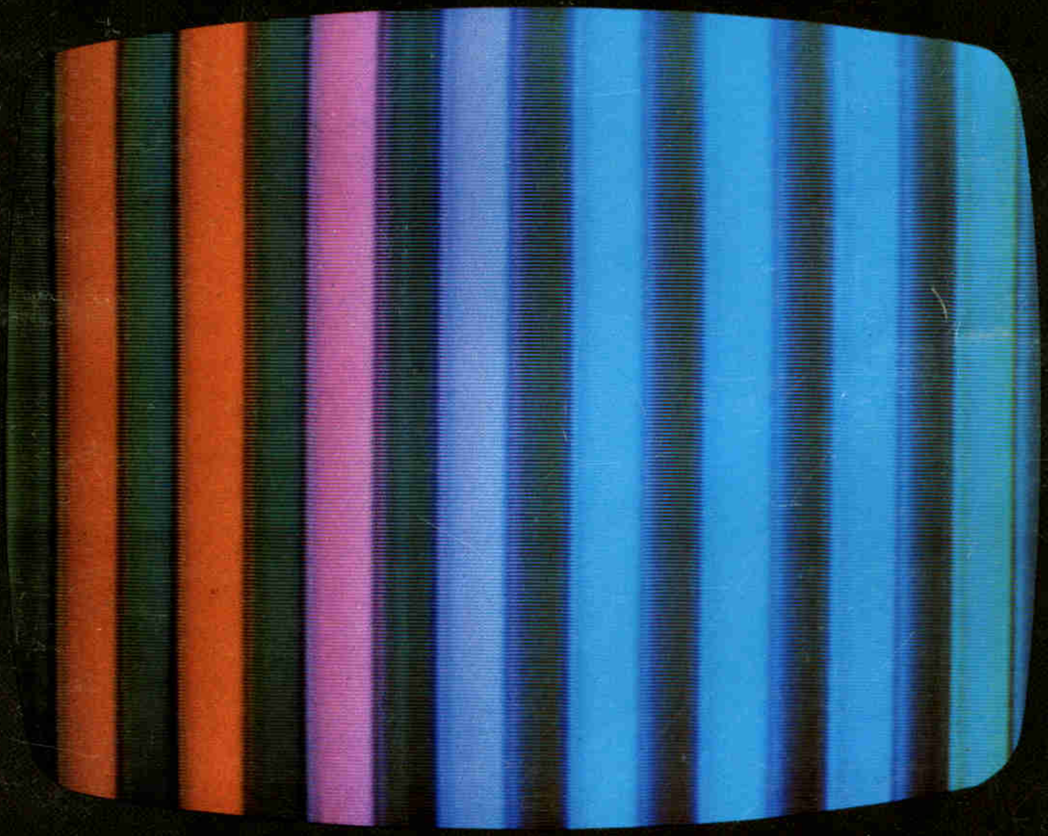
DECEMBER, 1971 75 cents

A HOWARD W. SAMS PUBLICATION

Electronic Servicing

Zenith DATA.



New In Color TV for 1972

General circuit analysis, page 10
Sony's large-screen trinitron, page 26

Testing SCR's and Triacs, page 42

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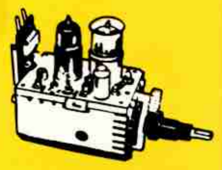

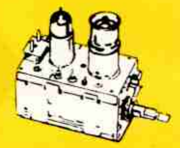

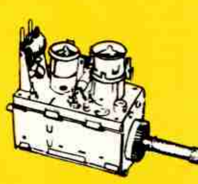

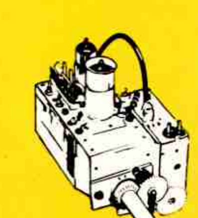

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*Supplied with max. length selector shaft (measured from tuner front apron to tip) . . . you cut to suit.

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CR7S	Series 600mA	1¾"	3"	41.25	45.75	9.50
CR9S	Series 450mA	1¾"	3"	41.25	45.75	9.50
CR6XL	Parallel 6.3v	2½"	12"	41.25	45.75	10.45
CR7XL	Series 600mA	2½"	12"	41.25	45.75	11.00
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EMERSON
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MUNTZ
PR0352-1, PR0364, PR0376, PR9021, PR9044, PR9045, PR9050, PR9058

OLYMPIC
CL4692-1, CL5220-1, CL28874-1, CL29554, CL29566, CL29650, CL33579, CL33858, CL34190, CL34835, K24013USA-1C, K50013USAH-3

PHILCO
76-12405-4, 76-13579-5, 76-13579-7, 76-13579-8, 76-13579-9, 76-13851-2, 76-13871-1, 76-13945-1, 76-13955-1, 76-13955-2, 76-13955-5

R C A
KRK103A, KRK103C, KRK103F, KRK103L, KRK104A, KRK104C, KRK104F, KRK104L, KRK107A*, KRK107B*, KRK107C*, KRK107D*, KRK107E*, KRK107F*, KRK108A*, KRK108B*, KRK108C*, KRK108D*, KRK108E*, KRK108F*, KRK113B, KRK116B, KRK118A*, KRK118C*, KRK118D*, KRK123D, KRK124AA, KRK124U, KRK127AA, KRK127AB, KRK127B, KRK127BA, KRK127E, KRK127L, KRK127T, KRK127U, KRK127W, KRK128AB, KRK128U, KRK133BC, KRK133D, KRK133U

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175-167, 175-168, 175-170, 175-201, 175-202, 175-202A, 175-203A, 175-204, 175-204A, 175-206, 175-212, 175-213, 175-214, 175-216, 175-220, 175-222, 175-228, 175-230, 175-232, 175-254, 175-256, 175-262, 175-264, 175-266, 175-268, 175-272, 175-402, 175-405, 175-406, 175-412, 175-416, 175-418, 175-420, 175-424, 175-426, 175-431, 175-454, 175-601, 175-602, 175-604, 175-621, 175-622, 175-640, 175-641, 175-642, 175-643, 175-644, 175-645, 175-646, 175-647, 175-660, 175-661, 175-662, 175-663, 175-666, 175-667, 175-668, 175-669, 175-671, 175-680, 175-681, 175-682, 175-683, 175-684, 175-685, 175-686, 175-687, 175-688, 175-689, 175-690, 175-708, 175-711, 175-712, 175-713, 175-715, 175-716, 175-717, 175-718, 175-719, 175-720, 175-721, 175-722, 175-731, 175-732, 175-733, 175-734, 175-735, 175-736, 175-737, 175-738, 175-739, 175-740, 175-741, 175-742, 175-743, 175-744, 175-745, 175-746, 175-747, 175-748, 175-750, 175-751, 175-752, 175-753, 175-754, 175-755, 175-756, 175-757, 175-758, 175-759, 175-760, 175-761, 175-762, 175-763, 175-764, 175-1101, 175-1102, 175-1103, 175-1104, 175-1105, 175-1106, 175-1108, 175-1118, 175-1119, 175-1120, 175-1121, 175-1122, 175-1131, 175-1132, 175-1133, 175-1134, 175-1135, 175-1136, 175-1137, 175-1138, 175-1139, 175-1140, 175-1141, 175-1142, 175-1143, 175-1144, 175-1145, 175-1146, 175-1147, 175-1148, 175-1150, 175-1151, 175-1152, 175-1153, 175-1154, 175-1155, 175-1156, 175-1157, 175-1160, 175-1161, 175-1162, 175-1163, 175-1164, 175-1165, 175-1168, 175-1172, 175-1175, 175-1176, 175-1177

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Dismantle tandem UHF and VHF tuners and send in defective unit only.

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When our inspection reveals that original tuner is unfit for overhaul, we offer an exact replacement

If exact replacement is not available in our stock we custom rebuild the original at the exchange price.

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December, 1971 • Volume 21, No. 12

Electronic Servicing

COLOR TV

SHOP MANAGEMENT

SERVICING TECHNIQUES (GENERAL)

AUTO ELECTRONICS

TV (GENERAL)

DEPARTMENTS

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electronic scanner

news of the industry

Philco-Ford Now Testing Color TV Leasing To CATV Subscribers

A color TV receiver leasing program for subscribers to a CATV system in four towns in western Pennsylvania was launched in September by Telesound, Inc., Philco-Ford's motel/hotel TV sales subsidiary.

Called Rentertainment, the program now is limited to CATV subscribers in Greensburg, Jeannette, Youngwood and Irwin, towns located near Pittsburgh, but, if successful, reportedly will be offered to CATV subscribers in other parts of the country.

The cost to the customer for leasing a 19-inch deluxe color receiver reportedly are an initial installation fee of $10 and $14.95 per month, which includes all servicing.

At present, leasing is handled directly through a local Rentertainment office; however, according to Leo C. Beebe, executive vice president, Philco-Ford, and general manager of the Philco-Ford consumer products division, franchised dealers in the area eventually will be given the opportunity to lease color sets to CATV customers. Mr. Beebe said that, within a short time, some Philco-Ford retailers in the area in which the leasing program is being tested will set up Rentertainment lease operations in their TV departments, to allow their customers to either rent or purchase new sets.

The Pennsylvania area reportedly was selected for the color TV leasing test because it is a "matured" CATV market. About 10,000 of the total 36,000 homes in the area reportedly are subscribers to the local CATV system, and, according to Philco-Ford officials, half of the 10,000 CATV subscribers do not presently have color TV receivers.

Sylvania Appoints New Franchised Distributors

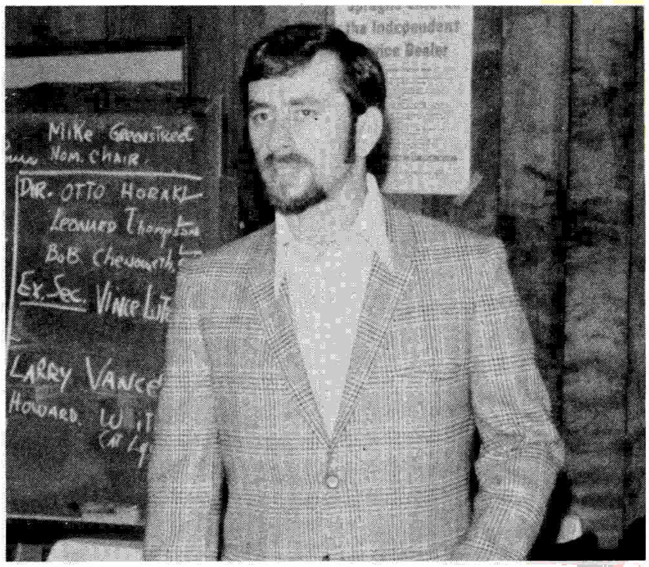
The Electronics Components Groups of GTE Sylvania Incoporated recently announced the appointment of the following franchised distributors:

Electronic Service Supply Co.
1109 Bolton Ave.
Alexandria, La.
(James Long, manager)

HBF Electronics, Inc.
East Petersburg, Pa.
(Barry Forman, president)

Buck Electronic Wholesalers, Inc.
12 Dock Street
Wilmington, N.C.
(Paul Boyer, manager)

The new Sylvania distributors reportedly will offer the complete lines of monochrome and color picture tubes, receiving tubes, ECG replacement semiconductors and special products.



D. Taber Elected President of Missouri Association

Doyle Taber, of Stone TV in St. Louis, was elected president of the new Missouri Electronics Service Association (MESA), at a meeting in Rolla, October 17.

Other officers elected include: Benton Linder, Springfield, vice president; John Hayes, Springfield, secretary; Travis Oviatt, Joplin, treasurer.

Hearings To Determine Need For TV Shop Licensing Held In New York; No Representatives Of Service Appeared

A hearing conducted by the New York State joint legislative committee for consumer protection was held in New York City on Sept. 23, to determine the need for licensing of television repair shops in that state.

The hearing was prompted by the introduction to the legislature of a TV shop licensing, or registration, bill sponsored by Assemblyman Joseph J. Kunzeman, the committee chairman.

State and local consumer officials testified in person before the committee, while submissions of related information by representatives of the TV service business reportedly were limited, by the committee, to written presentations.

According to reports of the hearing published in the *New York Times* and *Radio & Television Weekly*, Harry Smith, assistant district attorney of Queens County, New York, in charge of consumer frauds, stated that "television repairmen too often were incompetent or crooks and charged outrageous prices for ruining a TV set instead of fixing it."

The TV shop licensing bill sponsored by Assemblyman Kunzeman reportedly calls for licensing, or registration, of every TV repair shop in the state and provides for a maximum fine of $500 and cancellation of the license of any shop convicted of "gross negligence, fraud or deception."

Stephen Mindell, assistant state attorney general in charge of consumer complaints, reportedly said his office would like to see licensing of individual

(Continued on page 6)

(Continued from page 4)
repairmen as well as registration of repair shops. Bess Myerson, New York City consumer affairs commissioner, supported Mindell's request for licensing of both technicians and shops.

Reportedly, no witnesses representing the service industry appeared before the committee. According to the *Radio & Television Weekly* report, Assemblyman Kunzeman said, "Repairmen apparently had no organized associations except those set up by the major TV manufacturers, and no manufacturers' spokesman asked to appear."

R. Normandy Re-elected President of National Association of Service Managers

Robert Normandy, director of national service for the Business Equipment Group of Bell & Howell Company, was re-elected to a second term as president of the National Association of Service Managers (NASM), at the Association's annual national conference, October 4-6, in New York.

Information about NASM can be obtained by writing:

Marvin Lurie
Executive Director
NASM
4800 N. Milwaukee Ave.
Chicago, Illinois 60630

T. Bull Elected Vice Chairman of ISCET

Tom Bull, CET, owner of Tom's TV Clinic, Lake Grove, Oregon, was elected vice chairman of the International Society of Certified Electronic Technicians (ISCET), at the Society's board meeting in New Britain, Conn., October 3.

Mr. Bull recently was elected president of the Oregon Television Service Association, and is a past president of the Portland Television Service Association.

Information about ISCET can be obtained by writing:

Ron Crow, CET
Executive Director
ISCET
1306 Douglas St.
Ames, Iowa 50010

TV Service Industry Representatives Meet With GE

Six representatives of the independent television service industry, at the invitation of the TV Receiver Products Department of General Electric, on October 12, met with personnel of that manufacturer, at the General Electric plant in Portsmouth, Virginia, to "look at General Electric's programs and evaluate their relationship to the needs and wants of the servicing industry."

Key topics discussed during the one-day session were: product serviceability, replacement parts distribution, technical service support, and communications. Included also were a meeting with key engineers, a tour of the Portsmouth TV manufacturing center, and a presentation about General Electric's quality control programs.

The primary purpose of the meeting, according to General Electric spokesmen, was to improve two-way communications between manufacturers and servicers, which hopefully will help assure better television servicing.

Representing the television service industry were: Norris Browne, President, and Dick Glass, Executive Vice President, National Electronic Associations (NEA), Inc.; Leo Shumavon, President, and Frank Moch, Executive Director, National Alliance of Television Electronic Service Associations (NATESA); John Gooley, Manager, Service Division of the National Appliance and Radio Dealers Association (NARDA); and Walter R. Cooke, President, Virginia Electronics Association (VEA). ▲

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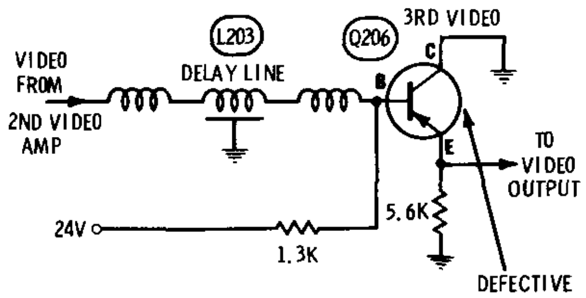
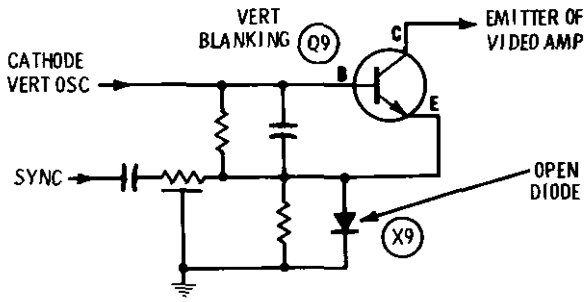
Symptoms and cures compiled from field reports of recurring troubles

Chassis—Zenith 4B45C19
PHOTOFACT—Not yet available



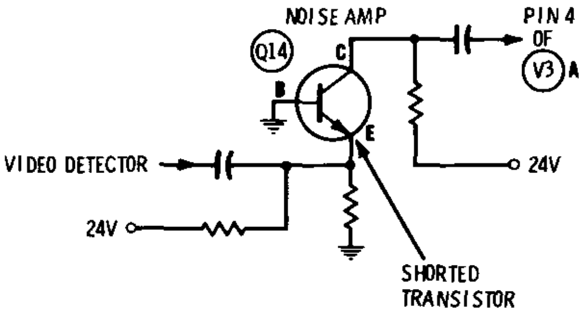
Symptom—Ghosts
Cure—Replace Q206, 3rd video transistor

Chassis—Zenith 16Z8C50
PHOTOFACT—1074-3



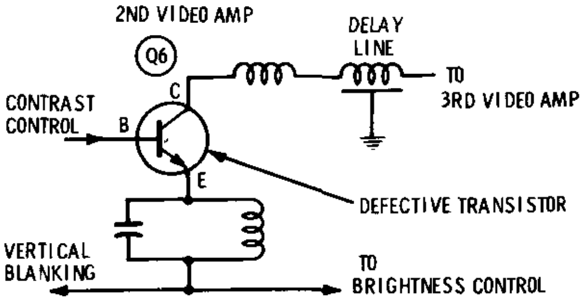
Symptom—Dark picture, bright retrace lines
Cure—Diode X9 open.

Chassis—Zenith 12B14C50
PHOTOFACT—1157-2



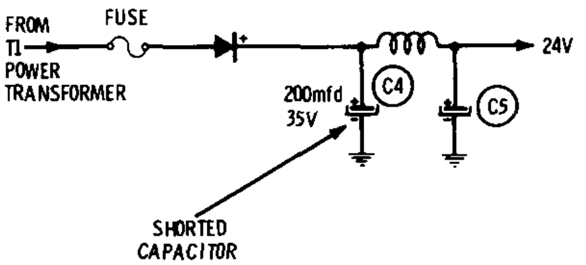
Symptom—Vertical jitter and horizontal bending
Cure—Check noise amplifier transistor, Q14; replace, if shorted

Chassis—Zenith 12B14C50
PHOTOFACT—1157-2



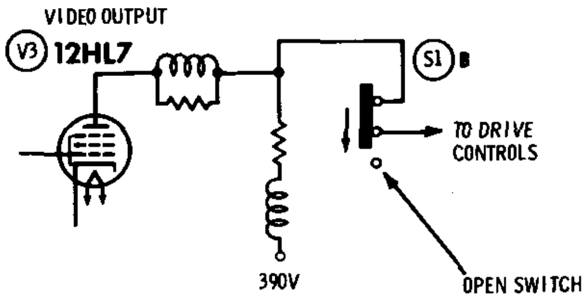
Symptom—Unable to vary brightness through normal range; white compression
Cure—Check 2nd video amplifier transistor Q6; replace, if defective

Chassis—Zenith 12B14C50
PHOTOFACT—1157-2

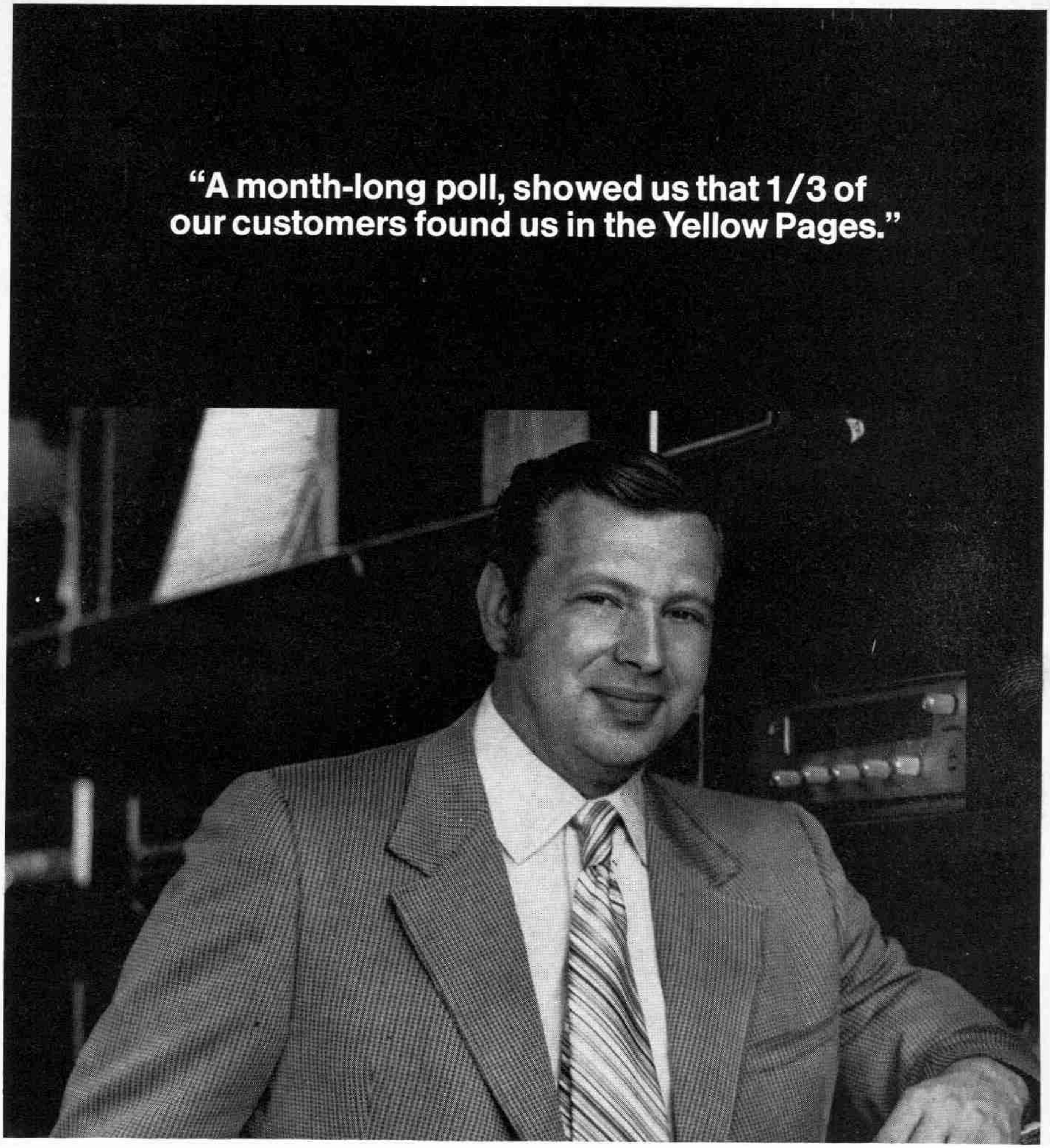


Symptom—AGC overload and no color
Cure—Check for shorted C4, filter capacitor in 24-volt supply

Chassis—Zenith 16Z7C19Z
PHOTOFACT—1105-3



Symptom—Dark picture with little video, and brightness control ineffective
Cure—Check for open in service switch, S1B; replace, if open ▲



"We double-checked the findings by having our sales people question customers coming into the store and got just about the same results," explains Sam Marder, of Radio Electric Service Company of Mount Holly, New Jersey. "Our company has been using the Yellow Pages since 1934 with great results. We're primarily a wholesale industrial distributor plus a retail hi-fi, commercial sound, and dealer sound shop. So we take full advantage of the Yellow Pages' multiple listings. We also carry a few lines that aren't widely handled, so we make them stand out in our ads. All in all, I'd say the Yellow Pages really helps bring in the business." Let the Yellow Pages do your talking. People will listen.

3 out of 4 prospects let their fingers do the walking.

New in color TV for '72, part 1

A two-part series which analyzes the most revolutionary circuitry used in the 1972 line of color TV chassis.

by Carl Babcoke

Trends in color TV features and circuitry for 1972 include:

- All-solid-state chassis are found in more brands and models than ever before.
- Integrated Circuits (IC's) are used for more functions than they were previously.
- Varactor-tuned VHF and UHF tuners are becoming popular. Numerous changes in AFT and remote-control circuitry often accompany the use of these all-electronic tuners. Because no moving parts or mechanical linkage are used inside varactor tuners, they are not mounted immediately behind the channel selector panel.
- Various color and tint functions, such as Automatic Chroma (gain) Control (ACC), Automatic Fine Tuning (AFT), "warming" of the b-w raster and preset tint and color controls, are often simultaneously switched on or off by one button.
- Plug-in circuit boards (modules or panels) continue a slow, but certain, advance in popularity.

Not one of these trends is new. We have reported on all of them before. However, they are being used in more models.

Admiral

Negative power supply

A separate rectifier circuit is used in the Admiral 3K16 color TV chassis, (Fig. 1) to furnish negative voltages for the master brightness control and the three CRT background controls.

Two rectifiers are connected in series to minimize failures, and each diode is paralleled by a 180-pf capacitor which protects against arcs, or other transient conditions, and also equalizes the voltages across the diodes.

High-voltage regulator

Control of high voltage and horizontal sweep in most hybrid models (which use tubes in the horizontal circuit) is accomplished by the type of system that varies the grid voltage of the horizontal output tube. The circuit of the Admiral 3K16 chassis, shown in Fig. 2, is typical of this trend.

Negative voltage produced by rectification of horizontal pulses by varistor R724 is nearly equaled during times of high CRT brightness by a positive voltage obtained from the power supply through R728. The negative voltage at the grid of the output tube, at that time, is the result only of grid rectification of the oscillator signal. The regulator circuit has no effect at maximum brightness.

When the brightness level is reduced, the amplitude of horizontal pulses supplied the varistor by C709 increases, and more negative voltage is produced. Because this negative voltage is higher than that previously produced at the grid, the regulator voltage (through R462) increases the negative voltage at the grid of the output tube.

