., Silver Spring, Maryland 20910. 2-73-8t

"BUILD A PRECISE AC VOLTAGE SOURCE for calibrating scopes and meters, with parts from junk box. Complete plans $2.00. Total Electronics, 27 Sunrise, Hawthorne, N.J. 07506." 6-73-3t

UNUSUAL SURPLUS electronics and parts catalog, thousands of items. $1. ETCO, Dept. ES, Box 741, Montreal, Canada. 2-73-10t

B&K 415, used once, complete with cables, book, etc. $300, prepaid; Hewlett-Packard 524C 8 Digit frequency counter with 525A 100mc plug in, complete with manuals, in daily use, $375. FOB, Peter Graulich, 1157 Concord Dr., Haddonfield, N.J. 08033" 8-73-1t

WANTED

"WANT TO BUY Supreme TV Servicing Manuals, no's TV 26 up. Also, color bar and sweep generators. - Write R. Barzel, 428 W. Roosevelt Blvd., Philadelphia, Pa. 19120" 8-73-1t

EDUCATION INSTRUCTION

REPAIR TV TUNERS—High Earnings; Complete Course Details, 12 Repair Tricks, Many Plans, Two Lessons, all for $1. Refundable. Frank Bocek, Box 3236 Enterprise, Redding, Calif. 96001. 5-73-5t

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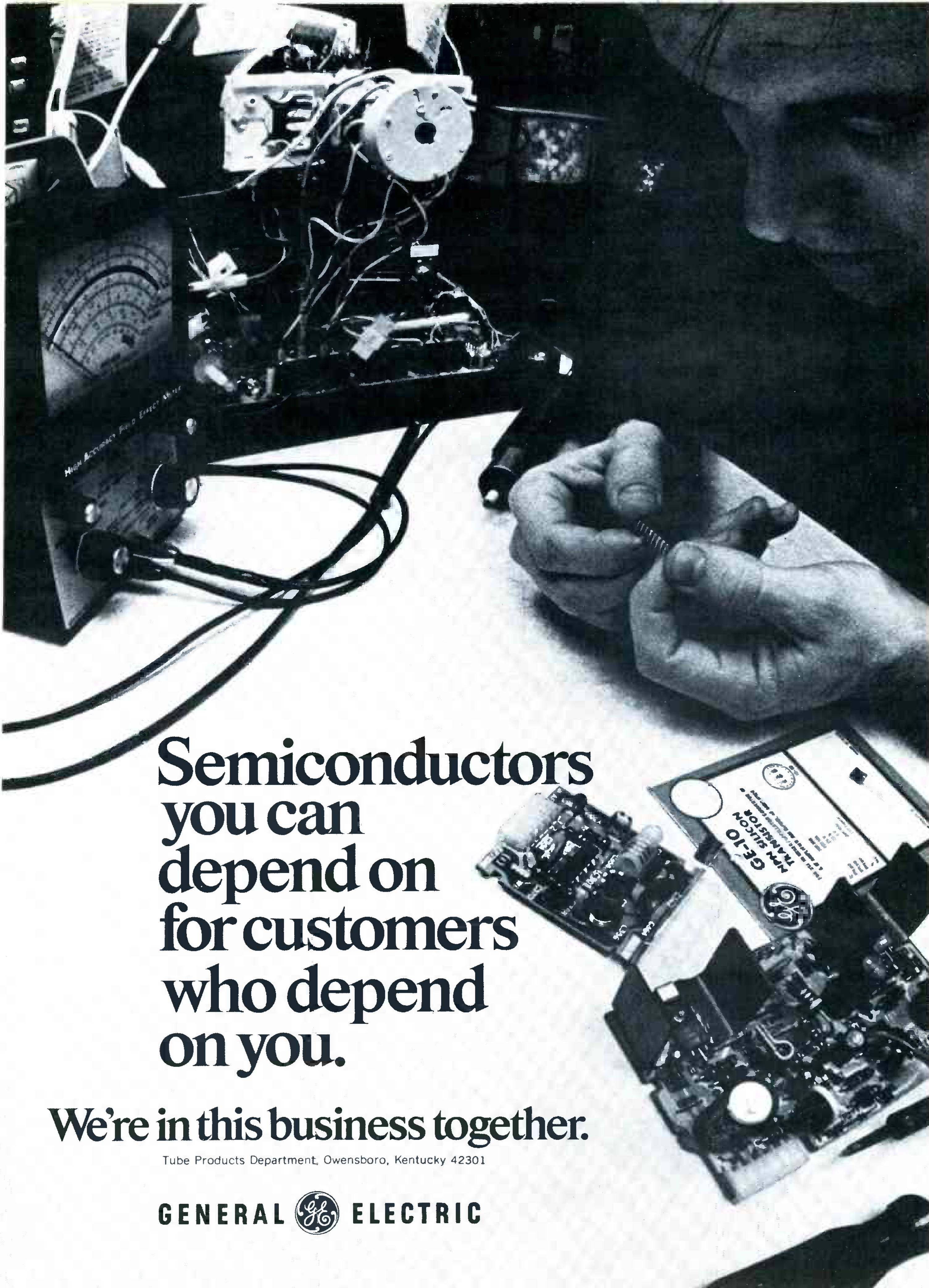
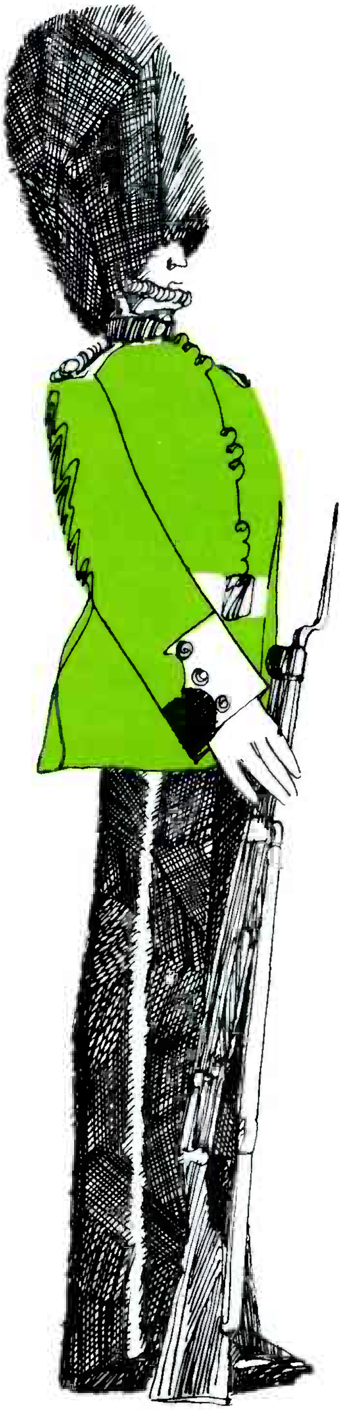
We value your comments and criticism.—Ed.

advertisers' index

For More Information On Items Advertised Use Our Reader Service Cards


GE-10
NPN SILICON
TRANSISTOR

24 hour watch



Everyday. All over the world. On millions of television sets, our sentry stands. The new Littelfuse Circuit Breaker. Meeting industry's new safety requirements of SE-O insulating materials, our breaker is demanded by virtually all set manufacturers. It's the perfect replacement part too!

Contact your nearest Littelfuse source. He'll show you the 19 available models with a variety of packaging choices.

24 hour watch. All over the world. It's a big assignment. But the Littelfuse Sentry is one of television's brightest stars.

LITTELFUSE

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For More Details Circle (2) on Reply Card