More negative voltage at the grid of the output tube, without any increase in oscillator drive, reduces the plate current and, in turn, the horizontal sweep power and high voltage. Thus, the width and high voltage are restored to nearly the values which prevailed before the brightness was reduced.

How a varistor, which responds the same to positive as to negative voltages, can function as a rectifier was explained in the Troubleshooter department of the November, 1971 issue of ELECTRONIC SERVICING. Simply stated, the waveform supplied to a varistor operated in a shunt-rectifier circuit *must* be nonsymmetrical for a DC voltage to be produced. A positive-going pulse produces negative voltage, and a negative-going pulse produces positive voltage. The amount of DC is much less than that obtained when a diode is used instead of a varistor.

Electrohome

Vertical deflection in the Electrohome C9 chassis has three controls instead of the usual two (Fig. 3). R620, C614 and R623 comprise a negative feedback path between the plate and grid of the vertical-output stage. Because C614 is small, the circuit varies the high-frequency response, which affects the linearity at the extreme top of the picture.

R618, R617 and C615 act as a variable low-frequency attenuation filter, the action of which affects the linearity at the bottom of the picture.

Magnavox

Several feaures of the Magnavox T952-02 color TV chassis are shown in the schematic of Fig. 4 .

Chroma tilt

R184, the CHROMA TILT control, affects the "Q" of L35, which is tuned to approximately 4 MHz. It should be adjusted only during sweep alignment, to equalize, or level, the overall response curve. (In most chassis, this resistor has a fixed value. Keep in mind, however, that the exact value of this resistor does affect the shape of the alignment curve.)

ACC

ACC starts with rectification of the burst signal by diode D6. The negative voltage produced by this rectification reduces the forward bias of Q21, the ACC control transistor. Q21 is operated as one leg of a voltage di-

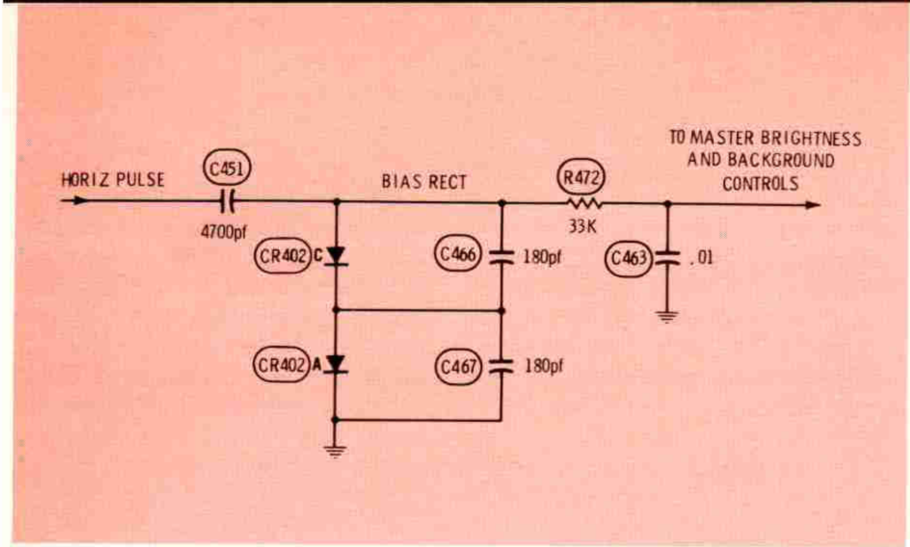


Fig. 1 Negative voltage for the background controls and the master brightness control is supplied by a separate double-diode rectifier circuit in the Admiral 3K16 color TV chassis.

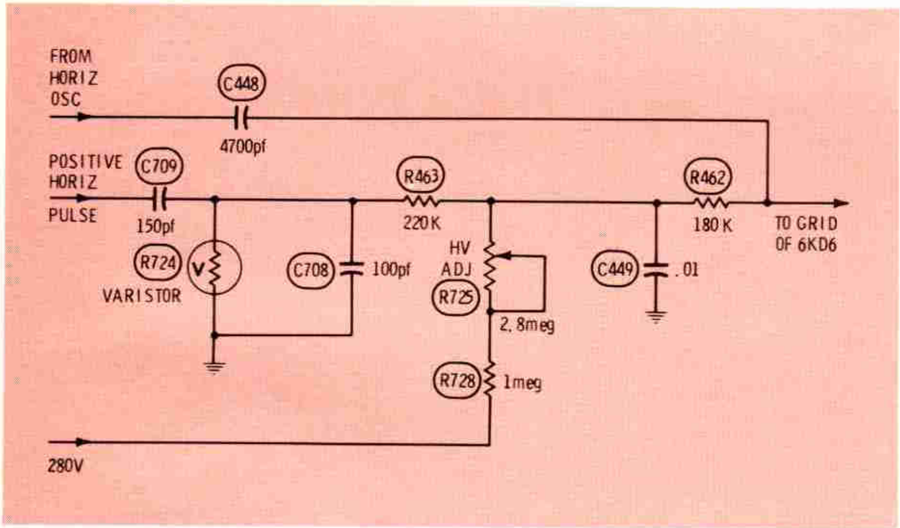


Fig. 2 The high-voltage regulator circuit of the Admiral 3K16 color TV chassis balances a positive voltage from the power supply with a variable negative voltage derived from rectification of positive-going horizontal pulses. This type of regulator is used in most of the hybrid chassis receivers.

vider, the "top" leg of which is R203. In addition, the emitter voltage provided by R201 and R202 acts as a minimum bias for Q19, to prevent over-action of the ACC.

The higher the amplitude of the burst signal, the higher the negative voltage at D6, and the lower the positive voltage at the base of Q21. In turn, the decreased forward bias causes a higher internal resistance in Q21, which raises the collector voltage. The collector voltage of Q21 is the forward bias of Q19, whose gain is reduced by the saturation effect when the forward bias is increased. Consequently, the gain of Q19, the 1st chroma amplifier, varies according to the amplitude of the burst signal.

Color killer

Color-killer action occurs in the base circuit of Q13, the chroma-output amplifier. A negative-going horizontal pulse is also injected at the base of Q13, to blank the gain during horizontal retrace time.

Negative voltage from the grid of the 3.58-MHz oscillator tube

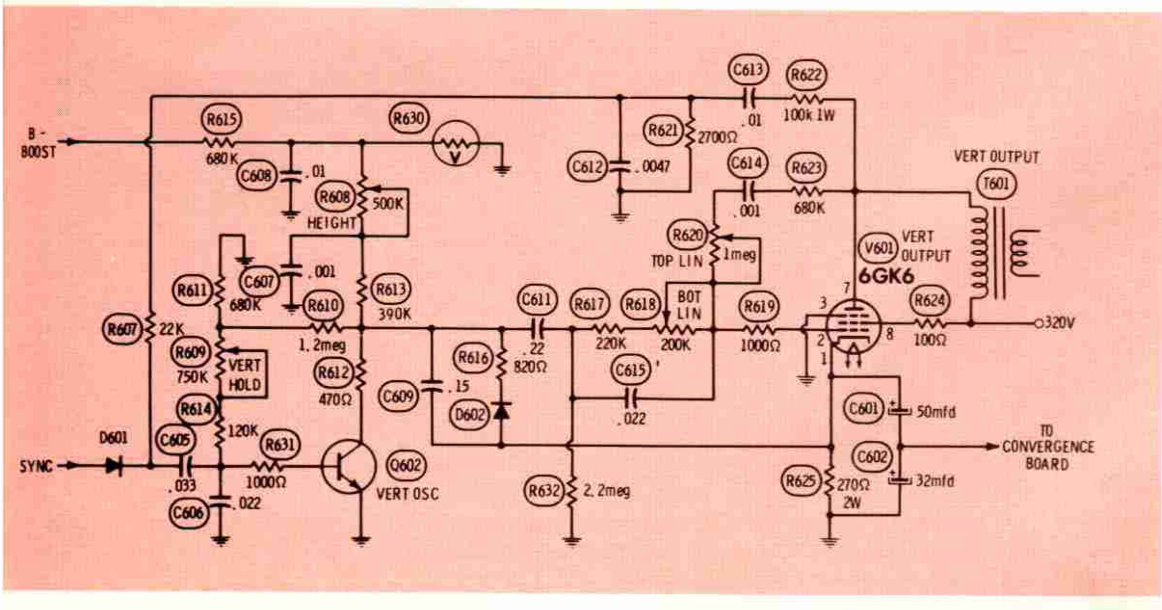


Fig. 3 Two linearity controls, one for adjustment of the linearity at the top and one for adjustment of the linearity at the bottom of the picture, are found in the Electrohome C9 chassis.

is applied through R82 to the base of Q12, the color killer. Because the color-killer control and R91 supply enough positive voltage to more than cancel the negative voltage from R82, Q12 is forward biased, and, therefore, conducts. The collector-emitter resistance of Q12 plus R89 are the lower leg of a voltage divider the other resistance of which is R93; the relative value of these resistances determine the base voltage of Q13. The emitter voltage of Q13 is semi-fixed by the voltage divider action of R95 and R96.

During reception of b-w programs, the resistance of Q12 is such that the base voltage of Q13 is less positive than the

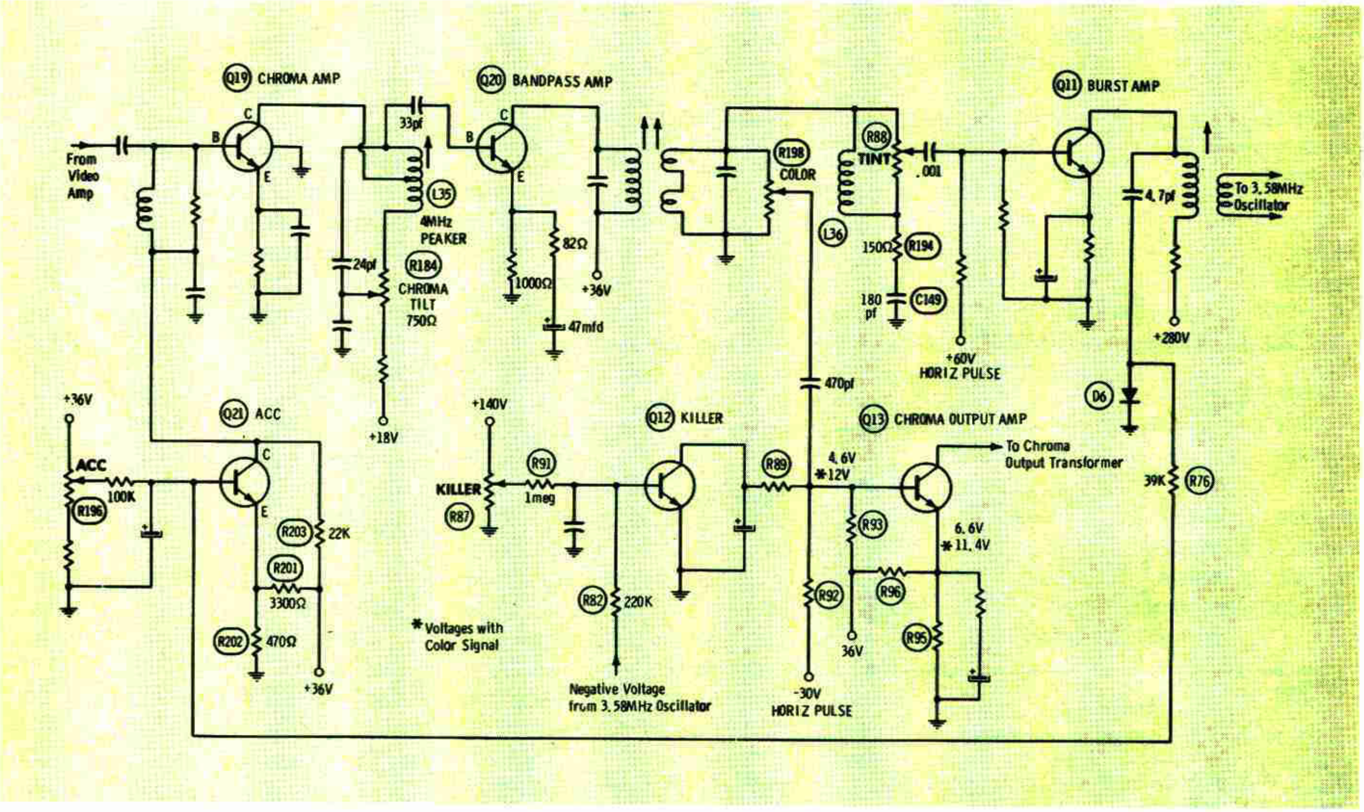


Fig. 4 This partial schematic of the chroma circuit in the Magnavox T952-02 color TV chassis shows the CHROMA TINT control, color-killer and ACC circuits.

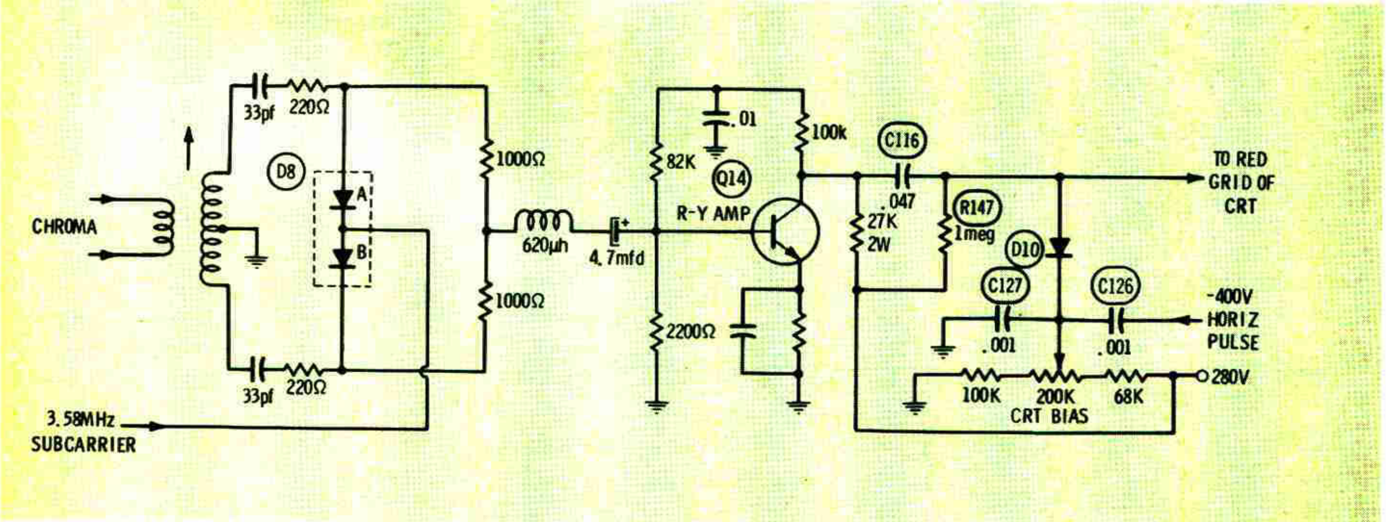


Fig. 5 A double-diode demodulator is followed by a transistor amplifier in the chroma circuit of the Magnavox T952 color TV chassis. DC restoration of each CRT grid voltage is by pulse rectification by D10. This voltage is modified by a DC voltage from the CRT BIAS control, to establish the desired CRT grid voltage.

emitter, and Q13 is reverse-biased and cannot conduct.

The burst signal reaches the grid of the color oscillator during colorcasts, causing the voltage at the grid to become more negative. This increased negative voltage reduces the forward bias of Q12, the color killer, increasing its internal resistance, which, in turn, increases the base voltage of Q13 above the level of its emitter voltage. This forward biases Q13, and it conducts.

Tint control

Variation of the tint of the picture produced by the new Magnavox chassis is accomplished by changing the phase of the chroma signal, including the burst signal, which is applied to the base of the burst amplifier, as shown in Fig. 4.

When the tint control is turned CCW (slider moved toward the end connected to T8), the signal travels through without any phase change. When the tint control is turned CW (slider moved toward R194), a low-pass filter is formed by L36 and C149. (R88 and R194 restrict the change and damp out ringing.) This filter delays the phase by about 80 degrees.

Demodulation and -Y amplification

A schematic of the R-Y demodulator and R-Y amplifier stages of the Magnavox T952 chassis is shown in Fig. 5.

The phases of the chroma sidebands and the 3.58-MHz subcarrier are compared in the phase-detection circuit, which includes dual diode D8. Any signal caused by phase differences of these two signals is obtained through the two 1000-ohm resistors, the 4.7-mfd coupling capacitor and the peaking coil, and is applied to the base of Q14, the R-Y amplifier.

Each of the three CRT grids has a DC restoration circuit, and the CRT BIAS control, R152, simultaneously adjusts the DC voltage to each grid. Restoration of the DC at the CRT grid is determined by the amplitude of the horizontal pulse supplied diode D10 by the capacitive voltage divider consisting of the two .001-mfd capacitors. This pulse does *NOT* provide horizontal blanking. This circuit is a peak-reading series rectifier. Diode D10 rectifies the pulse from the .001-mfd capacitors; C116 is the filter capacitor; and the load is R147 and grid of the CRT. Any series rectifier permits only a small amount of ripple. In this case, the ripple at the red grid of the CRT is a small-amplitude horizontal pulse too small to be of any consequence.

Leakage through R147 raises the positive voltage at the grid of the CRT. A negative voltage produced by rectification of the pulse by D10 restores the DC level of the grid to the original value. In this way, any tendency of the grid voltage to change because of any nonsymmetrical chroma waveforms is cancelled during each horizontal cycle.

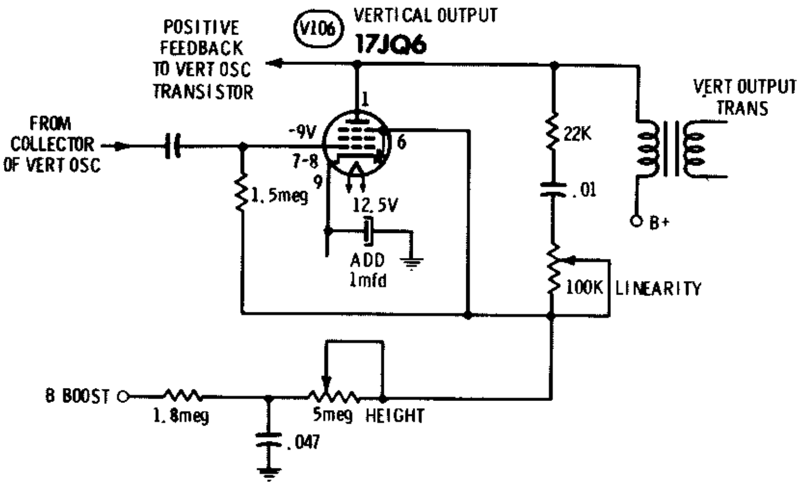


Fig. 6 An extra diode, which is connected internally to the suppressor grid of the vertical-output tube, is used for grid bias and linearity correction in the Magnavox T936 color TV chassis.

Vertical sweep

An unusual vertical-output stage, shown in Fig. 6, is used in the Magnavox T936 hybrid chassis. The 17JQ6 vertical-output tube has an internal diode-suppressor element which is used in the linearity and height circuit. The diode rectifies the pulse from the plate. The resultant DC is varied by the LINEARITY control before application to the control grid as bias. In addition, R145, C136, and LINEARITY control act as a filter in the negative feedback path from plate to suppressor grid. This improves the deflection linearity.

Late-production chassis have a 1-mfd capacitor added from the cathode, pin 9, to ground, to improve vertical stability.

Motorola

One of Motorola's new features is the "Insta-Matic" circuit, which, at the press of one button, switches in: AFT; ACC, which is determined by the *chroma* amplitude; different chroma demodulator phasing and a warmer raster; and preset hue, brightness, contrast, and video peaking controls. Some of these functions are an-

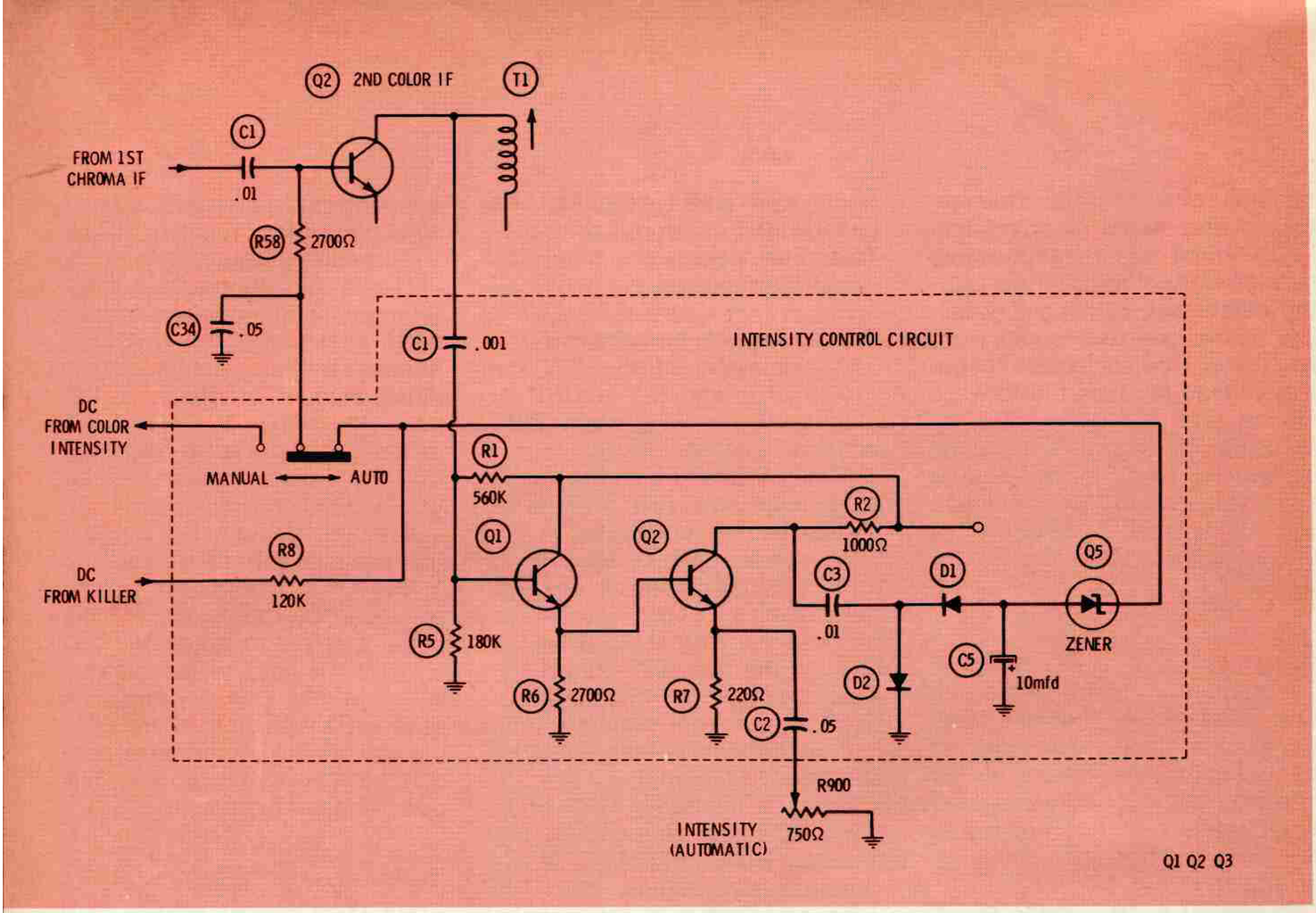


Fig. 7 The automatic intensity control circuit in the Motorola TS929 color TV chassis amplifies the chroma signal in a separate two-stage amplifier, rectifies the signal with a voltage doubler, then, after a voltage delay by zener diode Q5, applies this DC control voltage to the base of Q2, the 2nd color IF transistor amplifier. This unusual form of ACC is used when the Insta-Matic feature is operated.

alyzed in detail in the following paragraphs.

Automatic color intensity

Color saturation in the Motorola TS929 color TV chassis is controlled in the Insta-Matic mode by an ACC circuit which levels off the color gain at a preset point determined by the intensity of the color signal, not the burst. The schematic of the ACC (Intensity Control) circuitry is shown in Fig. 7.

Chroma sidebands from the collector of the 2nd color IF amplifier are amplified by Q1 and Q2 in the intensity control circuit. The gain of Q2 is adjusted by R900, the INTENSITY (AUTOMATIC) control, which controls the degeneration at the emitter of Q2. The output from Q2 is rectified in the voltage doubler circuit, which includes D1 and D2. The DC thus produced is filtered by C5 and applied through zener diode Q5 to

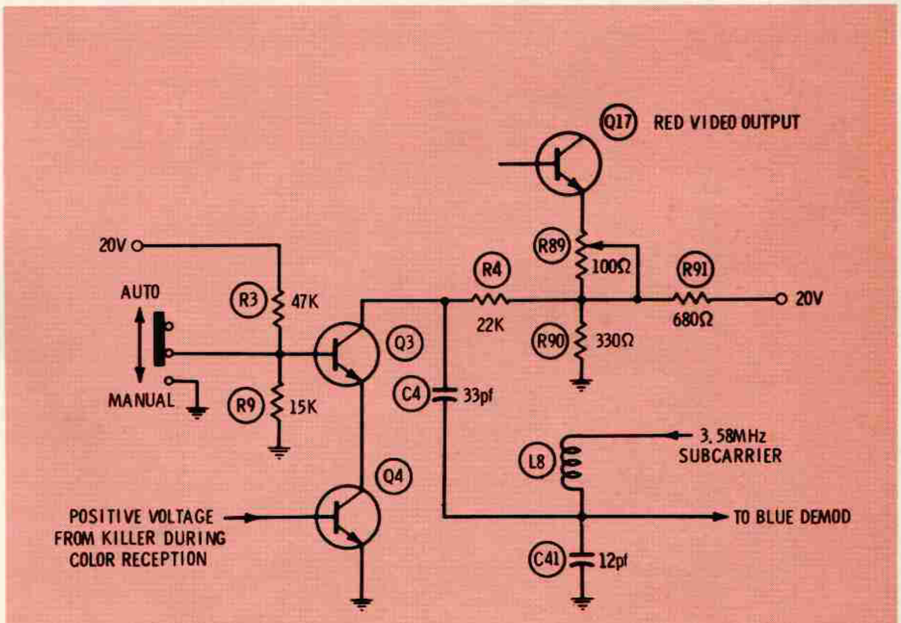


Fig. 8 Switching of the warmer screen color and expanded phasing between demodulators in the Motorola TS929 color TV chassis is accomplished by the use of two series-connected transistors in an "and gate" type of circuit. To accomplish this switching action, both transistors must be saturated.

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- 19JNP22
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- 490BDB22
- 490BGB22
- 490BHB22
- 490BRB22
- 490CB22
- 490CHB22
- 490CUB22
- 490DB22
- 490EB22
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- 25BVP22
- 25BWP22
- 25BXP22
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the base of the color IF transistor. The zener diode is provided so that gain reduction does not occur until the color intensity has reached a useable level. The gain of the 2nd color IF amplifier is reduced by cutoff bias when the forward bias is decreased during scenes having excessive color saturation.

Automatic tint circuit

Another action of the Insta-Matic switch is to tint the raster slighly red and to increase the phase angle between the demodulators. To accomplish these actions, two transistors, Q3 and Q4, are used as remotely controlled switches, to ground R4 and C4, as shown in Fig. 8.

To produce the tinting action, both Q3 and Q4 must be forward biased so that they become very low resistances. They are connected in what is called an "and gate" in logic-circuitry terminology. Q3 is biased into saturation by R3 and R9, except when the Insta-Matic switch is in the MANUAL position, at which time the base of Q3 is grounded.

Forward bias for Q4 is provided by the color-killer circuit only when the color killer is inactivated during color reception.

When both Q3 and Q4 are forward biased to saturation, they effectively become a low-value resistor which grounds R4 and C4. R4 decreases the emitter-to-ground resistance of the red video output transistor. This increases the forward bias of the transistor, producing more brightness from the red gun of the picture tube. When grounded, C4 is in parallel with C41 and the larger total capacitance increases the lagging phase of the 3.58-MHz carrier applied to the blue demodulator.

Electronically regulated, high-frequency power supply

A large reduction of the weight and the size of the low-voltage power supply has been achieved by Motorola in their TS931 and TS938 color receivers. The block diagram of the new high-frequency power supply is shown in Fig. 9, and a photo which provides a physical comparison of the old, regulated 60-Hz supply and the new regulated 15,734-Hz power supply is in Fig. 10. The actual circuitry is shown in Fig. 11.

Raw power for the electronic power supply comes from separate positive and negative half-wave rectifier circuits the outputs of which are connected in series to produce a voltage-doubled full-wave output. This voltage is not connected directly to the receiver circuits.

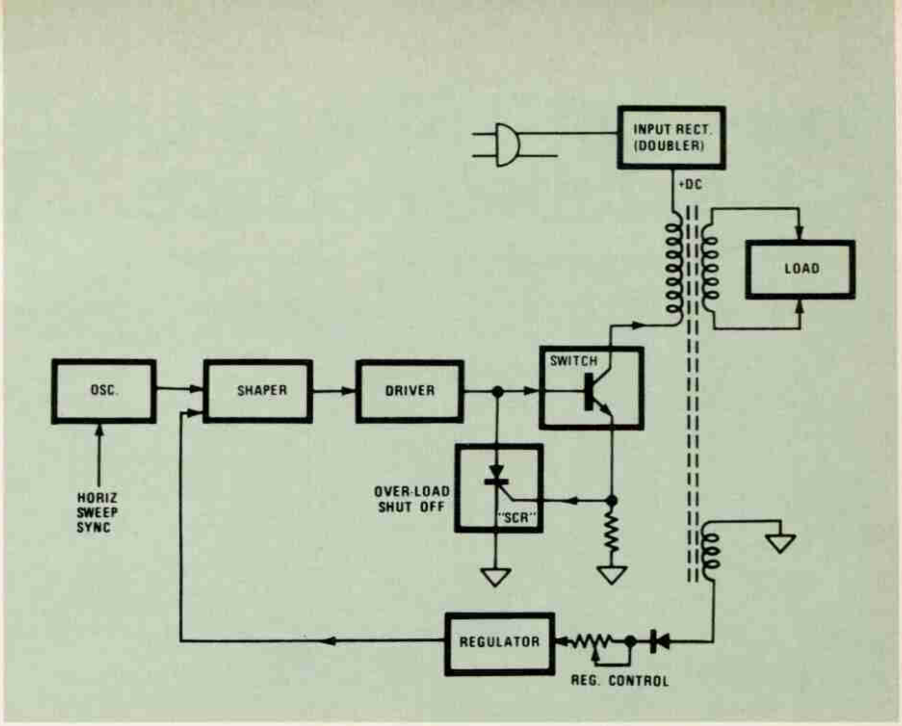

Fig. 9 The block diagram of the regulated, high-frequency power supply used in Motorola TS931 and TS938 color TV chassis is shown here. The oscillator is synchronized by the horizontal sweep in the television chassis, to avoid "notches" in the picture. Regulation is accomplished by varying the amount of time the switch transistor conducts during each cycle. Self-protection against overload of the switch transistor is by means of an SCR which eliminates the drive voltage in the event of an overload. **(Courtesy of Motorola.)**

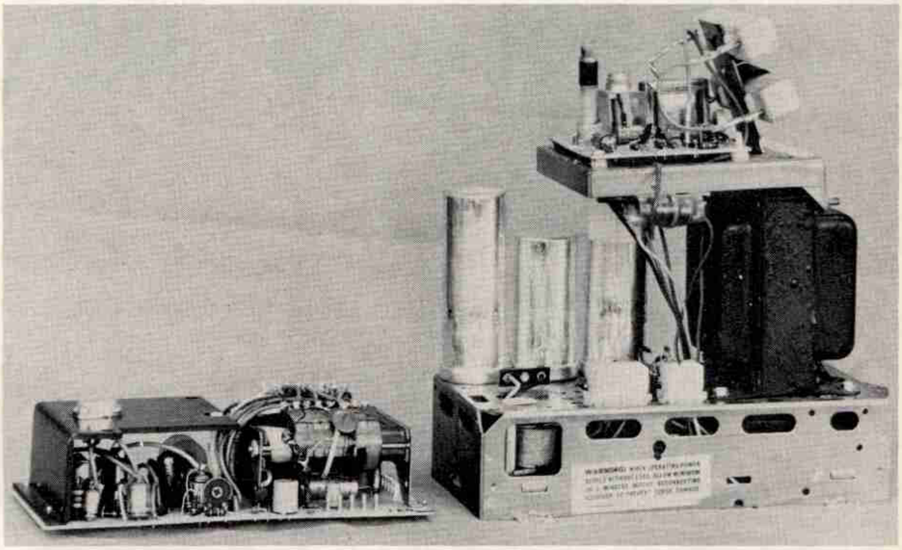

Fig. 10 A comparison of the new high-frequency power supply on the left and the older conventional regulated 60-Hz power supply on the right shows the reduction in size and weight, while still permitting "cold chassis" operation.

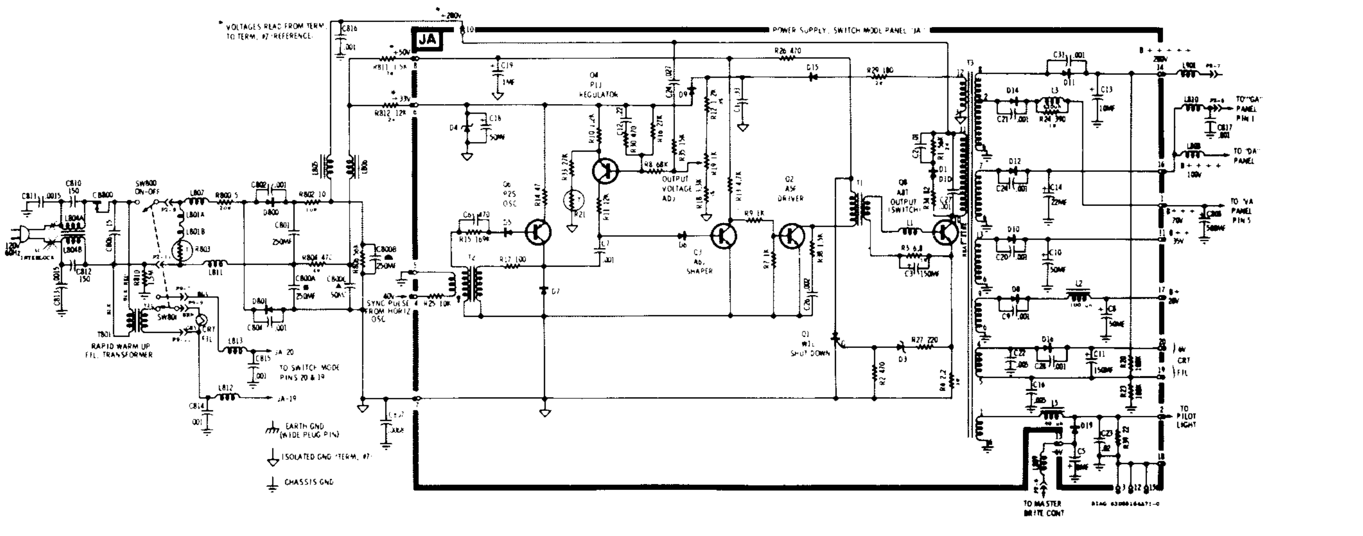

Fig. 11 The complete schematic of the Motorola high-frequency power supply shows the isolation between the line voltage and the regulated DC voltages supplied to the chassis. **(Courtesy of Motorola.)**

A horizontal-frequency oscillator, synchronized by the horizontal oscillator in the receiver, drives shaper and driver stages and a transistor used as a switch. The output of the switch transistor energizes a power transformer which supplies AC power to 7 rectifier circuits; these, in turn, power the circuits in the receiver. The power transformer has a small, light-weight, powdered-iron core, similar to that used in flyback transformers. The small size is possible because less iron is required at higher frequencies.

Voltage regulation of the AC outputs from the power transformer is accomplished by varying the width of the pulse of current which energizes the power transformer. A heavier load on any of the rectifiers which receive power from the power transformer causes the width of the pulse of current to increase, supplying the required extra power.

Self-protection for the power supply, and especially for the switching transistor, is provided by an SCR (silicon-controlled rectifier). When the emitter current exceeds a certain value, the voltage drop across emitter resistor R4 increases enough to trigger zener diode D3 into its avalanche mode, which supplies a pulse of positive voltage to the gate of Q1, the SCR. The SCR conducts (and continues to until its anode voltage is removed), shorting out the supply voltage for the driver transistor. Because the forward bias for the switch transistor has been removed, it merely "idles" in an unconducting state. (If the switch transistor is shorted, the main circuit breaker should open.) Operation is restored by turning the main power switch off and then on. This unlatches the SCR. If the overload was temporary, the receiver should operate normally again. The complete schematic of the new power supply in Fig. 11 shows that no continuity exists between the power supplied to the chassis and the power supplied to the electronic power supply.

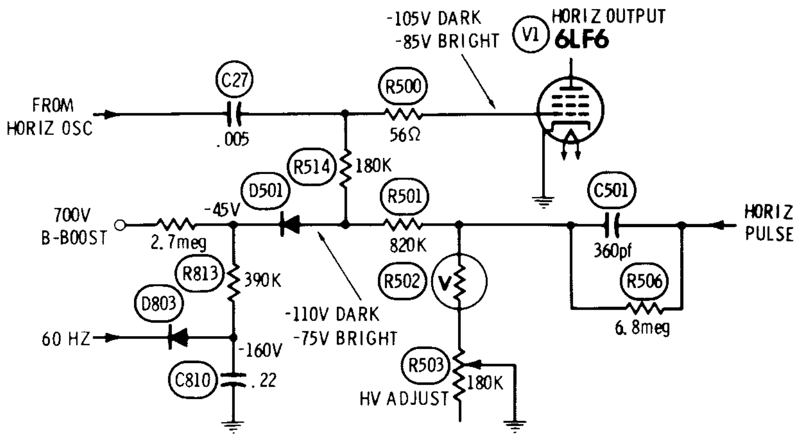

Fig. 12 A protective circuit which prevents damage to the horizontal-output tube if the drive from the horizontal oscillator ceases is another feature of the Motorola TS929B chassis. A negative voltage supplied by a rectifier operated from 60 Hz, is switched into the grid circuit by D501 when the drive and the negative voltage from the high-voltage regulator circuit are both missing.

In other words, the chassis is "cold", even though the main voltage doubler is supplied directly from the power line.

AC voltage from a small filament transformer is supplied to the heater of the CRT when the receiver is switched off; the CRT heater is supplied a regulated 6 volts DC when the receiver is on.

Protection from loss of horizontal drive

Protection against burn-out of the horizontal-output tube if the horizontal oscillator fails is provided by a special circuit in the Motorola TS929B chassis. The schematic is shown in Fig. 12.

In addition to the voltage provided the grid of the output tube by the high-voltage regulation circuit (R502 and associated parts), a negative voltage supply of approximately –160 volts is provided by rectification by D803 and C810 of a 60-Hz sinewave voltage. This voltage is relatively constant regardless of conditions in the horizontal circuit. A voltage of about –45 volts is produced by a combination of negative voltage through R813 and B-boost positive voltage through the 2.7-megohm resistor.

During normal operation—because of drive rectification and regulation voltages, the anode of D501 is more negative than the –45 volts at the cathode. Consequently, D501 is effectively an open circuit, and the protective circuit is disconnected.

If the horizontal oscillator ceases operation, no negative voltage is supplied the grid of the output tube. In fact, R506 attempts to drive the grid slightly positive. However, because the anode of D501 is now less negative than its cathode, D501 is forward biased and conducts. The –45 volts normally on the cathode of D501, which is now more negative because the B-boost voltage is much lower, is applied to the grid of the horizontal-output tube. Consequently, very little current flows through the output tube and no damage occurs.

Next Month

This analysis of the most significant developments in new circuit design will continue next month and will include those in the new Philco, RCA, Sylvania and Zenith color TV chassis. ▲

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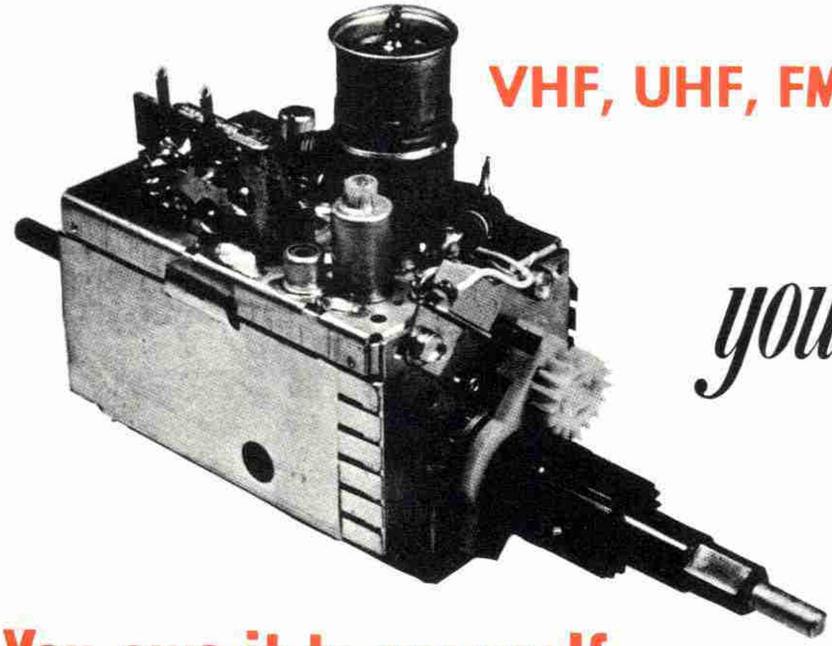

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Circle 10 on literature card

servicebulletin

a digest of information from manufacturers

Arcing of high voltage to picture tube shield
General Electric KE color TV chassis

Cases of high voltage arcing from the aquadag coating on the picture tube to the picture-tube shield are not usually caused by a defective picture tube. The most likely cause for the arcing is a defective 6LJ6 high-voltage regulator tube; however, in many cases, by the time the defective regulator-tube has been discovered and replaced, the arcing has damaged the aquadag coating on the picture tube.

To repair the aquadag coating:

- Re-bend the ground springs so that they contact undamaged spot on the aquadag.
- Or add a new aquadag coating to any damaged areas on the picture tube.

MAN sound module can be damaged by speaker with incorrect impedance
RCA CTC46 color TV chassis

A high-impedance speaker, with 32 to 35 ohms, is used with the RCA CTC46 chassis.

Do not use a conventional 4- or 8-ohm speaker when testing this chassis; use of these low-impedance speakers can cause damage to the components on the MAN sound module, according to RCA.

Repeated fuse failure
Sony KV-1200U, KV-1210U or KV-1220U color TV chassis

Failure of fuse F801 is usually caused by a defective fuse, damper diode D802 or high-voltage rectifier V801.

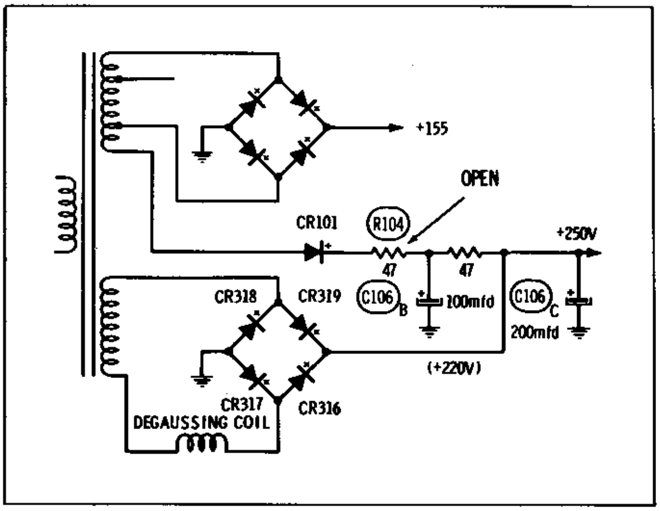
Sony recommends that all three components be replaced simultaneously in any chassis that has repeated fuse failures.

Hum bars in picture
RCA CTC44 or CTC47 color TV chassis

Failure of the 250-volt supply can cause hum bars in the picture of these RCA chassis, because the receiver will continue to operate on the lower voltage supplied by the bridge rectifier supply of the automatic degaussing circuit.

Test for this possibility by unplugging the automatic degaussing circuit (when the power to the set is turned off). Loss of video indicates the receiver was operating on the voltage supplied by the degaussing bridge rectifier.

Check for an open in R104, a 47-ohm, 2 watt, flame-retardative resistor, which, according to RCA, should be replaced by a 4-watt resistor (RCA stock number 132951), if open.



Elimination of beat pattern
Magnavox T950 and T951 color TV chassis

Some late-production versions of the Magnavox T950 and T951 color chassis might exhibit a "screen door checkering", or beat pattern, in the picture.

Reduce this effect by installing a 27-pf capacitor (Magnavox part number 250508-2705) in parallel with L106 in the T950 chassis, or a 20-pf capacitor (Magnavox part number 250508-2005) in parallel with L106 in the T951 chassis.

Intermittent vertical sweep
RCA CTC36 color TV chassis

Loss of all vertical sweep when no station is tuned in or during program switching might be caused by an off-tolerance vertical oscillator transistor, Q501 (Q1 in PHOTOFACT 1012-2).

Test for this possibility by moving the service switch to the "raster" position. If the vertical sweep disappears, it indicates that the vertical oscillator transistor should be replaced.

How to tighten sagging grille cloth
Magnavox, all models

Grille cloth that sags because of moisture or temperature conditions often can be tightened without removal of the cloth.

Use this method for plastic or plastic-cotton grille cloth:

- From a distance of about 10 inches, move a 250-watt heat lamp back and forth across the sagging area of the cloth until it tightens. Use caution to avoid "hot spots" or scorching.

Use this method for all-cotton grille cloths:

- Make a mixture of half-and-half water and isopropyl alcohol.
- Fill an atomizer with the mixture.
- Spray the sagging area enough to dampen it.
- Move a heat lamp back and forth across the sagging area until it tightens. ▲

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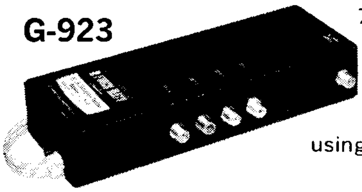

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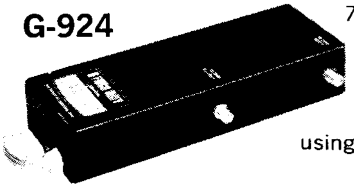

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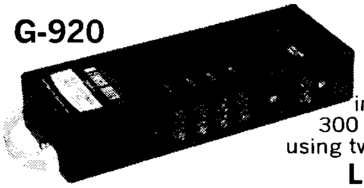

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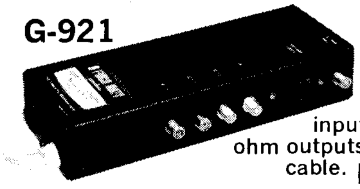

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letters to the editor

12FR8 Tube Availability

I have one 12FR8 tube made by General Electric for sale.

D. E. Brown
1141 Cleo
Lansing, Mich. 48915

I have found a solid-state replacement for the hard to find 12FR8 tube.

The unit consists of one Amphenol CP plug, two FET transistors, one diode and one resistor.

If anyone is interested, they can have these units for $6.00 including postage.

I enjoy your problem solving column, so keep up the good work and we will do a better job.

Don Jenkins
Bremerton Radio & TV
316 N. Callow
Bremerton, Wash. 98310

We have two solid-state replacements for the 12FR8 tube. These units go for $10.50 each.

Hanlan TV
343 S. Western Ave.
Los Angeles, Calif. 90005

I have a few 12FR8 tubes, as well as 78's and 24's in my stock that I will be glad to sell.

Warner Sawyer
Sawyers TV
1420 So. 53rd
Tacoma, Wash. 98408

I have one new General Electric 12FR8 tube, in the original carton, for sale at $10.00 plus postage.

A. D. Teall
24 Tolan
Milan, Mich. 48160

I have a few 12FR8 tubes that I am willing to sell for $8.00 apiece, on a first come, first serve basis.

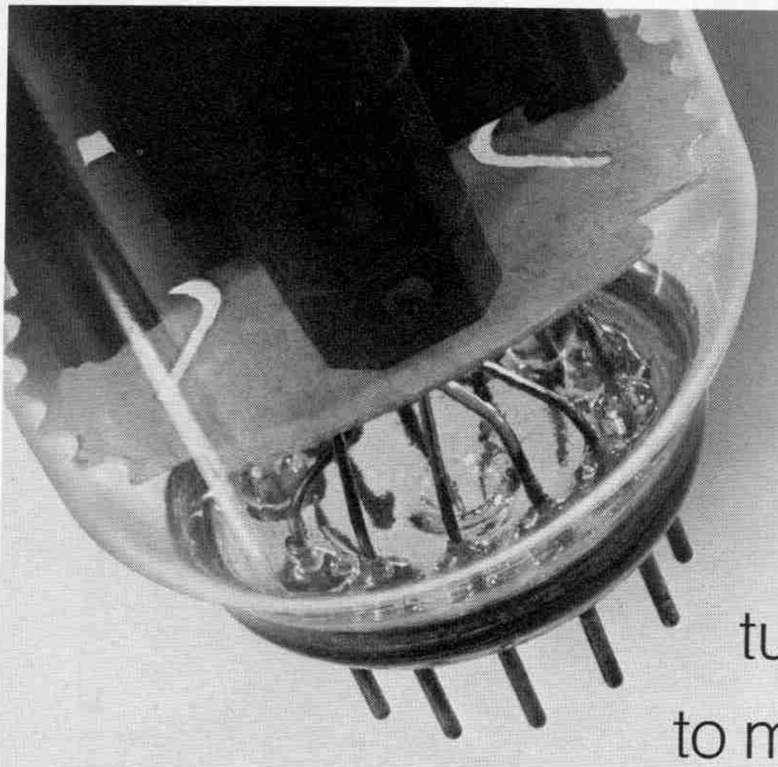
Gil's Radio & TV Service
86-11th Ave.
Madawasha, Maine

I have a 12FR8 tube I am willing to sell for $10.00. It is still in its original carton and tests good.

Eugene Claus
1697 Fairfax Rd.
West Islip, N.Y. 11795

I have found a couple of 12FR8's in my tube inventory. If anyone is interested or needs 12FR8 tubes please let me know.

Joseph J. De Luca
Livingston H. S.
Livingston, N.J. 07039 ▲



review

Study Guide for CET Examinations (Catalog No. 20834)
Authors: J. A. Wilson, CET, and Dick Glass, CET
Publisher: Howard W. Sams & Co., Inc., Indianapolis
Size: 5½ x 8½ inches, 272 pages
Price: Softcover, $5.95.

The material in this text is intended primarily to provide veteran technicians with a comprehensive review of the subject areas covered in the 12-section test which all technicians must pass to attain the status of Certified Electronic Technician (CET), a technician evaluation program originated by the National Electronic Associations (NEA), to provide both national and international recognition of "qualified technicians".

This text also serves as an excellent study guide for electronic technicians who must pass a state or municipal licensing examination, or as a review for any veteran technician prior to applying for a position in the electronic field. Recognizing that many technicians have not had formal training in all areas covered by the exam, the authors have keyed each chapter to two TV courses published by Howard W. Sams—the **PHOTOFACT Television Course** and **Color-TV Training Manual.** Each chapter in the book begins with recommendations of which chapters to read in the two reference courses. Following the reading recommendations is a review of the important elements of the subject area covered in that chapter. After reviewing these elements, the reader then completes a programmed questions-and-answers section designed to show him in which elements he needs improvement. A 50-question, multiple-choice review test is included at the end of each chapter.

The final chapter consists of a representative exam which will help the reader determine if he is ready to take the CET and/or licensing exam. This test is divided into ten subject areas; if the reader misses more than eight questions in any area, he is advised to review the associated section and reading assignments before attempting the CET or licensing exams.

Contents: The Scope of The Examination—The TV Signal—Antennas and Transmission Lines—Electronic Components—Transistors and Other Semiconductor Devices—Basic Mathematics and Circuit Analysis—Monochrome TV Circuits—Color TV Circuits—The Synchronizing Circuits—Troubleshooting Techniques—AGC, Power Supplies, and Waveform Analysis—Practice Test—Answers to Practice Tests. ▲

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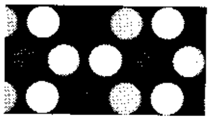

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Circle 15 on literature card

Sony's large-screen trinitron color receiver

by Larry Allen

How it differs from this manufacturers receivers which employ a previous design of the one-gun color picture tube.

■ The *Trinitron* is Sony's 9- and 12-inch color picture tubes that light three phosphor colors with only one electron gun. The picture tube gun produces three beams, from three cathodes. You can see a simple sketch of the gun structure in Fig. 1A.

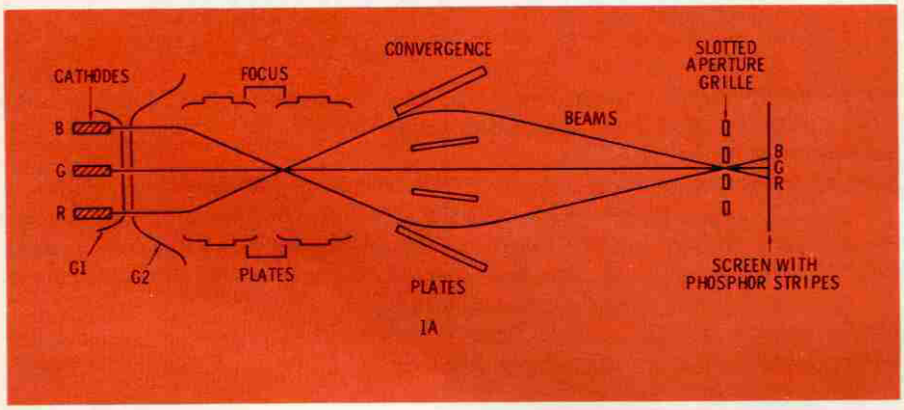
Converging this Trinitron CRT is quick and easy. There are only two controls to adjust. They shape a parabolic horizontal waveform that is applied to electrostatic convergence plates in the CRT. Vertical sweep hardly needs correction, because the phosphor is laid down in vertical stripes, as shown in Fig. 1B.

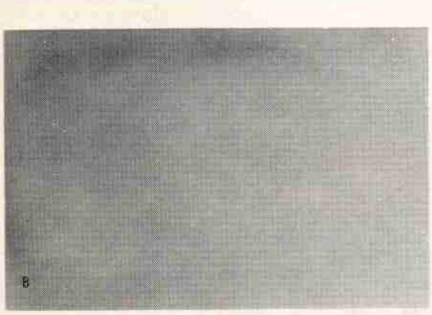
The only driven elements in this picture tube are the cathodes, one for each color. Because the Video, or Y, signal rejoins the color-difference signals right in the demodulators, there is no need to matrix them in the picture tube. The control grid (G1) is common to all three cathodes—as is G2, the screen or accelerator grid.

Early this year, Sony began importing sets with screens larger than the original 12 and 9 inch. The first, a 17-inch model with a square-corner face, shown in Fig. 2, introduces a whole new kind of Trinitron. One gun still produces the three beams, and the phosphor is still in stripes. Behind the phosphor is the same slotted aperture grille. But the new, larger Trinitron comes with *three grids.* Each cathode has a control grid of its own. To accommodate this change, the chassis includes much more CRT control circuitry.

Convergence, too, has become more complex. A convergence yoke mounts on the neck of the picture tube. Nevertheless, convergence is still simple compared to conventional color sets. Pincushion correction (PCC) is less complicated than in the old version. Previously, Trinitron PCC was magnetic; in the new sets, it is electronic.

The new chassis also incorporates other changes. Horizontal sweep and high-voltage circuitry are separate. The flyback transformer that develops high voltage does not drive the deflection yoke, as in conventionally designed receivers. The flyback also generates several DC voltages for other sections of the receiver.





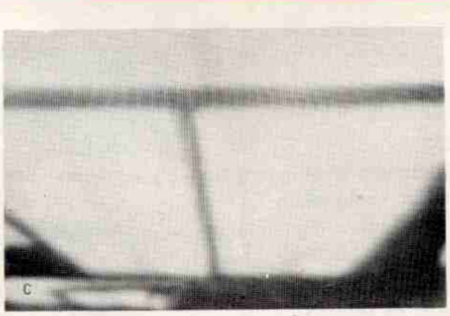


Fig. 1 A) Gun structure in 9- and 12-inch Trinitron picture tubes; one gun with three cathodes puts out three beams which go through aperture-grille slots to illuminate vertical strips of phosphor. Photos show phosphor without video **(B)** and with video **(C)**.

The New Trinitron CRT

The structure of the 17-inch Trinitron is shown in Fig. 3A. The three cathodes and their corresponding grids are in-line, side by side. The G2 cylinder has a hole for each beam.

The beams cross in focus assembly, as in the previous Trinitron. A high DC voltage on the convergence plates bends them back to cross again at the aperture grille. (In the old version, a parabolic convergence waveform was superimposed on this high-voltage DC. The larger version omits the parabolic signal voltage.)

Despite the additional grids in the gun, the neck of the 17-inch Trinitron is still smaller in diameter and shorter than the neck of a conventional picture tube of comparable size. A closeup view of the Trinitron neck is shown in Fig. 3B.

If you're familiar with the circuitry used with the smaller Trinitron, you can see from Fig. 4 that some simplicity has been lost with the larger screen. When there was only one control (G1) grid, it carried approximately zero DC voltage. Blanking pulses also were applied to it. The brightness level for each beam was set by DC controls in the three cathode circuits. There were no color-video drive controls.

In the new Trinitron, each grid has a background bias control of its own. Each potentiometer applies between zero and 125 volts DC to its respective control grid.

DC voltage on each CRT cathode depends on DC coupling from the color/video output stages. Drive pots alter how much color-difference signal drives the emitters of the output transistors. Because these potentiometers vary the bias of the output emitter circuits, to a small degree they also control CRT bias. Drive-control settings affect mostly the highlights of the picture. So, for gray-scale tracking, the low-level-whites (or rather, grays) in the Trinitron are controlled by the G1 circuits and controls. (In a conventional picture tube the gray scale is controlled primarily by the G2 circuits.) Drive controls do the same in Trinitrons as they do in conventional CRT's: they make the highlights white.

Matrixing for the new Trinitron, as in the previous Trinitron, is outside the picture tube. As shown by the diagram in Fig. 4, the Y signal is applied equally to the bases of the three color/video output stages. Y mixes with the color difference signals,

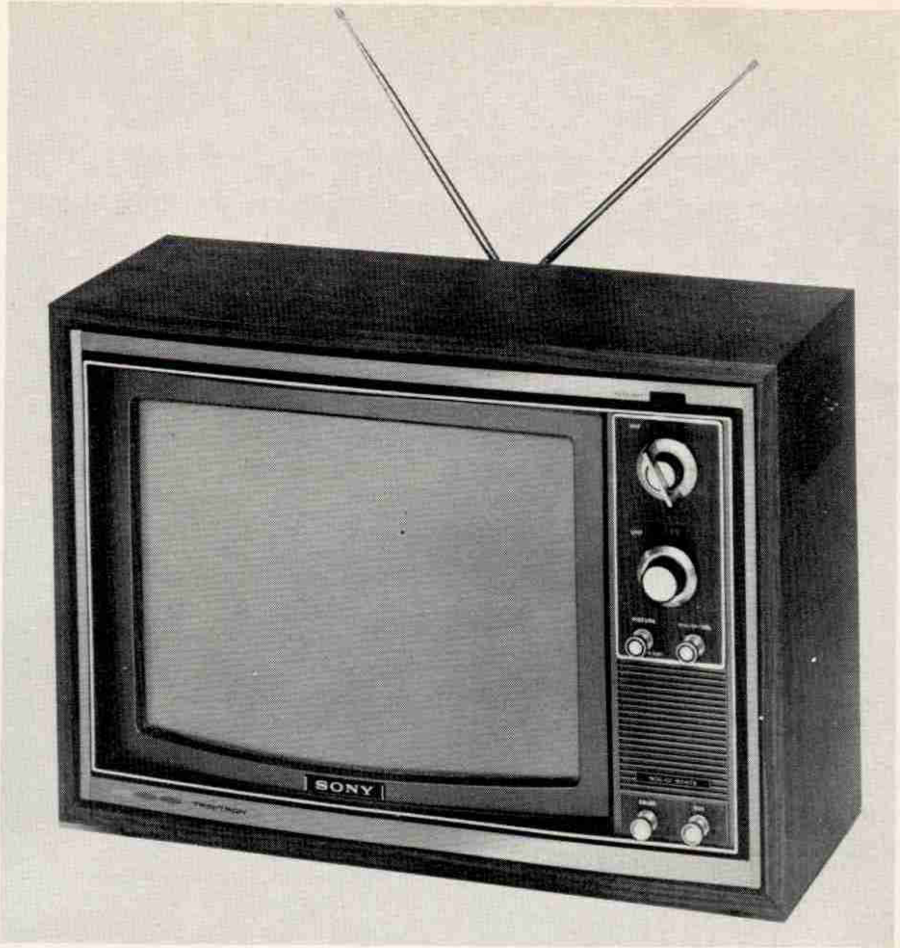


Fig. 2 Newest Sony color receiver uses larger, square-corner Trinitron picture tube. Circuitry around CRT is not as simple as with earlier versions. Chassis also contains other changes from older models.

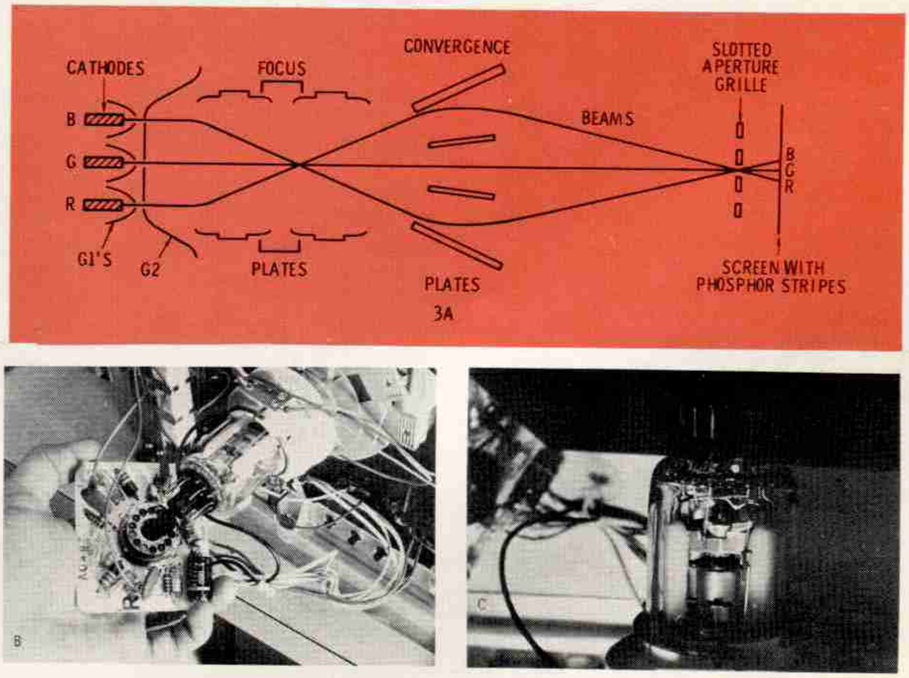
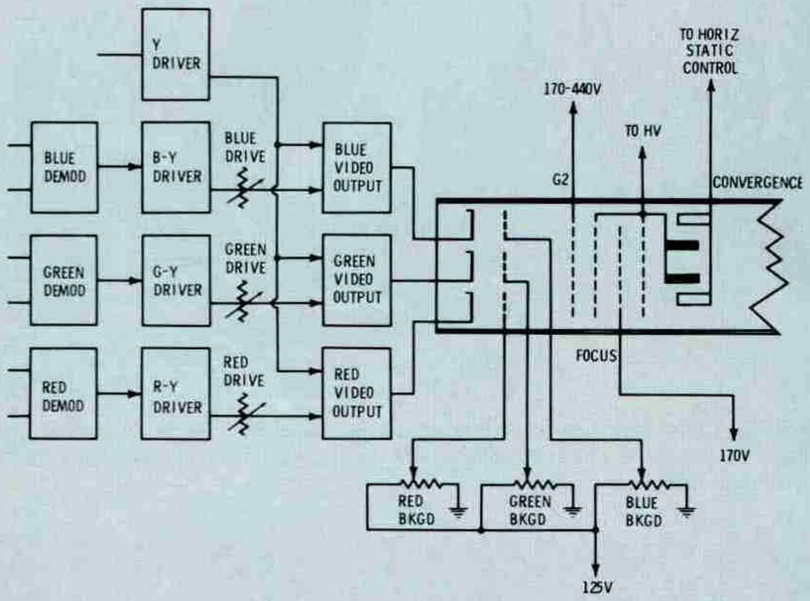


Fig. 3 A) Three cathodes AND three grids characterize the new 17-inch Trinitron. Otherwise, it handles beams the same as in small-screen Trinitron guns. Neck size **(B and C)** is still small and short compared to conventional color CRT.

which are applied to the emitters. The Y signal is amplified and fed through a delay line before it is applied to the Y driver. In earlier Trinitrons, the Y signal mixes with the color signals in the three demodulators. (In conventional picture tubes, Y is applied to the three cathodes or, occasionally, to the three grids. Color difference signals are applied to the grids, if the cathodes get Y, or to the cathodes, if the grids get Y.)

The accelerator grid G2 in Fig. 4, is common to all three beams, and operates on a voltage that is adjustable between 170 and 440 volts DC. The adjustment produces an effect somewhat similar to the Beam (or Kine Bias) control or switch in conventional color-TV chassis. You set it so that the cathode-grid bias (Background) can be adjusted for proper beam cutoff while maintaining high-



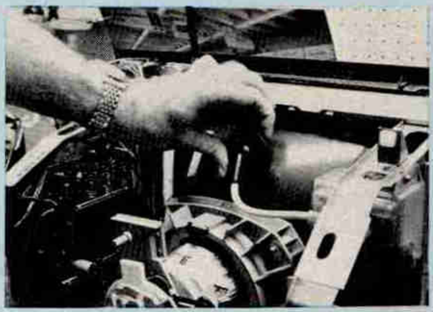
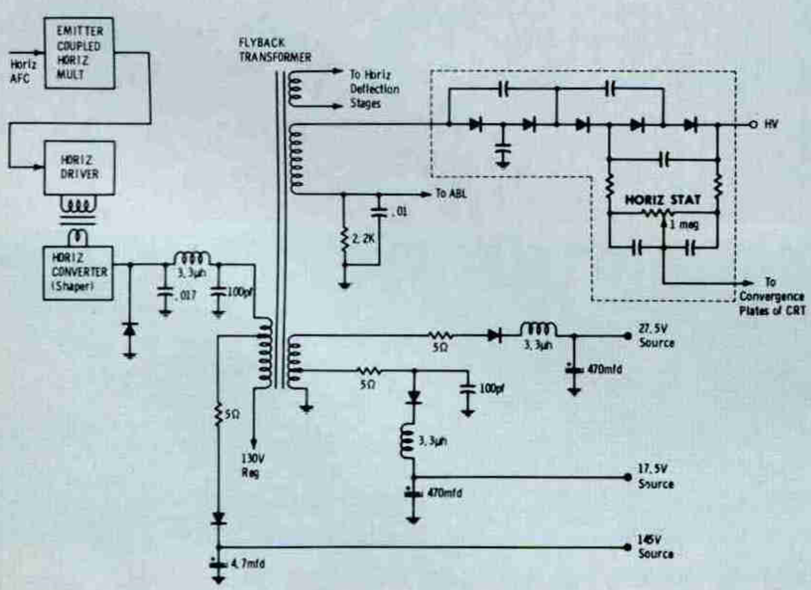


Fig. 4 Circuits for the 17-inch Trinitron CRT are not as simple as for 12- and 9-inch models. Y signal rejoins color in color-video output stages instead of at demodulators; still no matrixing inside CRT. **Photo** shows that high-voltage button in larger Trinitron is on top rather than on side as in smaller tubes.



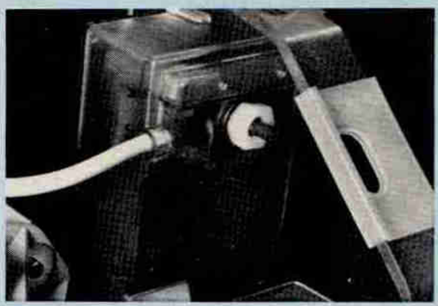
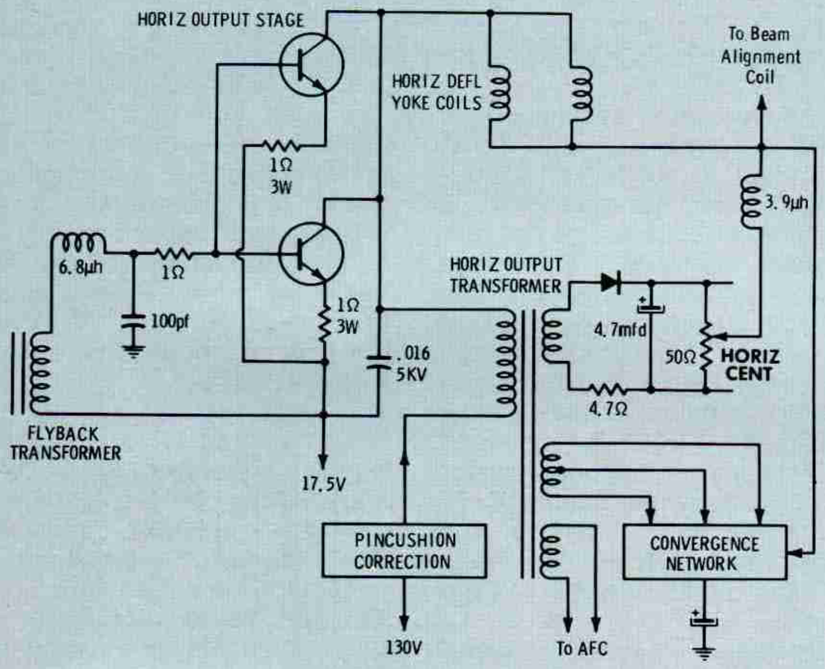


Fig. 5 High-voltage system incorporates solid-state quintupler driven by flyback transformer. But same transformer does not drive deflection yoke. Flyback, high-voltage quintupler, and convergence potentiometer are housed together in a sealed unit, as shown in **inset photo.**



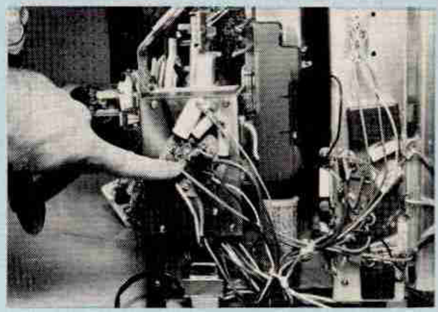
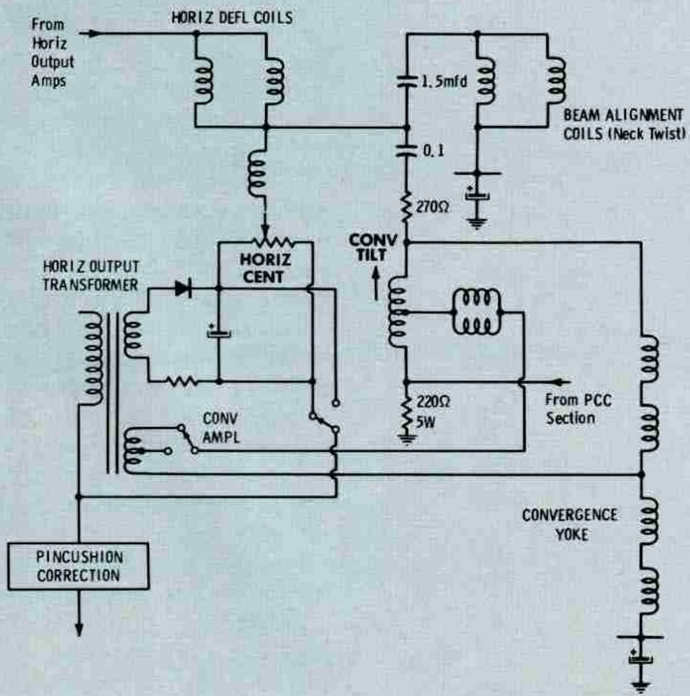
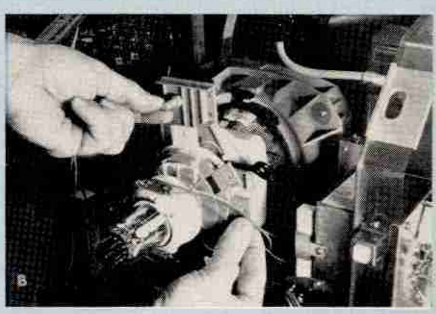


Fig. 6 Deflection yoke is driven by paralleled transistors and impedance-wired horizontal output transformer. Latter is inside shielded cage, shown in **inset photo**. Return for yoke is through convergence system as well as through centering network, and includes beam-alignment coil on CRT neck.





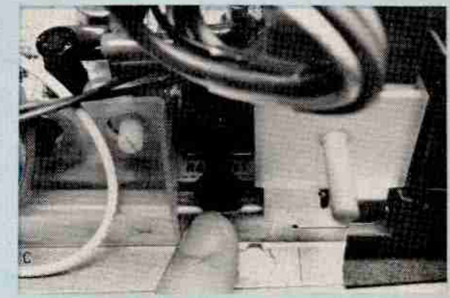


Fig. 7 A) Horizontal deflection coils return to ground through complex of beam-alignment, centering, and dynamic convergence networks. Static convergence magnets **(B)** fit on neck of tube, similar to conventional-CRT magnets. Main dynamic convergence control, R-G Tilt is by itself on chassis **(C)**.

lights during strong video scenes.

The focus grid operates *at* a comparatively low voltage—only 170 volts DC. In some instances, focus is as good or better with the focus anode grounded.

The convergence anode operates at a high DC potential, which is established by a Horizontal Static convergence adjustment that is part of the high-voltage quintupler (described in detail later). Keep in mind, however, that the large-scene Trinitron does *not* use a parabolic signal on its convergence plates. It uses only the high DC voltage—which is almost as high as the voltage applied to the second anode. (The second connection is shown in the photo in Fig. 4).

Horizontal Deflection and High Voltage

The 17-inch Trinitron chassis is the first Sony to use a high-voltage quintupler. What's unusual is that the quintupler is not driven by the deflection output stages but by a flyback transformer. Fig. 5 shows the section that generates high voltage—and, incidentally, produces several other DC voltages for the chassis.

The horizontal oscillator is a cathode-coupled multivibrator. Its output is applied to a horizontal driver transistor that is transformer-coupled to an impedance converter. This stage develops a pulse shape that has a large current-driving capability. DC for the converter-stage transistor comes through the primary winding of the flyback transformer from a regulated 130-volt source. A diode, resistor and filter capacitor connected to a tap on the primary of the transformer develop 145 volts DC for other stages in the chassis.

The bottom secondary winding of the flyback transformer is tapped and supplies two other rectifying networks: One develops 17.5 volts DC, the other 27.5 volts DC.

The high-voltage secondary on the flyback transformer returns to ground through a 2.2k-ohm resistor, which "senses" the CRT current and supplies a corresponding voltage to automatic brightness limiter circuit. The high end of that winding supplies pulses of between 4000 and 5000 volts to a hermetically sealed quintupler (dotted lines). Diodes and capacitors in the quintupler multiply voltage on a half-wave basis. The quintupler produces more than 20 kV, for the second anode of the Trinitron CRT.

Bridged across part of the "high" end of the quintupler is a network that includes the Horizontal Static convergence potentiometer mentioned previously. The slider of this pot connects to the convergence plates of the Trinitron. The control can be set to produce between 14 and 20 kV. This voltage is used to adjust the beam crossover point at the center of the CRT screen. Dynamic convergence, near the outer edges, is handled by convergence coils (explained shortly).

One important thing to remember: The flyback system in Fig. 5 does *not* drive the horizontal deflection yoke. The flyback develops only high voltage and some low voltages, and a DC voltage for the convergence plates. A separate winding on this flyback supplies a pulse output that is applied to the horizontal deflection amplifiers.

The horizontal deflection stage is shown in Fig. 6. The separate winding of the flyback transformer feeds a pair of power transistors connected in parallel. The deflection coils are driven directly, but their ground return is complex. It includes a beam alignment assembly (sometimes called neck-twist coil by Sony), a horizontal centering network, and the convergence system.

The two transistors also drive a horizontal output transformer. DC voltage for the transistor collectors comes from a 130-volt source, but runs through a pin-

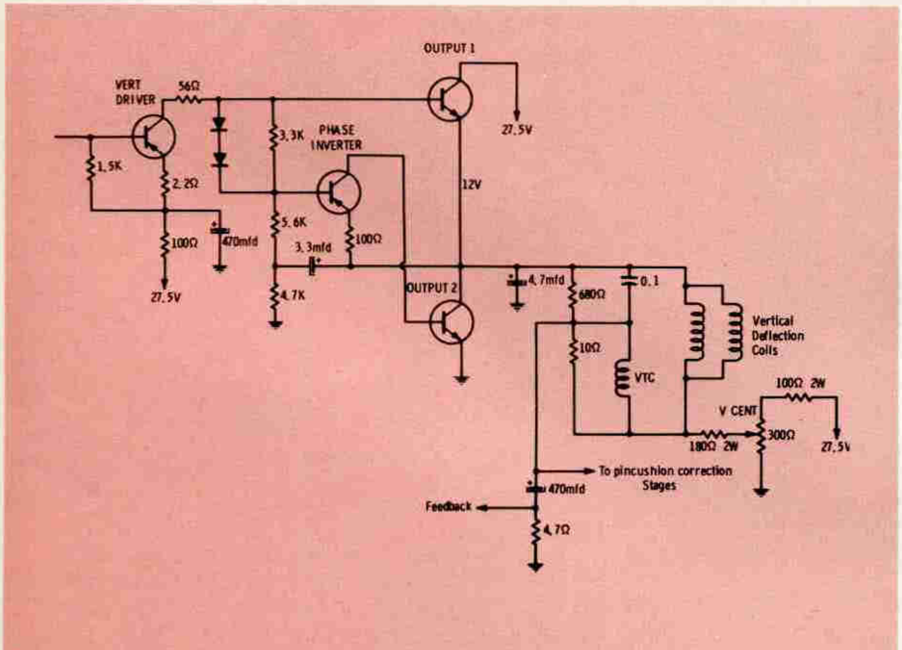


Fig. 8 Output-transformerless (OTL) stage, common in hi-fi amplifiers, is not common for vertical-output stages in color-TV receivers. Return path for vertical deflection yoke includes pincushion-correction takeoff and DC divider for centering.

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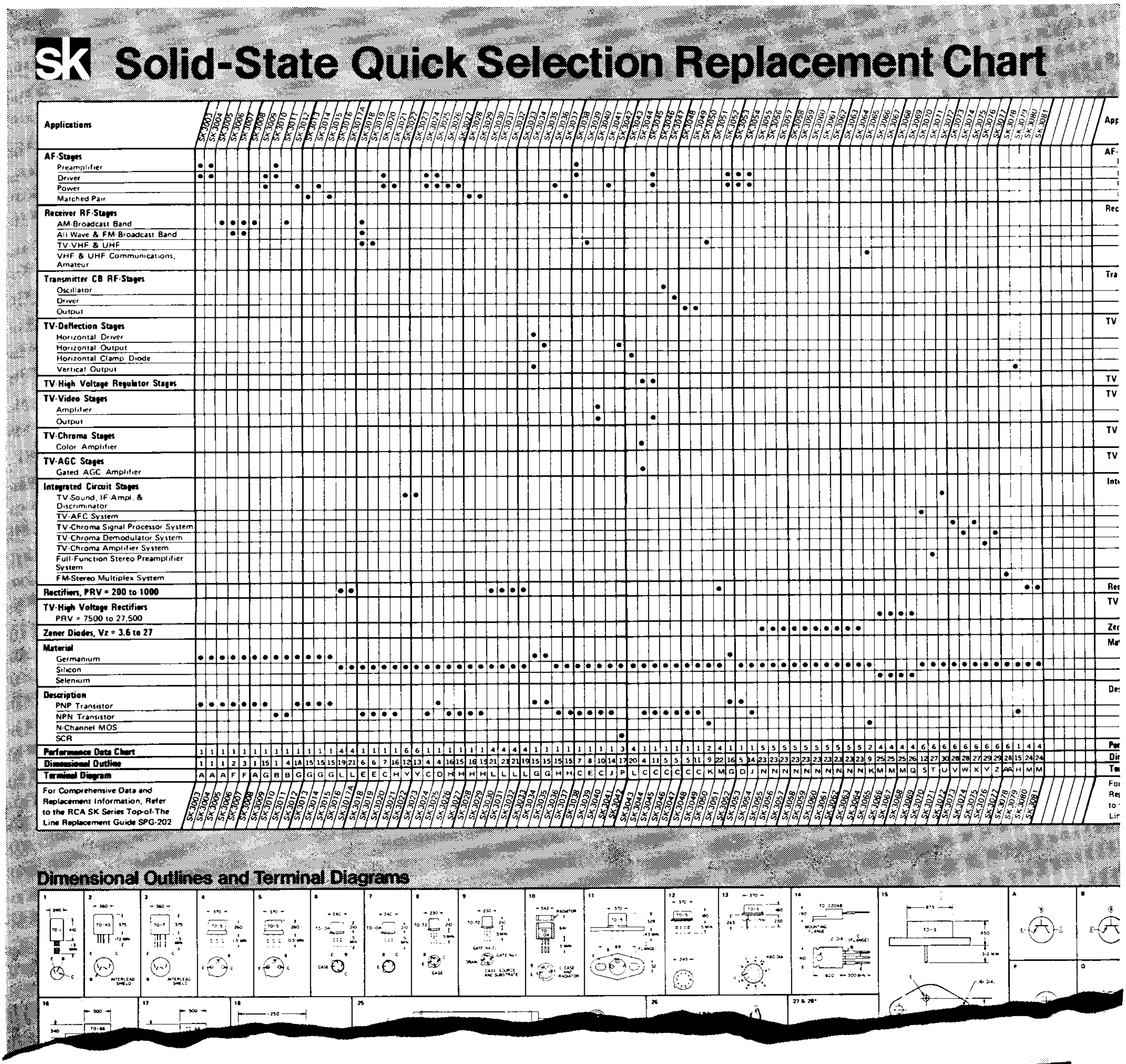

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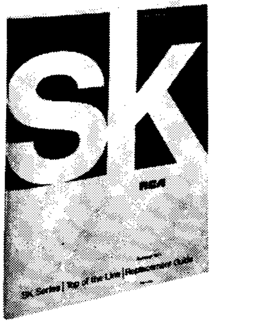


RCA

cushion correction system before it reaches the primary winding of the output transformer. Pincushion-correction waveforms are thus added to the output-stage waveforms in the output transformer. This mixes pincushion correction with the signals applied to the convergence networks.

Fig. 7 illustrates how the deflection coils return to ground through three various networks. Actually, three branches are involved:

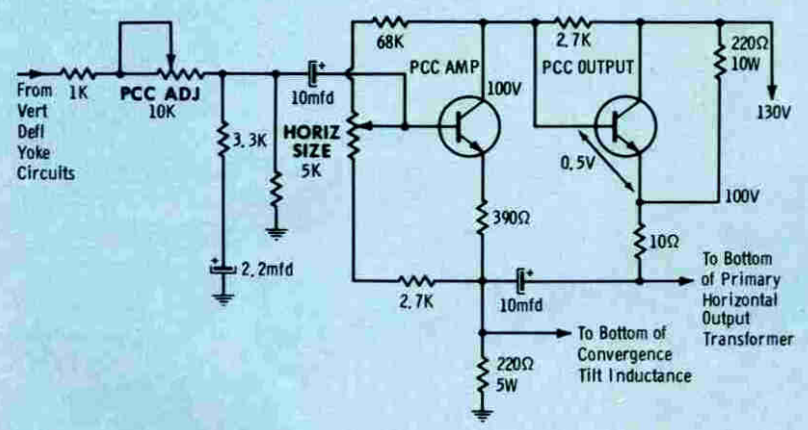
1) The neck-twist coil or beam alignment assembly, which carries almost the same waveform as the deflection coils.

2) The horizontal centering return, part of which is shown in Fig. 6 and the remainder of which is shown in Fig. 7. A tap arrangement lets you refine the centering adjustment. The tap returns to the bottom of the horizontal-output transformer primary, *above* the pincushion correction system. The 130-volt DC coming through the PCC network goes to one end of the horizontal centering potentiometer. DC from the diode and filter adds to or subtracts from the 130 volts. The centering-pot slider moves between maximum or minimum voltage and establishes how much DC goes through the deflection coils. This DC magnetic field joins the deflection signal and centers the sweep on the face of the picture tube.

3) The third branch is convergence. A 0.1-mfd capacitor couples the return circuit. The 270-ohm resistor helps shape the signal reaching the convergence yoke. A tapped inductance, labeled Convergence Tilt, and its associated network are parallelled across part of the convergence yoke. A signal voltage from a winding of the output transformer is applied to the Tilt coil; the Convergence Amplitude taps determine how much.

Horizontal Centering, Convergence Amplitude, Convergence Tilt, and Horizontal Static comprise the convergence adjustment. You do have to adjust the static magnets and the beam alignment coil on the picture-tube neck, but there are no other controls to adjust. As with earlier Trinitrons, the need for vertical convergence is negligible, and is designed right into the circuits.

One point worth mentioning about Fig. 7: The two capacitors shown grounding the bottom end of the convergence yoke and the beam alignment coils are actually one capacitor, which is the filter for the 17.5-volt DC source described earlier. It is a convenient place to return these coils to signal ground. Very little DC current flows through the convergence yoke and tilt inductance.



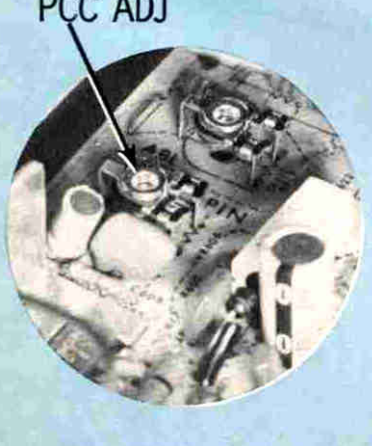


Fig. 9 Pincushion correction (PCC) in 17-inch Trinitron is electronic, and is accomplished by applying PCC waveforms that modify sweep and convergence signals in horizontal deflection. Chassis location of PCC adjust is shown in **Inset photo.**

Vertical Sweep System

The vertical-output section in the 17-inch Trinitron chassis is another change from earlier Sony receivers. This one uses a two-transistor transformerless output, shown in Fig. 8. You might have seen a similar design in hi-fi amplifiers.

A signal from the vertical oscillator/amplifier is applied to the driver transistor, which, in turn, applies a signal to the base of the first output transistor (output 1). This stage, functioning as an emitter-follower, drives the vertical deflection coils.

A 3.3k-ohm resistor and a pair of clamp diodes couple the signal from the collector of the

vertical driver to the base of a phase inverter, which turns the vertical signal upside-down and applies it to the base of the second output transistor (output 2). This output transistor functions as a grounded-emitter amplifier. The output from its collector is applied to the same end of the vertical deflection coils as that of output 1.

The 4.7-mfd capacitor on the output line—plus the network comprised of resistors, a capacitor, and a coil across the deflector and a coil across the deflection coils—assures proper shaping of the waveform for vertical deflection. The need for a vertical output transformer is eliminated, reducing both weight and cost.

The 680-ohm and 10-ohm resistors form a divider. The 0.1-mfd capacitor and the coil in series with it form another type of divider whose primary purpose is shaping. The waveform thus divided and shaped is fed to the pincushion correction stages.

The signal ground return for the vertical deflection coils is through the 10-ohm resistor, the VTC coil, the 470-mfd electrolytic capacitor, and the 4.7-ohm resistor. For DC, the shortest return from the bottom end of the vertical deflection coils is through the vertical centering network.

The vertical centering pot is part of a simple adjustable divider across the 27.5-volt DC line. About 12 volts exists at the top end of the vertical deflection coils. The vertical centering slider can be set to tap from zero up to about 22 volts. Thus, the amount of DC in the coils can be controlled by the pot and the direction of DC flow. The resulting magnetic field positions the vertical deflection on the face of the picture tube.

Pincushion Correction

Pincushion correction in the large-screen Trinitron chassis is far simpler than the earlier, smaller-screen versions. Pincushion correction is electronic rather than magnetic. The system is shown in Fig. 9.

The signal from the vertical-yoke divider shown in Fig. 8 is applied to the PCC amplifier through a shaping network which includes the PCC Adjustment. The Horizontal Size control affects pincushioning in the horizontal direction—side pincushioning. This latter control determines the bias on the PCC amplifier. Thus, the PCC Adjust takes care of top and bottom pincushioning while the Horizontal Size control handles the sides (and has some effect on side convergence).

The pincushion correction signal is amplified by the two transistors. The output transistor operates as an emitter-follower, for impedance matching. Its output PCC signal is developed across the 10-ohm resistor. This resistor actually is in the collector supply circuit for the horizontal output stage (see Fig. 6). The DC path extends from the 130-volt line, through the 220-ohm resistors (Fig. 9) and then through the horizontal-output transistors (Fig. 6). The PCC signal across the 10-ohm resistor adds to whatever signal is developed in the horizontal-output primary, particularly correcting pincushioning.

Another connection, from the convergence section, makes the 220-ohm, 5-watt resistor (Fig. 9) common to both the PCC system and the dynamic convergence system (Fig. 7, bottom of the Tilt inductance).

A Larger Trinitron To Come

Sony has promised an even larger Trinitron later this year or early next year. Size hasn't been established, but it will probably be 21 or 23 inches. Sony has offered no clue to whether the gun structure will be the older version, the newer version, or some other design. ▲

better

managementguides

by Robert G. Amick/ES Business Consultant

Selecting insurance for your business—a primer

The old saying that goes: "If you don't know medicine, you'd better know your doctor," is equally true of insurance.

It's a complex subject, confusing and legalistic to most small businessmen. It's not a field in which it's easy to become an expert, and it's like so many others a small businessman must cope with. It simply isn't as profitable for him to become an insurance expert as it is for him to become more expert in his own field.

So, the easiest way out is to 'hire' an expert by letting a knowledgeable and trustworthy agent handle your insurance matters for you.

Still, you need a reasonable acquaintance with insurance principles, so you can talk with your 'expert' intelligently. And, so that you can lay down some basic guidelines for yourself and your agent.

Uncertainty, or risk, is a part of life. It's also a part of business. A big part, in some businesses, all the time—as in plants manufacturing explosives. Or, a big part in other businesses only at certain times, like the risk of loss through shoplifting in a department store during the Christmas rush. And, a big part in what should be low-risk businesses when certain conditions aren't met. As when the help ignores safety rules, or where practices about handling valuables are too loose.

Insurance is one way of reducing the hazard that goes with ownership of property, or doing business, or engaging in certain activities (like driving a car). It does this by pooling the risk of a large number of people, using a mathematical concept, called the 'law of large numbers', to predict the frequency with which a given peril will occur within that number of people. Once that's known, the insurer can assess each person a fair share of the expected total loss from that peril.

In effect, when you take out an insurance policy on your car or property, you're trading the possibility of a large and uncertain loss for the small and certain loss which is your insurance premium.

When you guarantee the work you do, or the goods you sell, you're acting as an insurer. You're taking over the risk your customer would otherwise take on your work.

A Basic Insurance Philosophy For Businesses

When you're considering an insurance program to protect your business, your first job is to set down your philosophy about what your insurance program must do. Most small businessmen accept this position:

"I will insure all risks except those which are not likely to do serious harm to my cash position in the event of a loss.

"I will cover the largest risks first, and extend my protection to the lesser, or more frequent risks later, as budget permits.

"I will cover minor risks, not protected by insurance, from cash reserves or surplus of my business."

That's the kernel of insurance planning. (As we've discussed before, it's almost like stating your business objective.) Begin by covering yourself against the biggest likelihood of serious loss. An auto liability claim that can break you, rather than the collision claim that will only hurt you for a while. It's vital to be protected against the perils which can wreck your business and you, before you worry about protection from those hazards which will only strap you for a year or so.

Two errors to avoid

The preceding approach to insurance selection keeps you heading away from two of the most serious insuring errors of small businessmen: Covering risks which, if they did become losses, would only be trivial; and buying unnecessary and overlapping protection, including protection for the wrong risks. For example:

If you and your wife run your business with no outside help, you don't need protection against thefts by employees.

Or, if you have an eight-year-old truck with a book value of $450, collision insurance on it would cost you about 20 percent, or more, of its value. It really isn't economical to insure the truck against collision damage.

Alternatives to 'formal' insurance

Another frequent error made by small businessmen is failure to recognize that there are alternatives to insurance policies to protect them from hazards. There are four other ways of dealing with risk:

- *Non-insurance.* That's when you do absolutely nothing about the risk. It's fine for the trivial risks, or the ones which can be prevented or reduced, and where the potential loss is low.

- *Loss-prevention.* You recognize the risk, and plan a program to control it. You refuse to store flammables on your premises. You install special protective devices, such as safety mats and railings. Whatever the risk is, you set up a program to minimize it.
- *Risk transfer.* That's what you do when you buy an insurance policy—you transfer the risk of loss to the insurance company. But, there are ways that don't involve commercial insurers. Instead of owning property, you can lease it. Your landlord carries the insurance on the building. You're only responsible for insuring the contents you own or have charge of. Some firms lease furniture, automobiles and trucks, office equipment, even personnel. They pass on the insurance cost (and some other problems) to the leasing company. Sure, it's part of the lease rate they pay, but many times the leasing firm is insuring many units instead of one. This lowers their insurance cost. And, other firms have such low-loss experience on their equipment leased out that they don't insure it at all. Or, they insure it only for certain risks.
- *Self-insuring* is the fourth alternative to commercial insurance. It isn't really the same as non-insurance. You accept the risk, plan around it and allow for reserves to handle the losses. When you self-insure, you must know fairly well what the losses are likely to be, and you must be able to put aside cash to handle the loss. You'll find self-insurance programs backed up by strong loss-prevention programs.

There are cases where self-insurance is practically the only insurance available. Some areas can't buy flood protection at any price. Some stores, in high-crime-incidence areas can buy burglary or robbery insurance only at prohibitive rates.

Self-insurance is mainly the method of bigger businesses. But, you can use it in a few ways. Take automobile collision insurance as an example. You probably carry it with a 'deductible'—which means you pay the first $50 or $100 of any loss. That deductible is a limited form of self-insurance. You're insuring yourself until the loss gets above that level. Now, have you checked the difference in cost between the $50 and $100 deductible protection? You can pay as much as $35 a year for that extra $50 in protection. If you don't have a lot of small accidents, you can bank that $35 and cover your deductible from the savings, in just three years.

Coverages You Probably Need

What coverages you actually need depends on your business, its location, the assets for which you need protection, the type of perils involved, and the type of business operations you perform. These are some forms of insurance which most businesses of your type will need:

- ☐ *Fire Insurance*—on the contents of your shop which belong to you or your customers, certainly. On the building, if you own it. An All-Risk policy might give protection from other important hazards, as well as fire.
- ☐ *Liability Insurance* — to protect you from claims by customers, deliverymen and the general public who may suffer injury or loss on your premises. The law requires that you provide a safe place for them to transact business with you. A moment's forgetfulness may put you in the wrong in a damage suit. If you're an employer, you may also need Employer's Liability, to protect you from employees' claims. And the law might require you to carry Workmen's Compensation insurance.
- ☐ *Crime Insurance* — You may need several kinds, to protect yourself from loss of your own property or that left in your care by your customers.
  - *Burglary* insurance covers you against thefts by those who break into your shop (but not against sneak thieves who leave no sign of forcible entry).
  - *Robbery* insurance covers you against loss on or off your premises to a holdup man.

There are special forms and combinations of the two which might fit your needs. You may want special coverage for tools, equipment or parts stolen from your truck.

  - *A Fidelity Bond* covers you against loss if one of your employees is dishonest. Don't think only in terms of those who handle cash. A shop man who never gets near the cash drawer can steal tools, parts, supplies, or even customers' equipment.
- ☐ *Automobile Insurance* — Types you'll probably need include:
  - *Liability* that covers use of any vehicle in your business by you or your employees —the business's truck, your car or one of theirs.
  - *Theft insurance,* if loss of the truck for any appreciable time would cripple your business. Many theft coverages provide for rental of a substitute unit until yours is recovered.
  - Collision coverage depends on your judgment. If your truck's mortgaged, you'll have to carry collision insurance. If it's not mortgaged, is still fairly new, and its loss would hurt you badly, insure it. But, as it grows older, keep

weighing the cost of insuring it against the prospective loss.

The preceding are the main types of insurance you'll probably need. In addition, there are special forms of insurance which cover you against loss when your business is interrupted by an insured peril; there's credit insurance for those who do a credit business, or sell on installment plans; there's business-owner insurance, to protect you from loss arising from illness or disability, and your family from loss of your business through your premature death. Plus, of course, the various insurances that make up today's 'employee benefit package'.

Recovering The Loss

Okay. You're insured against your real and significant risks. What about losses? It's a fact that insured losses are less frequent than uninsured losses (except where automobile insurance is involved). That's partly because people who should insure don't. And, it's partly because most insurance companies do work with their customers to prevent loss or minimize risks.

Complying with the terms of your policy

When you do have a loss, your insurance contract (policy) probably requires you to do certain things:

1) Notify the insurer of your loss as soon as possible.
2) Furnish whatever proof of loss is required. (Here, again, good accounting records are the best source of proof.)
3) You must assist and cooperate with the insurer: to reduce the amount of loss; to prevent further loss to insured property; to establish the amount of loss in court, if necessary, to collect from third parties; and furnish all records and other insurance policies required to determine liability and amount of loss.

If you don't do these things, your coverage might be voided.

Conditions that can delay payment for a loss

When you have a major claim for loss, a number of conditions can delay settlement. Most of these conditions arise from lack of planning, or haphazard insuring attitudes.

If you have *overlapping coverage* by two or more policies, the insurance companies must settle among themselves which is to accept the liability. Then, and only then, will the one who's 'it' settle your claim.

Another problem with too many policies is *nonconcurrency,* which happens when the terms of several policies overlap and have, in addition, conflicting terms and provisions. Here, again, the companies insuring you have to settle the problem themselves before any one of them has a legal right to approach you with a settlement offer.

Finally, there's the problem of *overinsurance.* When you carry too much insurance on a piece of property, there's apt to be overlapping coverage and nonconcurrence at the same time. Over-insurance is expensive. You pay too much for coverage, without gaining anything. You just can't collect $40,000 for the loss of a $20,000 building.

Overinsurance can delay your settlement. But, underinsurance is a bigger headache. If you're underinsured, you can't collect in full for all your insured losses. While most people underinsure through neglect—they don't review their protection plan periodically and never catch up with changing property values — quite a few do so through bad judgement. You hear them argue, for example, that most fire losses are only partial, so full fire insurance coverage isn't necessary.

That's unrealistic. For one thing, the additional premium for full coverage isn't likely to be that much greater. But, mainly, it's unrealistic because the fire insurance companies have a built-in penalty for that approach. It's called *'coinsurance'* and it means that you must carry 80 or 90 percent of the property's value in insurance, or bear a share of your own loss proportionate to the amount you're underinsured. This can stick you for one-third of the loss, while the insurer pays the other two-thirds.

Lack of planning, bad judgment, just plain ignorance account for some of these mistakes. But, there's another reason that gets quite a few small businessmen into difficulties.

You'll find they've spread their insurance business among a fair number of agents—hoping that each will 'pay them back' with business. It might pay off, and it might not. A bunch of individual premiums for a bunch of separate policies with separate companies might cost more than keeping the business in one basket. It certainly makes overlapping and nonconcurrent coverages more probable—and maybe overinsurance, too.

Guidelines For Buying And Handling Insurance

From the foregoing discussions, we have evolved some guide-lines for buying and handling your insurance:

- *Decide which of the methods of risk management will work best, and most economically, for you, in each of the risk exposures your business involves.* You'll probably find that several, or all, work out in combination.

- *Cover your largest exposure first.* Step down to the smaller ones and the more frequent ones as your insurance budget permits. Use your premium dollar where you need it most.

- *Be sure you're covering the correct exposure.* You probably will need expert advice on this from your agent.

- *Make good use (and proper use) of deductibles.* Protecting yourself against the first dollar of loss is sometimes expensive. But, don't take big deductibles you can't handle just to save money on premiums. Keep them to an amount you can afford.

- *Review your insurance, and your insured property, periodically.* Be sure you're covering what's important, and covering it for the right amount, as today's inflation changes property values. Be sure you're not covering property you no longer own. Avoid gaps in coverage just as surely as you avoid overlaps.

- *Check the market occasionally,* to be sure your premiums are reasonable and consistent with those offered by other companies. Don't switch every time a lower price is quoted, but be aware of the averages and trends for your types of coverages. When you do consider a price-based change, find out *why* you're going to save money before you change. Is it because you get less service? Are necessary protections going to be excluded? (If so, you'll have to get them in another policy, and there goes your saving.) Or does the company pinch pennies when settling claims?

- *Put your insurance in one agent's hands.* Pick an agent you trust, give him a clear idea of your wants, listen to his advice and use it. With one man handling it, your program can avoid overlaps, nonconcurrency and the rest of the problems. He'll be your only link with your insurers, and his commissions will be big enough to justify your expectations of service from him. Keep him posted about changes in your risk situation.

- *Do all you can to keep your losses down.* It will keep your rates low and it will also protect you from the indirect (and uninsurable) losses that come with trouble. ▲

test equipment report

Solid-State, Dual-Trace Triggered-Sweep Scope

Sencore has announced the availability of a wide-band, solid-state, dual-trace, triggered-sweep scope which can simultaneously display two waveforms by either the alternate or chopped modes of operation.

Calibration of the VOLTS/DIV gain control switches in both vertical amplifier channels includes the 10X loss that is normal when using a low-capacitance probe. Consequently, no multiplication of the reading is necessary when a low-capacitance probe is used.

Viewing of either the 10 x 10 centimeter grid or the vector grid patterns is possible without changing graticules. A scale-illumination switch turns on bulbs that light either one grid or the other in the graticule, which has two layers of grids.

Other reported features and specifications include:

Vertical Amplifiers

- Sensitivity—5 millivolts/cm to 50 volts/cm divided into 13 calibrated ranges when a direct probe is used. The sensitivity with a low-capacitance probe is 0.05 volts/cm to 500 volts/cm. Accuracy of calibration when the vernier controls are turned fully clockwise is ±2 percent. A vernier control in each channel provides variable gain adjustments.
- Frequency response—DC to 8 MHz at ±3 dB. Rise time is reported to be 35 nanoseconds, with overshoot of 1 percent or less.
- Input impedance—1 megohm shunted by 35 pf at the input terminals. With the low-capacitance probe, the input impedance is 10 megohms shunted by 11 pf.
- Maximum input voltage — 1000 volts DC with direct probe; 5000 volts P-P when the low-capacitance probe is used.
- FET amplifiers—Each vertical amplifier channel has a field-effect (FET) transistor employed as input amplifier. Protection of the FET against damage from overloads is provided.

Sweep Circuit

- Sweep system—Automatic- or manually-triggered or free-running sweep is available.
- Sweep time—0.1 microsec/cm to .1 second/cm in 19 calibrated ranges. Vernier control provides sweep in between the marked steps. This corresponds to free-running frequencies of 1 Hz to 1 MHz in 19 ranges. Accuracy when the vernier is turned fully clockwise is ±2 percent.
- Sweep magnifier—5X sweep width.
- Horizontal input adjust—Variable, uncalibrated control.
- Horizontal input impedance—1 megohm shunted by 40 pf.
- Triggering—Can be from either vertical channel, 60-Hz line or external source. Also triggers from either positive or negative polarity.
- Preset sweep—Vertical and horizontal positions are provided for use when servicing television receivers. A sync separator is used only to separate sync from a composite video waveform for triggering these two positions.

Vector Display

- Channels—Channel A is used for vertical. Channel B is used for horizontal vector display. Low-capacitance probe is used for minimum loading of the receiver.
- Sensitivity—The same sensitivity as for dual-trace operation.
- Frequency response—DC to 8 MHz for vertical, and DC to 7 MHz for the horizontal vector channel.

General Features

- Calibration voltage—1 KHz, 2

volt P-P signal, available at a binding post on the front panel.

- Input connectors—BNC type for Channels A and B, binding posts for others.
- Retrace suppression—The CRT is blanked by a DC-coupled signal.

Dimensions—12 inches x 10 inches x 15½ inches.

Weight—30 pounds.

Power Requirements—105 to 130 VAC, 60 watts, 60 Hz.

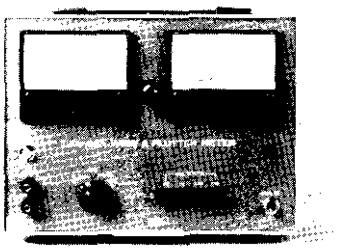
Price of the Sencore Model PS163 scope is $495.00, without probes. A set of two 39G34 low-capacitance probes are available for $25.00.

Circle 50 on literature card

Solid-State Wow and Flutter Meter

The new Model LFM-36A can simultaneously measure wow and flutter as well as drift according to the manufacturer, Leader Instruments Corp.

A solid-state, direct-reading instrument for checking tape recorders and other similar devices, the LFM-36A reportedly has separate meters on the face panel for readout of each function.



Features include: an overall accuracy of ±5 percent of full-scale value; a test range that covers a wide band with minimal adjustments; input signal level at 15mV to 10 volts (rms); input impedance over 100KΩ unbalanced (one side grounded); and a reference oscillator, to assure stable performance.

Price of the LFM-36A, complete with 3-KHz test frequency source, is $550.00 ▲

Circle 51 on literature card

For more information about above products use reader service card

SCR's and Triacs—Testing and Theory of Operation

Conventional diodes effectively are voltage-controlled switches. When the anode voltage is made more positive than the "barrier voltage", relative to the cathode, the diode becomes a conductor. Voltages of opposite polarity cause the diode to become an open circuit.

SCR's (silicon-controlled rectifiers) and triacs (see Fig. 1) have more than the one "PN" junction employed in semiconductor diodes. One of these added sections, called a "gate", has the ability to block conduction through the device.

SCR's and triacs are available in many of the case dimensions and lead arrangements commonly used for transistors. The lead locations of two popular types are shown in Fig. 2. Because this similarity of outward appearance can cause costly mistakes and wrong identification during servicing, tests which indicate whether a device in question is a transistor, SCR or triac will be explained in this article.

Basic Characteristics of SCR's

An SCR can be visualized as a diode in series with a switch, as shown in Fig. 3A. Conduction is controlled both by gate action and by the polarity and amplitude of the anode voltage.

Following are some of the normal responses of an SCR with the listed voltages applied:

- Anode voltage negative relative to the cathode—No conduction, regardless of the voltage applied to the gate. This is normal diode action.
- Anode voltage positive and the gate zero or negative relative to the cathode—No conduction. This is gate action.
- Anode voltage positive and the gate sufficiently positive—Full conduction. The change from non-conduction to full conduction is a regenerative effect which occurs instantaneously when the gate-cathode voltage is increased slightly above the breakover, or "trigger", point.
- After conduction has started, a "latching effect occurs and the gate loses control and cannot block conduction, which continues until the anode voltage and/or current are reduced below the "holding" point.

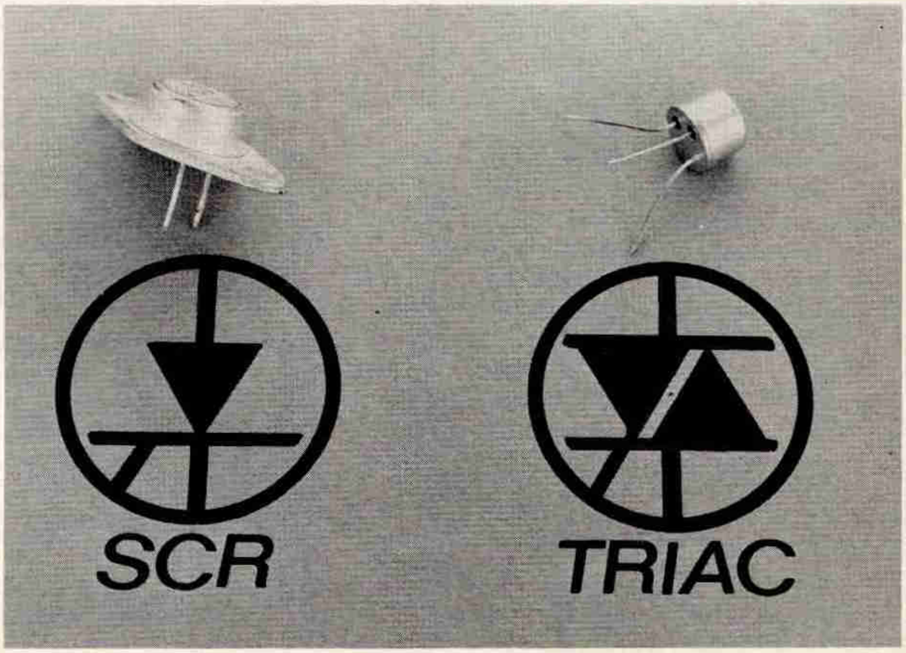
The resistance between gate and cathode of an SCR is about a few hundred ohms. Resistance indications should be similar to those produced by two conventional semiconductor diodes paralleled front-to-back. About the same ohmmeter reading should be obtained when the

Testing LDR's

The maximum resistance of an LDR can be determined accurately only by maintaining the cell in complete darkness for several minutes before measuring it with an ohmmeter. Because many circuits, including the one in Fig. 8, do not utilize the high-resistance characteristic of the LDR, this reading usually is not critical.

The minimum resistance of an LDR can be determined by subjecting it to bright light. A rough test can be made by shining a flashlight at the cell from the same distance each time. I would guess that the LDR shown in Fig. 8 would measure less than 1000 ohms if a 2-cell flashlight beam were directed at it from a distance of 2 feet.

Fig. 1 Shown here are an SCR and a triac and their respective symbols. Note the physical similarity to transistors.



test leads are switched. Also, the lower the range used, the lower will be the reading obtained. The resistance between the anode and either the cathode or gate should be nearly infinite.

Basic Characteristics of Triacs

A triac effectively functions as two paralleled front-to-back diodes in series with a switch, as shown in Fig. 3B.

Some of the responses of a non-defective triac when operated under different voltage conditions are as follows:

- Anode voltage negative and the gate zero relative to the cathode—No conduction. Diode action.
- Anode voltage positive and the gate zero relative to the cathode—No conduction. Gate action.
- Anode voltage negative and the gate voltage sufficiently negative—Full conduction.
- Anode voltage positive and the gate voltage sufficiently positive—Full conduction.
- The change from non-conduction to conduction is a regenerative effect, which occurs when the gate-cathode voltage is increased slightly above the "trigger" point, just as in SCR's.
- After conduction has started, a "latching" effect occurs, in which the gate loses control and the conduction continues regardless of subsequent changes in the gate voltages. Conduction continues until the anode voltage and/or current are reduced below the "holding" point.

The junction resistances of triacs are nearly identical to those of SCR's. The gate-to-cathode readings should be

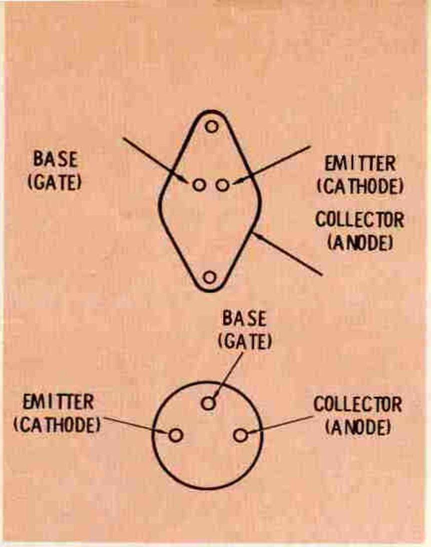


Fig. 2 Because the typical base configurations of SCR's and triacs, shown here, are almost identical to those of transistors, specific tests, described in the text, are required for positive identification.

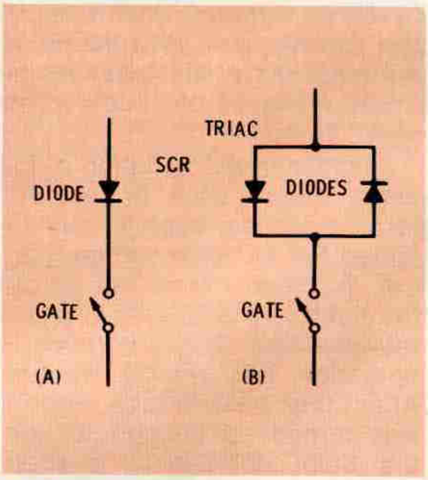


Fig. 3 These circuits illustrate the effective action of SCR's and triacs. **A)** An SCR is the equivalent of one diode in series with a switch. **B)** A triac is the equivalent of two diodes, connected back to front in parallel, in series with a switch. When properly triggered on, a triac conducts in both directions.

similar to those produced by measuring two diodes which are paralleled front-to-back. Infinite resistance should exist between the anode and either the cathode or the gate.

A Tester You Can Build For Checking SCR's And Triacs

An SCR or a triac should be tested first by use of an ohmmeter. An open circuit between gate and cathode, or a short circuit or leakage from anode to gate or from anode to cathode proves the device is defective, and no other testing is required.

Shown in Fig. 4 is a tester which checks SCR's, triacs and power transistors by applying 6 volts DC that is limited to 150 milliamps. This is a good operational test for these devices, and provides the operator visual evidence of SCR, triac and diac triggering and holding actions. The tests also indicate whether the device is a transistor, an SCR or a triac.

To test an SCR, triac, or power transistor:

- Adjust the polarity switch (S1) to the SCR-NPN position, the toggle type on/off switch (S2) to "off", and the gate-voltage control (R1) to minimum.
- Connect the tester to the device through color-coded clips and test leads.
- Turn the on/off switch to "on". If the bulb lights, the device being tested is shorted, or the test leads are touching.
- Gradually turn up the gate-voltage control. At a certain critical voltage (measured by a meter for the most detailed information) the bulb should light, indicating conduction of current through the device.
- A gradual brightening of the bulb when the control is turned up, and a gradual decrease in brightness as the control is turned down indicates that the device is an NPN transistor.
- A sudden lighting of the bulb to full brilliance at one point on the gate-voltage control, and no reduction in brilliance when the gate-voltage control is turned down, indicates that the device is an SCR *or* a triac. Subsequent tests will determine which. The bulb should remain lit after the control is turned down until a momentary open in S3 extinguishes it.
- Slide the polarity-reversing switch (S1) to the TRIAC-PNP position, and, starting at minimum, turn up the gate-volt-

age control.

- A gradual brightening and darkening of the bulb when the gate-voltage control is increased and decreased indicates that the device is a PNP power transistor.
- If the bulb does not light when the gate-voltage control is increased, the device is an SCR.
- If the bulb suddenly lights to full brilliance at one position of the gate-voltage control, and the brilliance does not decrease when the control is turned down, the device is a triac.
- Turn the on/off switch to the "off" position, to minimize battery drain.

Tips About Using The Thyristor Tester

The first version of this thyristor tester was designed and built about three years ago, when the RCA CTC40 chassis, which uses two SCR's in the horizontal sweep circuit, was introduced. The original version of the tester used two 67½-volt batteries, a neon bulb, and several more switches to test for leakage, which might occur only at higher voltages. Such a sensitive leakage test was found to be unnecessary and was discontinued in favor of simple ohmmeter tests.

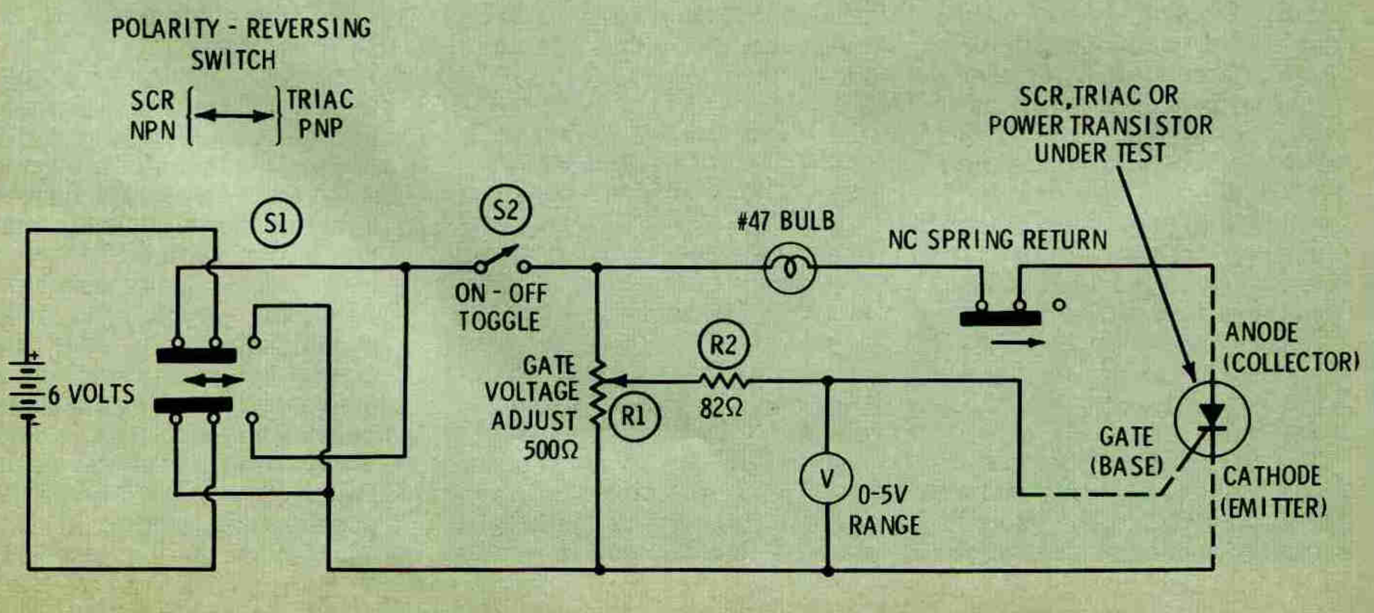
Another useful variation of the tester circuit used 6 volts AC for the anode supply, but retained the DC gate-voltage control. A scope connected across the light bulb displayed the curret waveform. One difference in operation was readily evident: After the gate-voltage control was turned up enough to light the bulb, decreasing it extinguished the bulb. The reason is that the anode voltage decreased to zero 60 times per second, and unlatching could occur during any of these "zero" times.

An SCR conducts during only the positive alternation of a sine wave applied to its gate, as shown by the current waveform in Fig. 5B. No conduction through the SCR occurred when negative voltages up to –5 volts were applied to its gate.

Triacs conduct during both alternations of a sine wave, as shown in Fig. 5C. The crossover-type distortion at the mid, or zero, points on the waveform is produced because the voltage must increase from zero to .8 volt DC or more before conduction can occur. Also, conduction ceases during the .8 volt DC just preceding zero voltage. Together, these areas of non-conduction caused a measured voltage drop of .6 volt RMS across the triac (from main terminal 1 to main terminal 2).

When the gate voltage was positive and the gate-voltage control was advanced very slowly, the triac triggered first into half-wave operation (See Fig.

Fig. 4 Schematic diagram of a tester which helps determine whether a device is a transistor, an SCR or a triac and indicates whether or not it is operating correctly.



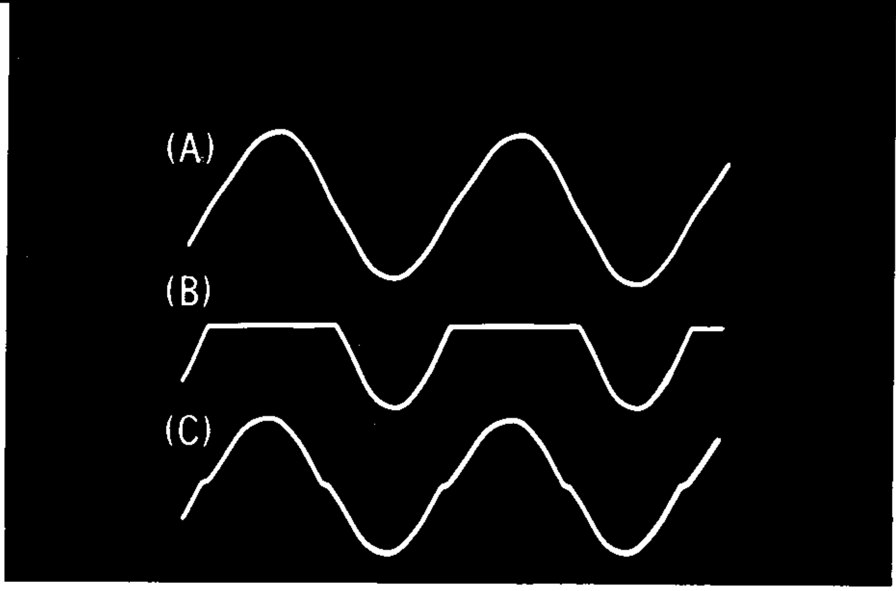


Fig. 5 Waveforms of the load current produced when SCR's and triacs are operated from an AC anode supply. **A)** Waveform of the input 60-Hz sine wave from a heater transformer. **B)** Waveform of the current (voltage across bulb) when 6 volts AC was supplied to the anode of the SCR in the schematic shown in Fig. 4. **C)** Waveform of the conduction current when 6 volts AC was supplied to the anode of a triac connected to the tester diagramed in Fig. 4. The voltage drop across the triac measured .6 volt RMS.

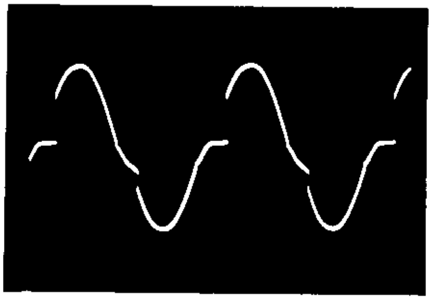


Fig. 6 Partial conduction that occurred when insufficient negative gate voltage was applied to an SCR of higher voltage rating than the one which produced the waveform in Fig. 5C.

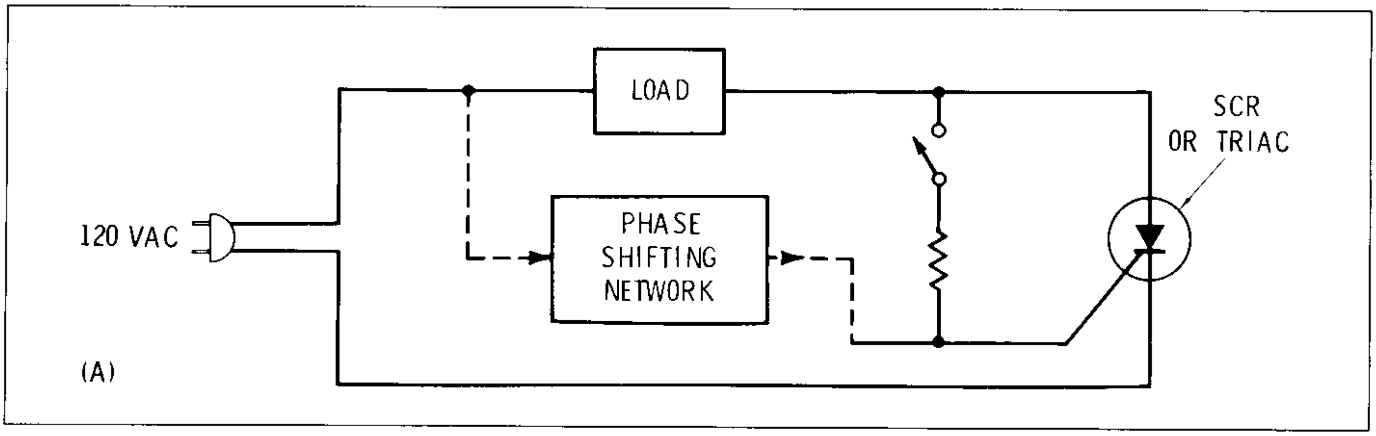
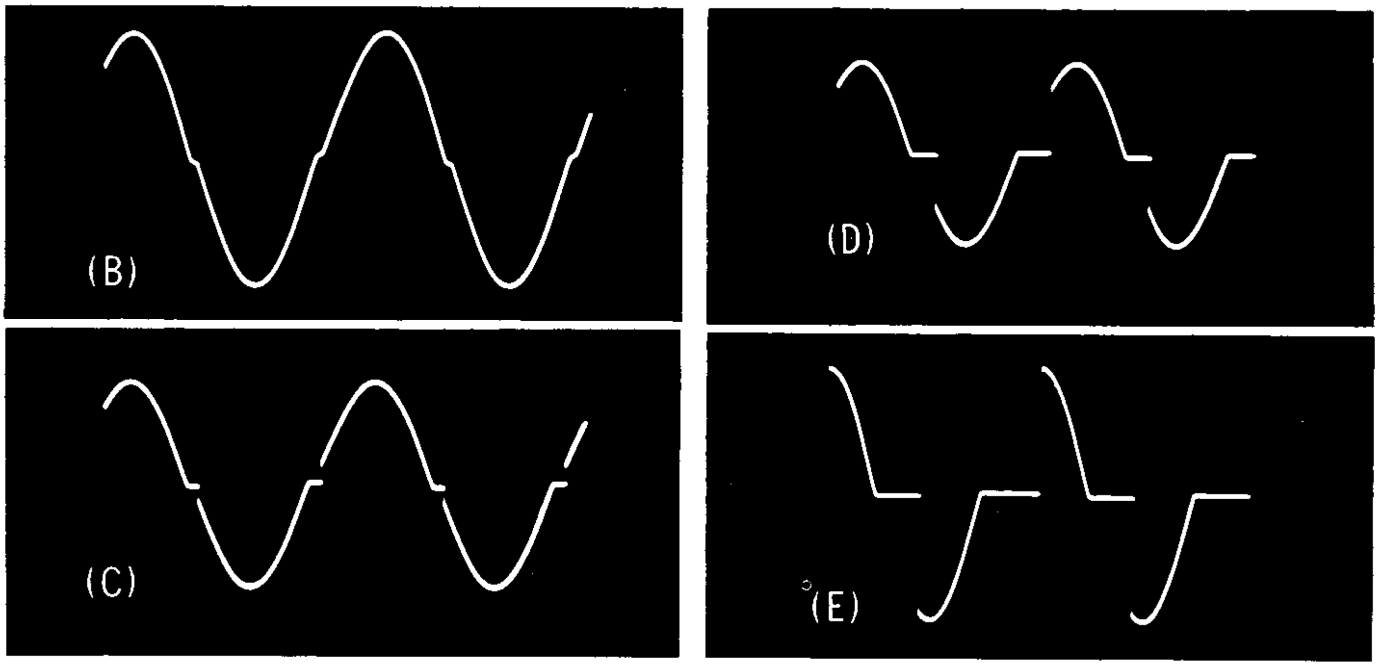


Fig. 7 SCR's and triacs can be triggered on by a resistor connected between anode and gate, or by a sample of the input voltage that has been phase shifted. **A)** Block diagram of the triac circuit. **B)** Conduction current produced with AC supplied to both gate and anode. **C)** Effect of a small phase shift in the gate voltage. **D)** The triac is triggered into conduction later by more phase shift. **E)** Conduction of just over 50 percent is caused by a large phase shift.



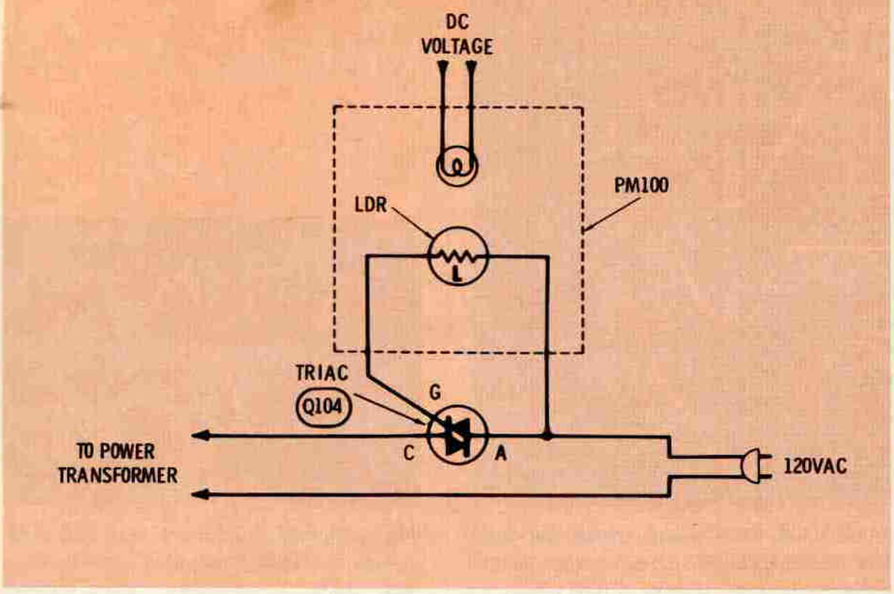


Fig. 8 Remote power on/off circuit of RCA CTC54 color TV chassis. The lamp is lighted by action of the remote control. The light reduces the resistance of the Light Dependent Resistor (LDR), or cadmium-sulfide cell; this triggers on triac Q104, which applies AC to the receiver power supply.

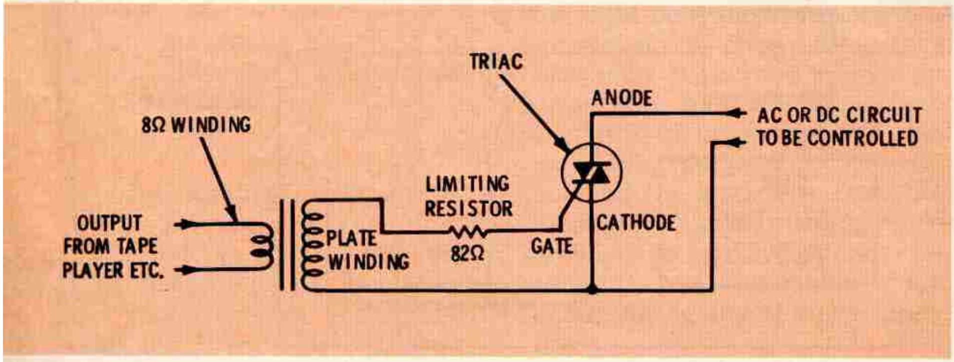


Fig. 9 Schematic of a triac circuit which will start the change cycle of a slide projector, or will turn lamps on and off according to the amplitude of the audio input.

5B) when the potential on the gate was +0.8 volt. This voltage instantly dropped to +0.7 because of the increase in gate current. The gate-voltage control was advanced further and triggering for conduction of both peaks (see Fig. 5C) occurred at +0.85 volt, after which the gate voltage dropped to +0.4 volt. These three modes of operation were very distinct, as if a 3-position switch were used. The bulb was unlit, then was lighted to partial brilliance and, finally, to full brilliance, with no variation between.

The action when negative voltage was applied to the gate was somewhat different. Triggering into the full-wave mode occurred at –0.98 volts, which promptly dropped to –0.6. However, there was a tendency for the bulb to light dimly and then brighten. The current waveform shown in Fig. 6 helps explain the reason: Because conduction was triggered on late, during the peak, the bulb was supplied with less total current. Increased gate voltage produced normal conduction.

When tested in the thyristor tester, different brands of triacs with higher voltage ratings required higher gate voltages, than did the smaller sizes. The scope waveforms of the larger triacs generally were less smooth than those produced by smaller ones.

Uses For SCR's And Triacs

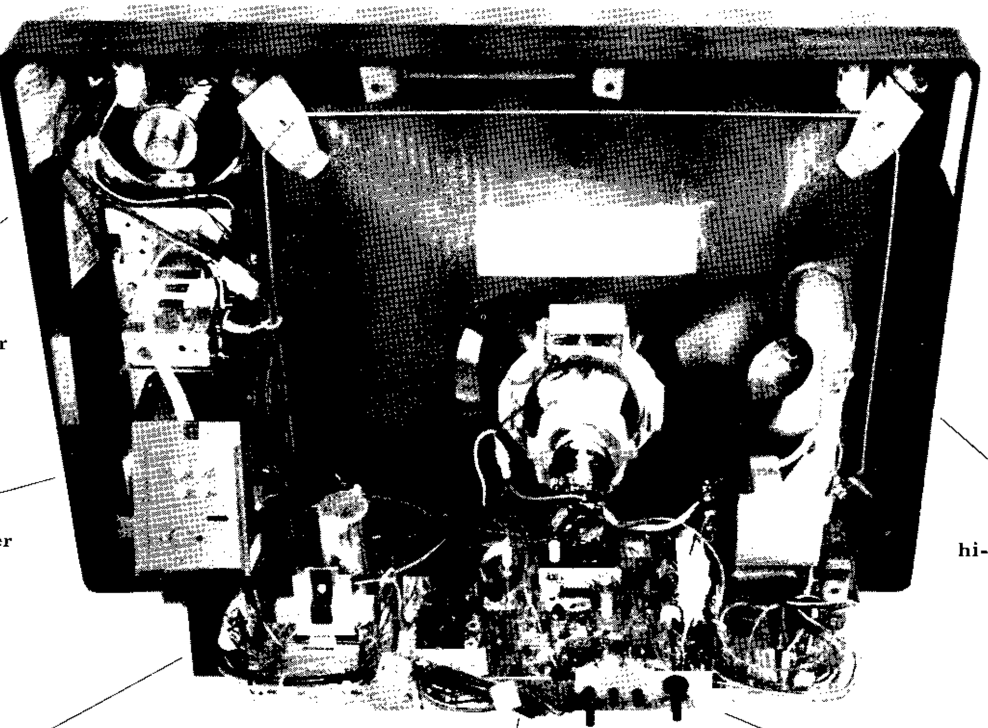
A triac or an SCR can be used to turn on and off resistive loads or to provide variable lighting or motor speed. Two alternate methods of controlling the conduction of these devices are shown in Fig. 7. For example, a 56-ohm resistor connected between the anode and gate will dependably trigger on a triac operated from 6 volts AC. A higher value should be used for 120-volt operation, to avoid gate damage. Use the highest value that will dependably trigger on the triac.

A variation of this method is employed in the RCA CTC54 color TV chassis, to turn on and off the power to the entire receiver when remote control is used. The circuit is shown in Fig. 8. The remote control supplies power to the bulb, which is located inside a light-tight assembly. When the bulb is lighted, the illumination decreases the resistance of the Light Dependent Resistor (LDR) enough so that the triac conducts and applies 120 volts AC to the power transformers. (LDR's are also called cadmium-sulfide cells.)

One simple triac-equipped circuit I have used for several years to initiate the change cycle of an automatic slide projector is shown in Fig. 9.

The narration or sound effects which accompany the slide presentation are recorded on one channel of a stereo tape recorder. The speaker is connected to this channel during playback. A short audio tone, of perhaps one second, is recorded on the other channel at any interval where a slide change is desired, so that the narration and the slide changes are in perfect synchronization. The frequency of this tone is unimportant; even 60 Hz is okay. The volume of the stereo unit is at the minimum level required for dependable operation. ▲

This General Electric solid state television received a 94.6% serviceability rating.



Nobody's perfect.

With the help of independent servicers, we designed General Electric's new 19″ (diag meas) black and white solid state set to service like a tube set. It has a plug-in chassis that includes 21 transistors, 16 diodes and an integrated circuit module. And it was given a 94.6% serviceability rating by an independent service panel.

This is just one of the things we're doing to make General Electric television products as easy to service as possible. Our warranty policy now provides for prepaid transportation on in-warranty parts. We are also testing direct telephone lines to regional parts centers. To improve local parts availability, we are expanding parts distribution through independent parts distributors.

General Electric's television products aren't perfect yet. But we're getting closer. For additional information about GE service, call collect or write "Dutch" Meyer, Television Receiver Products Department, Portsmouth, Virginia. Telephone: (703) 484-3521.

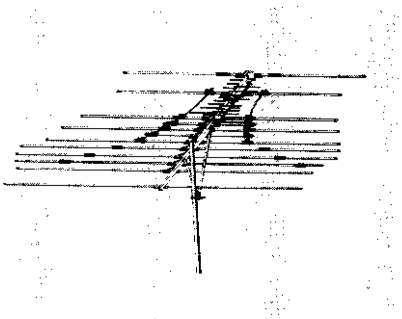
GENERAL ELECTRIC

antenna systems report

All-Channel TV Antennas

A new series of high-gain, all-channel television antennas, called "Ultron", have been introduced by GC Electronics.

Designated Models 32-1200, 32-1202 and 32-1204, the three new antennas are reportedly for metropolitan- suburban- and fringe-area uses respectively. The metropolitan model has 19 elements; the suburban has 21 elements arranged on a longer-than-standard boom; and the fringe model has 29 elements, according to the manufacturer.



The new antennas are designed for all-channel reception, VHF/UHF/FM. They reportedly have good ghost rejection and can be used for color and/or monochrome reception.

Models 32-1200, 32-1202 and 32-1204 sell for $9.95, $16.95, and $24.95 respectively.

Circle 60 on literature card

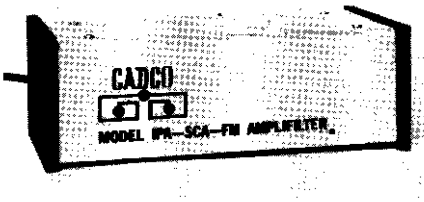
FM Pre-Amplifier

A high-gain, low-noise, single-channel FM pre-amplifier has been announced by CADCO.

The Model IPA-SCA-FM amplifier has been tested as an RF weak-signal pre-amplifier, intended as a between-the-antenna-and-the-receiver package, to boost weak off-the-air signal levels for main channel and SCA channel uses, according to the manufacturer.

The amplifier has a reported 1.3 dB maximum noise figure, and features 3-dB b-w products of plus or minus 500 KHz. Input and output impedance are 75 ohms. The unit operates from a built-in 117 VAC power supply.

Model IPA-SCA-FM sells for $49.50.



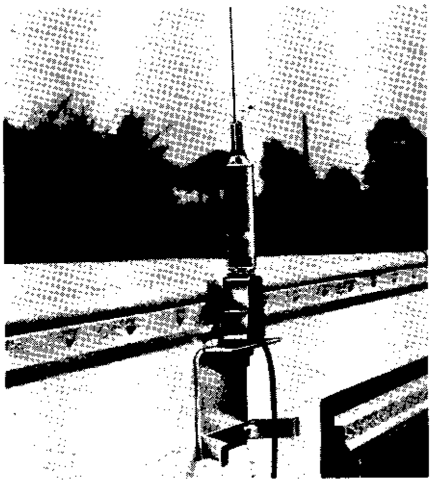
Circle 61 on literature card

CB Two-Way Radio Antenna

A new CB two-way radio, mobile antenna with a universal mounting feature has been announced by the Antenna Specialists Company.

Model M-189, reportedly can be mounted, without special tools, on almost any level or slanted surface. A special swivel base and full 90-degree vertical adjustment make possible either top- or side-mounting. This makes it easy to install on campers, trailers, trucks, and buses, even if they have irregularly shaped vehicle bodies.

Model M-189, reportedly is a tapered, stainless steel whip with a high-efficiency loading coil, and is completely weatherproof. Its shortened design helps prevent hitting low obstructions, yet allows the antenna to be mounted high on the vehicle for maximum performance, according to the manufacturer.



The M-189—complete with antenna, universal mounting bracket, 20 feet of coaxial cable and connector—sells for $20.95.

Circle 62 on literature card

Attenuator Pads

Jerrold Electronics Corp. has introduced a new line of fixed attenuator pads designed for 75-ohm all-channel TV distribution systems.

The attenuators are available in Models PDA-1, PDA-3, PDA-6, PDA-10 and PDA-20, the model number indicating the attenuation in dB.

The PDA series of attenuators use a resistive "T"-network, applicable for in-line use. All models reportedly cover the range from DC to 890 MHz. Fittings are type F-61A, with universal center clutch adaptable to RG-59 through CAC-11 cable sizes.

Specifications include:
Return loss—21 dB
VSWR—1.2:1
Impedance—75 ohms

The PDA attenuators reportedly are all-channel replacements for the earlier PDL models, and sell for $6.75.

Circle 63 on literature card

Balun-Type Impedance-Matching Transformer

The new Model T-2000 all-channel, balun-type matching transformer, which reportedly matches a 75-ohm unbalanced circuit to a 300-ohm balanced circuit in any MATV, ETV, CATV system, has been announced by Jerrold Electronics Corp.

Through use of a special fitting provided, the T-2000 can reportedly mate a 75-ohm input with an F-59 cable connector, while the 300-ohm twin lead output terminates in lugs, for attachment to the TV receiver antenna terminals.

The T-2000 sells for $2.65. ▲

Circle 64 on literature card

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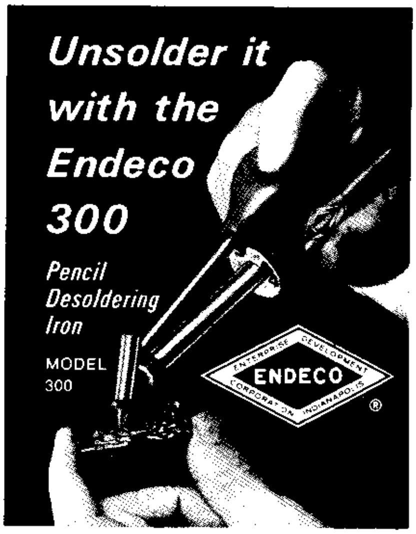
Circle 25 on literature card

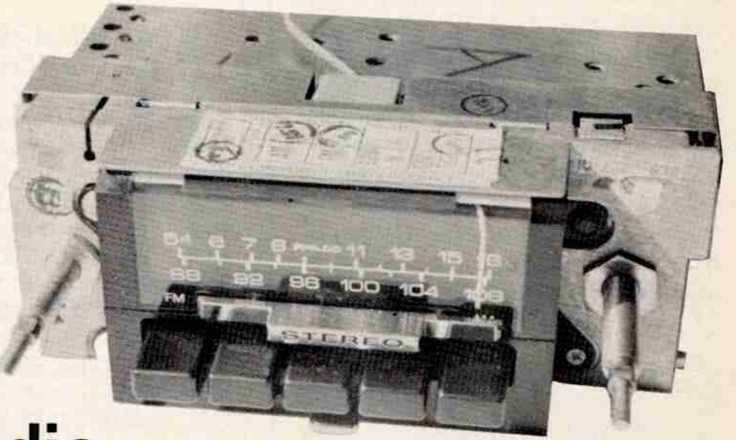


Circle 26 on literature card

Circle 27 on literature card

by Joseph J. Carr/ES Auto Electronics Editor

Philco-Ford's New Varactor-Tuned AM/FM/ FM Stereo Auto Radio



Philco-Ford recently introduced, for 1972, their first AM/ FM stereo auto radio. (Previously, FM and FM stereo radios used in Ford autos have been produced by the Automotive Division of the Bendix Corporation.)

Although Philco-Ford is a newcomer to stereo FM auto radio production, it is no newcomer to the development and production of a variety of other even more sophisticated electronic products. The innovative design of its first FM stereo auto radio is evidence of this experience.

Varactor Tuning

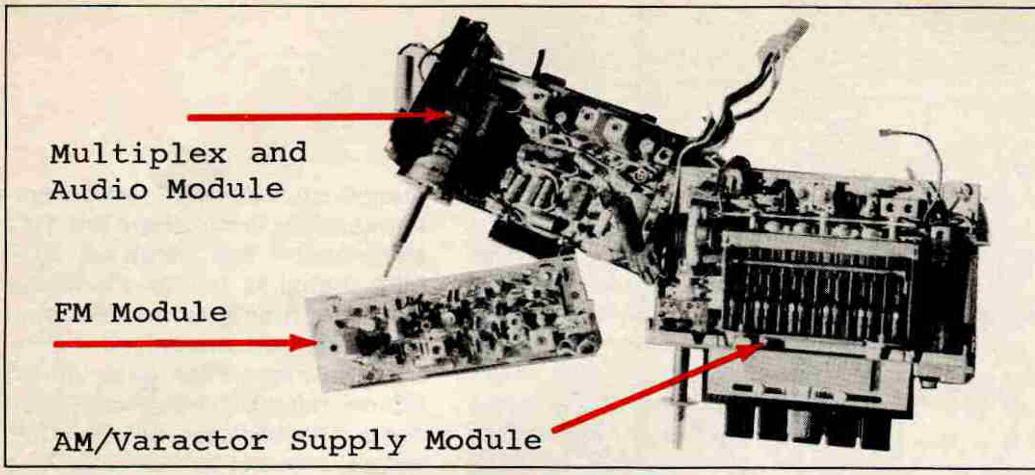
One of the most radical departures from normal design is the use of voltage tuning in the FM front-end. That's right . . . voltage tuning. Don't look for the usual FM tuning slugs in the tuner mechanism. There are none. The FM band is tuned by a well-filtered DC control voltage.

A block diagram of the receiver section which generates the control voltage is shown in Fig. 1. It includes an oscillator which is permeability tuned; the slug of the tuning coil is ganged to the core bar in the manual-pushbutton mainframe assembly. The frequency of this oscillator is in the several-hundred-kilohertz region, far below the FM broadcast band. The precise frequency is unimportant, according to Philco-Ford. A detector and RC filter network provide the actual control voltage which is fed to varactors in the receiver front end. Another detector furnishes an error correction voltage to a DC negative feedback circuit. This stabilizes the control voltage to within plus or minus .005 volts.

The control-voltage circuitry is shown in Fig. 2. Transistor Q1 and associated components form a common-base Colpitts-style circuit. L1, the variable coil, and L2, the fixed coil, form the inductive branch of the oscillator tank circuit. This branch of the circuit also doubles as an inductive AC (signal) voltage divider network. The AC voltage across L2 has a value proportional to the ratio of the respective reactances of the two coils. This voltage varies as the slug of L1 is moved in and out of the coil form by the action of the tuner core-bar assembly. Diode D1 rectifies this voltage and feeds it to the input of a double-pi RC network, which removes the residual AC and smoothes out the DC component so that it is suitable for use as the tuning control voltage.

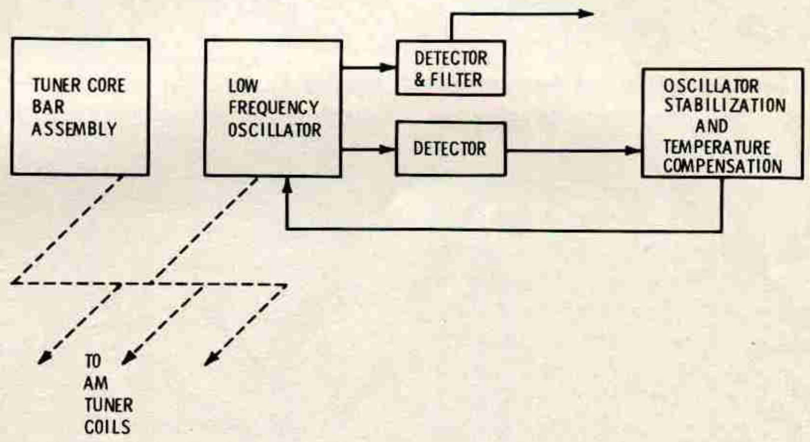
Another diode detector is used to supply a stabilizing voltage to the input side of the oscillator. The diode generates the correction voltage sensed by the negative feedback circuit consisting of transistors Q2, Q3, and Q4. The feedback action of this circuit stabilizes the level of the signal applied across coils L1 and L2. There are two adjustments in this circuit which are used to assure that the local oscillator in the FM front end tracks with the dial scale. On the high end of the band, the 10k-ohm potentiometer in the base circuits of Q2 and Q3 is used to set the received frequency. Trimming the slug of L1 sets the low-frequency end of the dial.

Fig. 3 shows the input circuitry to the FM RF amplifier stage. The variable tuning element is a dual, common-cathode varactor diode. A varactor is a diode that changes it's junction capacitance with changes in the reverse bias voltage. This reverse voltage, called the tuning control voltage, is fed to the common-cathode junction of each varactor via an isolation resistor. This control voltage varies from .7 to 6.8 volts depending on the frequency selected (see Fig. 4). It is extremely stable, varying less than 5 millivolts (.005 volts) as the car battery voltage varies between



Philco-Ford's new AM/FM stereo FM auto radio is comprised of three separate modules shown here. Featured in the receiver are varactor-controlled tuning, automatic switching from stereo to conventional FM when the stereo FM signal is too weak for acceptable reception, transformerless audio output, and other unconventional circuitry not ordinarily used in auto radios.

Fig. 1 Block diagram of section in Philco-Fords AM/FM Radio which generates tuning control voltage applied to varactors to tune the receiver front end.



11 and 16 volts. Thermal stability of the tuning voltage is also excellent; it is maintained within plus or minus 5 millivolts over the range of –22 degrees F to +140 degrees F. The junction capacitance of the varactor varies from 14 to 28 pf as the control voltage varies from .72 to 6.8 volts.

RF amplifier

The RF amplifier configuration, shown in Fig. 3, is a standard common-base arrangement. This type of circuit is usually preferred by most car-radio designers because it rarely requires neutralization and it has superior performance where either intermodulation or cross modulation is a problem.

Intermodulation and cross-modulation are different, although they commonly are lumped together into the same category. Intermodulation is a condition in which two signals separated by 10.7 MHz (the IF frequency of FM receivers) mix together in the RF amplifier under nonlinear conditions. Such nonlinearity can occur when at least one of the signals is capable of overloading the RF amplifier. An example of this condition occurs when two FM stations are 10.7 MHz apart or when the frequency of an FM station and either the funda-

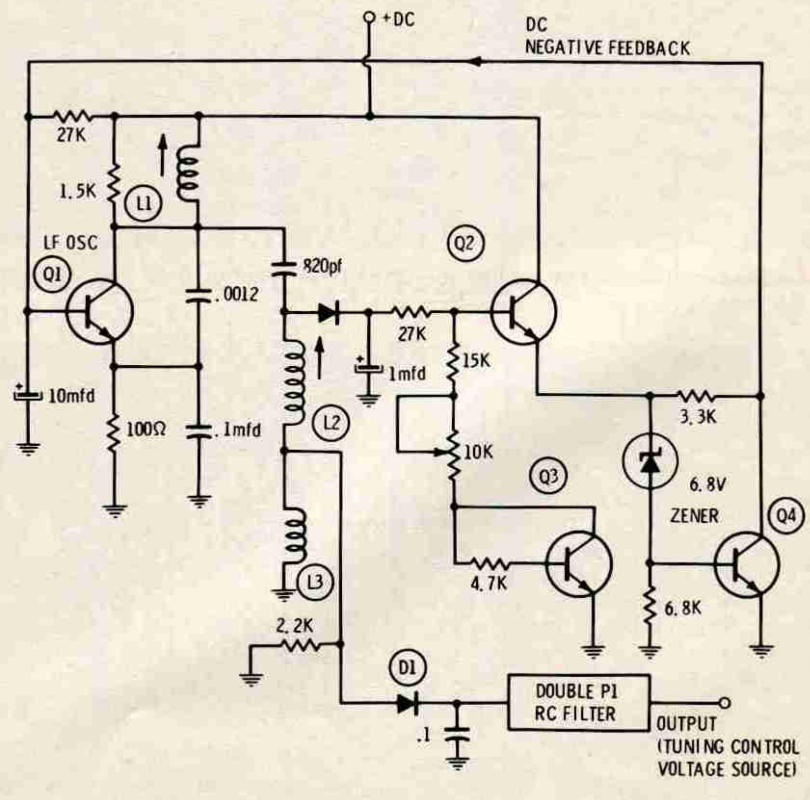


Fig. 2 Schematic diagram of control voltage circuitry.

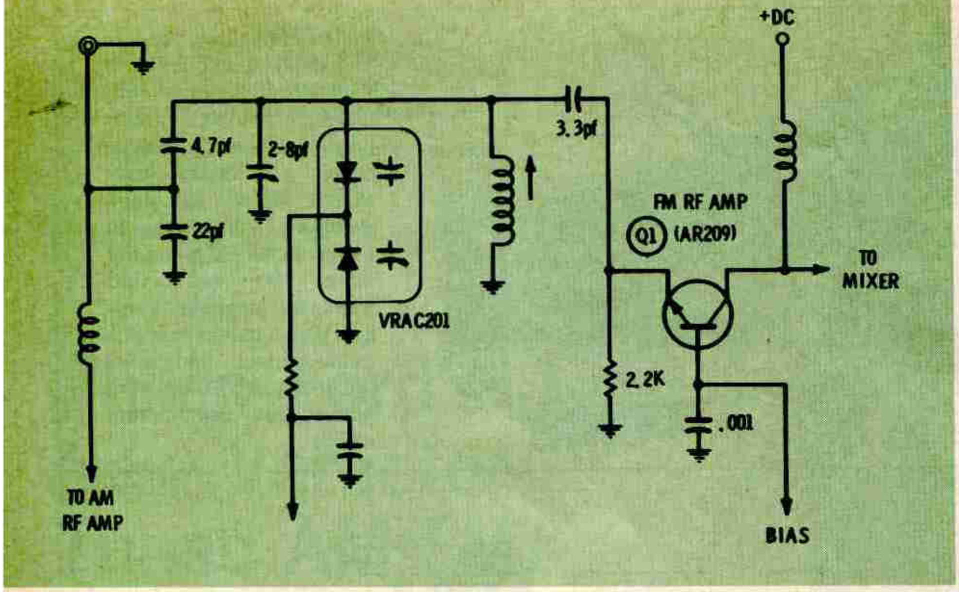


Fig. 3 FM RF amplifier and associated input circuitry.

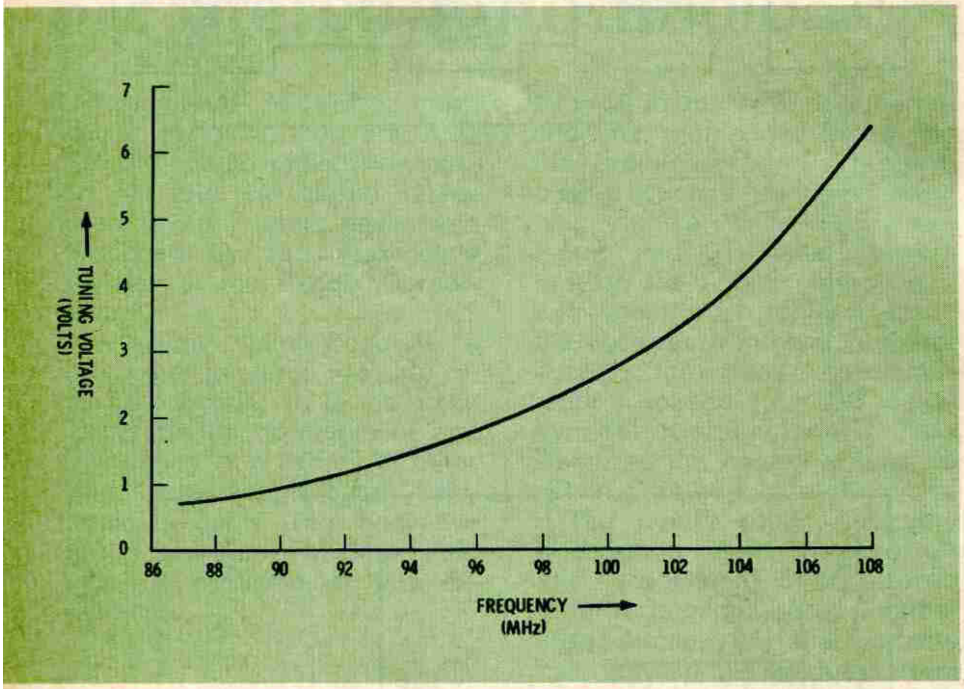


Fig. 4 Tuning-control voltage applied to varactors in receiver front end varies from .7 to 6.8 volts, according to the frequency selected.

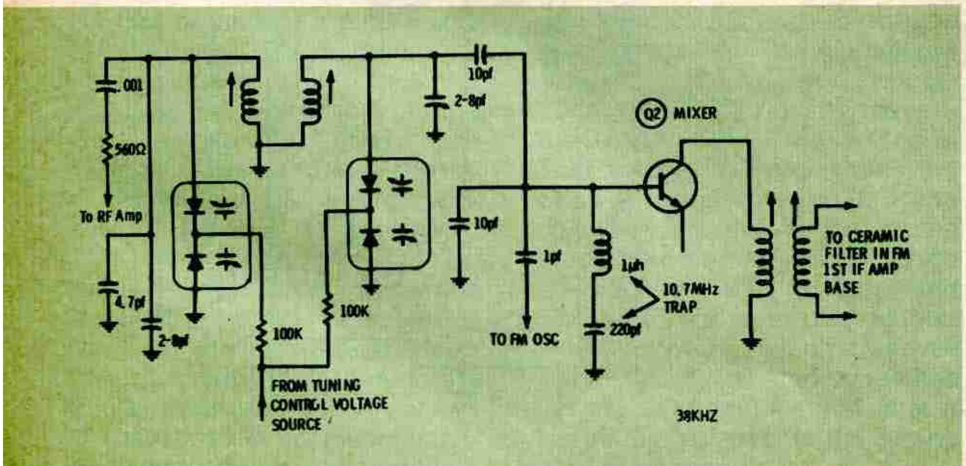


Fig. 5 Double-tuned varactor circuit couples output of FM RF amplifier to mixer.

mental or a harmonic of a communications transmitter are 10.7 MHz apart. The resultant 10.7-MHz signal is fed to the mixer, which then acts as an additional stage of IF amplification.

Cross modulation is similar to intermodulation; however, it can occur regardless of the frequency spacing of the two signals. Crossmodulation is produced when one signal amplitude modulates another signal.

In either case, there are only a few effective ways to eliminate the problem. One is to eliminate one of the signals. This is relatively easy to accomplish if one signal is a harmonic. A highpass filter in the antenna lead will usually suffice in such cases. If the fundamental frequencies of the two signals are exactly 10.7 MHz apart, however, the only cure is to design an RF amplifier which can handle a large signal without becoming too nonlinear. Hence, the use of FET and common-base bipolar RF amplifiers.

Mixer stage

A double-tuned varactor circuit couples the FM RF amplifier stage to the mixer (Fig. 5). The varactors are connected to the tuning-control voltage source through 100k-ohm isolation resistors.

The mixer circuit itself is relatively standard (Fig. 5). There is the usual 10.7 MHz series-tuned trap connected between the base of the mixer transistor and ground. The output transformer, however, requires a warning note. It is broad-band and is preset at the factory. Because of it's relationship to the passband characteristics of the ceramic filter, it is recommended that you do not attempt to "align" this transformer, unless a complete alignment is being performed.

Local oscillator

At first glance, the FM local oscillator (Fig. 6) also appears to be a relatively standard common-base circuit. It does, however, present a few wrinkles not previously seen:

A bifilar-wound coil (L1) is used between the transistor and the LC circuit. This is supposed to eliminate the need for an RF choke in the oscillator B+ line.

The automatic frequency control (AFC) system also is relatively standard. It uses a single-unit varactor to adjust the oscillator frequency in step with a DC error voltage generated in the discriminator. The main tuning varactor is a hand-picked dual unit which has tighter voltage-vs-capacitance characteristics than do the RF-amplifier and mixer-coupling varactors. An exact-replacement varactor unit, color coded white, must be used in the oscillator circuit, to maintain the accuracy of the dial calibration.

FM IF Amplifier

Ceramic bandpass filters

At first glance, the FM IF amplifier, shown in Fig. 7 and Fig. 8, appears a little short of parts. This section of the receiver gets all of the necessary gain from one transistor and a special-purpose integrated circuit (IC). Input and output coupling to the transistor stage, in Fig. 5, is through ceramic bandpass filters rather than through conventional IF transformers. These filters are not adjustable. For this reason, Philco preselects filter units according to their bandpass characteristics. The criteria for selection is such that there are five different basic filter groups differentiated from each other by a color-coding system. If it becomes necessary to replace one of these filters, it is important that you order one with the same color coding as the original. State the Philco part number, followed by the color in parenthesis.

The NPN transistor used in the 1st IF amplifier circuit is also a specially selected unit. It is chosen to match the impedance levels presented by the ceramic filters. Because of this, it might prove difficult to use a universal replacement in this slot. Should you use such a replacement and experience low gain or other unusual symptoms, switch to an original Philco part-numbered transistor.

Limiter/amplifier/discriminator

The Philco IC FM detector, although similar in appearance to the Delco IC quadrature circuit, is not the same. A quadrature detector circuit can be distinguished by the presence of a resonant "phasing" tank circuit in place of the discriminator or ratio-detector input transformer.

AM-FM Bandswitching

Fig. 9 shows the rather unique AM-FM bandswitching circuit used in the new Philco auto radio. B+ for the AM circuitry is supplied through a standard voltage divided network consisting of resistors R1 and R2. FM B+ is supplied from the same source but passes through a transistor series voltage regulator, Q1. With the bandswitch in the AM position (open) Q1 is reverse biased, cutting off the flow of current to the FM sections of the radio. Switching to the FM position (closing the switch) grounds the AM B+ line and forward biases the FM voltage regulator transistor.

Multiplex Circuitry

There are no really new features in the multiplex circuit except a noise squelch circuit which automatically switches the receiver to the monaural mode when the stereo signal is too weak to provide acceptable stereo reception.

As you are probably aware, good mono reception from any given station is possible at great-

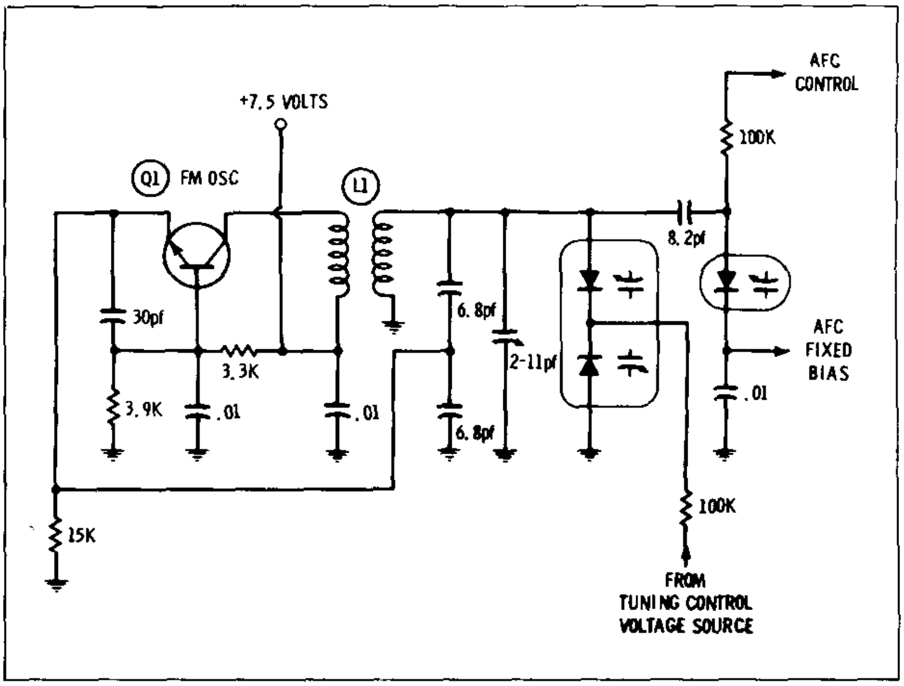


Fig. 6 The dual-unit main-tuning varactor in the FM local oscillator is a close-tolerance type which requires an exact replacement to maintain the accuracy of the dial calibration.

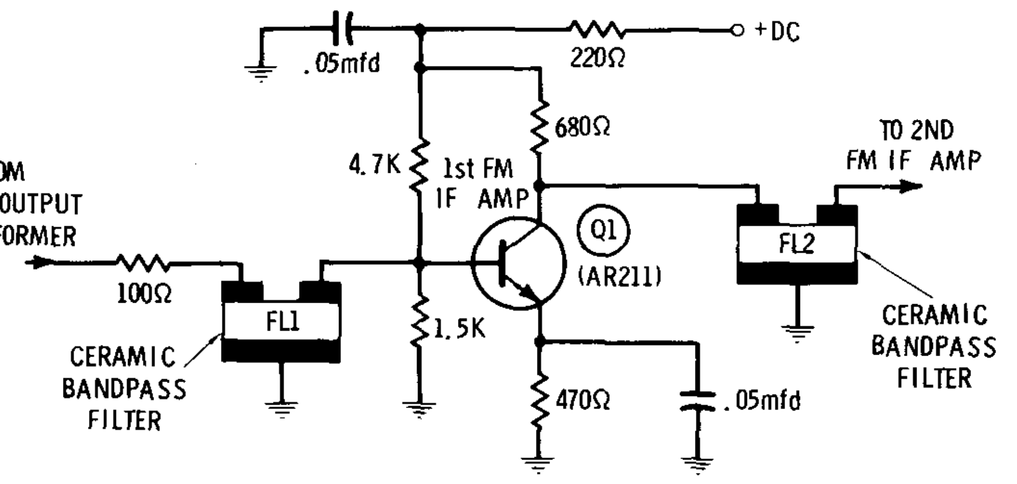


Fig. 7 Non-adjustable ceramic bandpass filters provide input and output coupling for 1st FM IF amplifier stage.

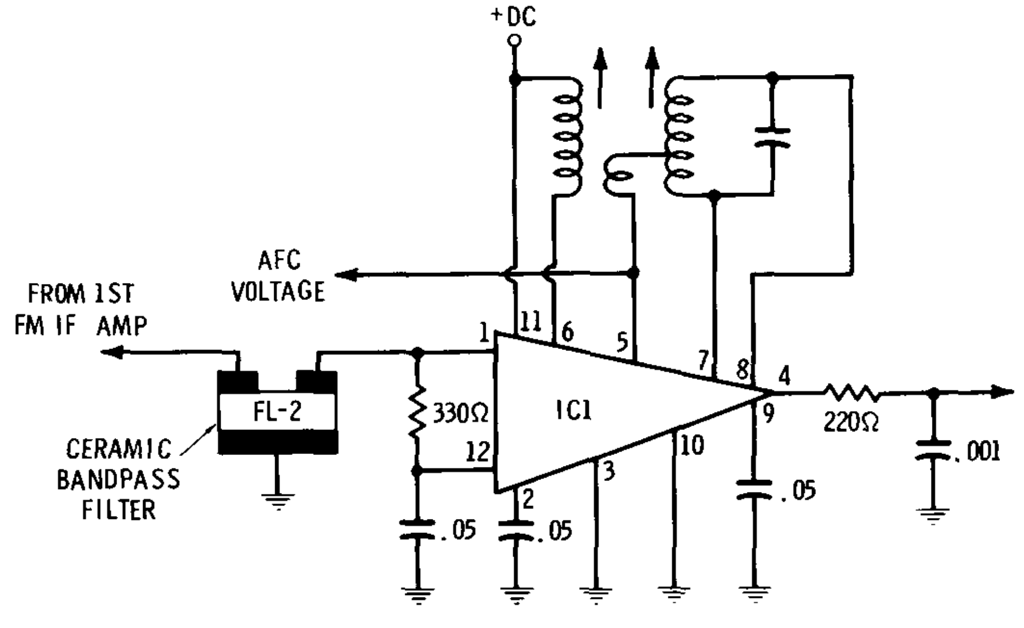


Fig. 8 Integrated circuit shown here functions as the FM limiter, 2nd FM IF Amplifier and discriminator.

er distances than is good stereo reception. This is due, in part at least, to the fact that the encoded stereo information and the synchronizing pilot signal each modulate the FM broadcast transmitter a total of only ten percent. This means that the two multiplexed signals are correspondingly weaker than the L+R mono signal at the output of the detector. Consequently, at distances of about twenty miles, stereo reception can be weak and noisy while the mono information produced by the same signal is loud and clear.

Because of limited front-panel space, most sets are not equipped with a stereo-defeat, or 'mode", switch to switch to conventional FM when stereo FM reception is not acceptable. To overcome both the original problem—the inability to switch from stereo FM to conventional FM when the quality of stereo FM reception is unacceptable—and the related problem of limited front-panel space, Philco-Ford has equipped its stereo FM receiver with the "automatic mode switching" circuit in Fig. 10.

This circuit uses the 19-KHz component of the interstation noise to reverse bias the class B, 38-KHz amplifier, Q2. When the receiver is tuned to a weak station, the accompanying noise will appear in the audio output from the detector. The components of the noise that are centered around 19 KHz are passed by the pilot amplifier to the frequency doubler (diodes D1 and D2). To prevent the noise amplifier from responding to the 38-KHz signal, there is a low-pass filter—consisting of R1, C1 and C2—positioned between the doubler diodes and the base of the noise amplifier, Q1. Q1 amplifies the remaining lower-frequency noise components before passing them on to a voltage doubler rectifier. The DC output from the rectifier filter circuit is negative. Because it is of greater value than the 38-KHz signal, it tends to reverse-bias Q2. With Q2 reverse biased, no 38-KHz signal can reach the decoder matrix. The result is that the receiver functions in the mono mode until the set is tuned to a station signal strong enough to "quiet" the receiver and overcome any noise present. When the receiver is "quieted" by a signal strong enough to drive the limiters, no noise gets through to Q1. Under these conditions, Q2 functions normally and the program is received in stereo.

The multiplex decoding system, shown in block diagram form in Fig. 11, is the time-switching matrix type. The composite stereo signal from the IC discriminator is applied to the input of a composite preamplifier. The amplified composite signal is fed to a splitter.

The 19-KHz pilot signal is "picked off" the collector of the splitter transistor by a transformer tuned to that frequency. The secondary of this tuned transformer is connected to the base of the 19-KHz amplifier transistor.

The remaining portions of the composite are "picked off" the emitter of the splitter transistor and fed to an LC parallel tuned trap which surpresses any SCA signals which might be present. The remaining signals, which include both L+R and L–R components, are passed to a follower stage and phase inverter. The output of the phase inverter is applied to the RC matrix, for final decoding.

The 19-KHz pilot signal is amplified in the tuned stage following the splitter and then is fed to a full-wave frequency doubler. The frequency doubler functions in much the same way as does a full-wave rectifier power supply. The 19-KHz signal is applied across a center-tapped transformer. Two diodes, connected in a common-cathode arrangement (Fig. 10), rectify it. One diode conducts during positive peaks of the 19-KHz signal

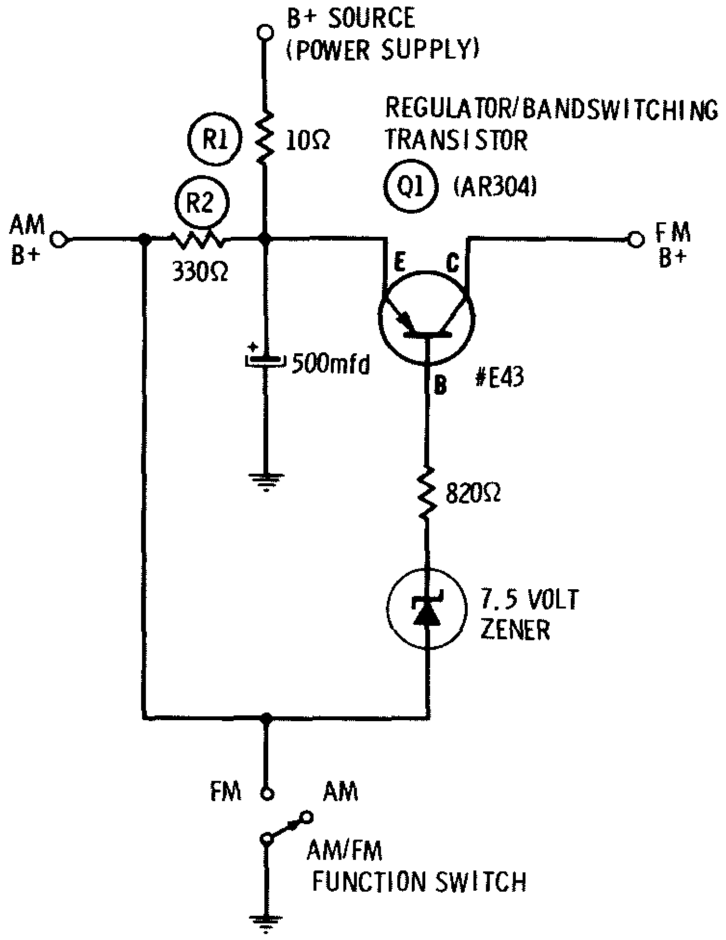
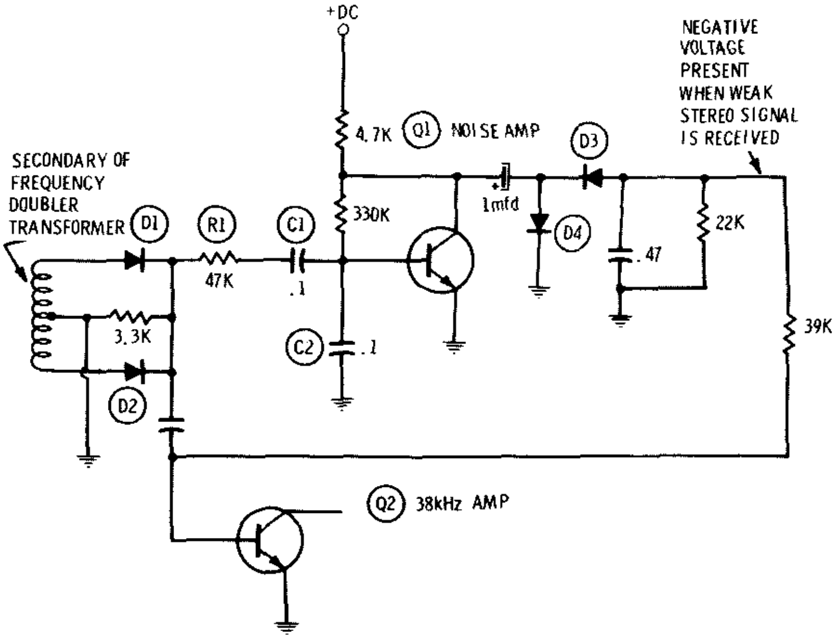


Fig. 9 Switching from AM to FM operation is accomplished by this circuit. See text for details of operation.

Fig. 10 Circuitry shown here automatically switches the receiver from stereo FM to conventional FM operation when the stereo FM signal is too weak to produce acceptable reception.



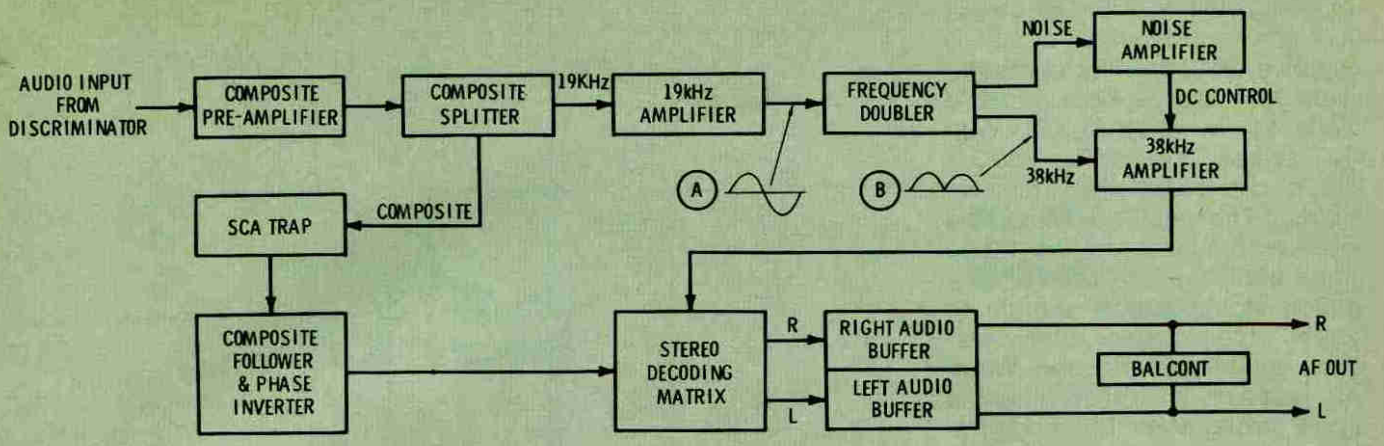


Fig. 11 Block diagram of time-switching multiplex decoding system employed in first Philco-Ford AM/FM auto receiver.

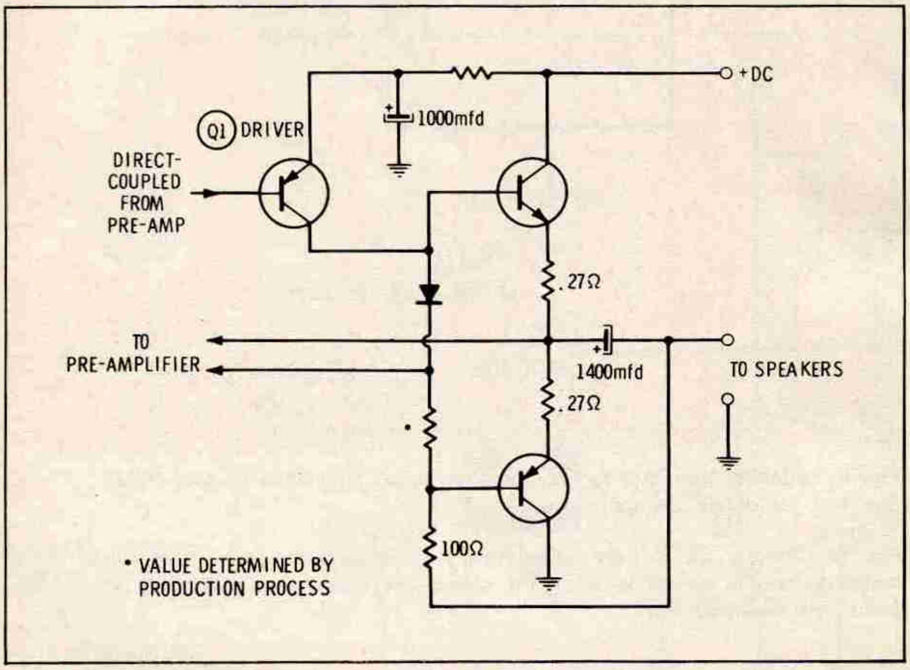


Fig. 12 The audio section of new Philco-Ford receiver uses single-driver-complementary symmetry output. See text for explanation of operation.

while the other conducts during negative peaks. The result is a waveform that looks like that at "B" in Fig. 11.

The half-wave signal is changed back into a near sine wave by the "flywheel effect" action of the tuned 38-KHz transformer. The "purified" 38-KHz signal is then applied to the decoding matrix, to mix with the L+R and L–R signals from the phase inverter. The outputs of the matrix circuit are left- and right-channel signals. These are fed to their respective buffer amplifiers and then to the main audio section of the receiver.

The Audio Section

The two audio amplifiers, shown in Fig. 12, are single-driver-complementary symmetry types. Amplifiers similar to these are being used in many of the newer car radio designs. Although relatively new to the car radio field, circuits such as this are, and have been for years, commonly used in all grades of home audio equipment. All circuits similar to this generally are lumped under the term "output transformerless" (OTL), or "ironless" in foreign equipment.

The operation of the audio amplifier stage is basically push-pull. The bases of the two output transistors, however, are fed in parallel. For push-pull operation, the amplifier inputs normally must be 180 degrees out of phase. In this circuit, the phase inversion is accomplished by using complementary output transistors. Such transistors are identical in every electrical specification except one: Their polarity. One is a PNP while the other is an NPN. A PNP transistor conducts more current as the base becomes negative with respect to the emitter. An NPN operates just the opposite; it conducts more current as the base becomes more positive with respect to the emitter. It is this difference which provides the phase inversion needed for push-pull. The two transistors conduct on opposite halves of an input cycle.

Coupling to the speaker is through a large-valve electrolytic capacitor; hence the term, "output transformerless".

General Servicing Requirements and Peculiarities

Probes

Alignment of Philco-Ford's new stereo FM radio requires the usual assortment of dummy loads, illustrated in Fig. 13.

Also needed, however, is an amplifying detector probe. Because such probes are not generally available, it probably will be necessary for you to build your own. The probe recommended by Philco-Ford is shown in Fig. 14.

Frequency drift common causes listed

FM frequency drift can be a difficult problem to solve in any radio. In this radio, it might prove to be even more difficult. However, the Philco service manual comes to the rescue by listing the parts that chiefly influence drift. These are the .1-mfd emitter capacitor at Q1, the .0012-mfd tuning capacitor, the 820-pf coupling capacitor, and the fixed coil, L2, all shown in Fig. 2. Also to be considered are the positive temperature coefficient of the Zener diode, the negative temperature coefficient of the regulator transistors, and the negative coefficient of the rectifier diodes in Fig. 2.

Summary

This Philco radio represents one more step away from traditional designs in car radios. Their voltage tuning opens the way for such features as remote control of the radio without messy mechanical problems and "mechanicalless" signal seeker tuners. Such innovations promise to be the meat of our trade in the later seventies. ▲

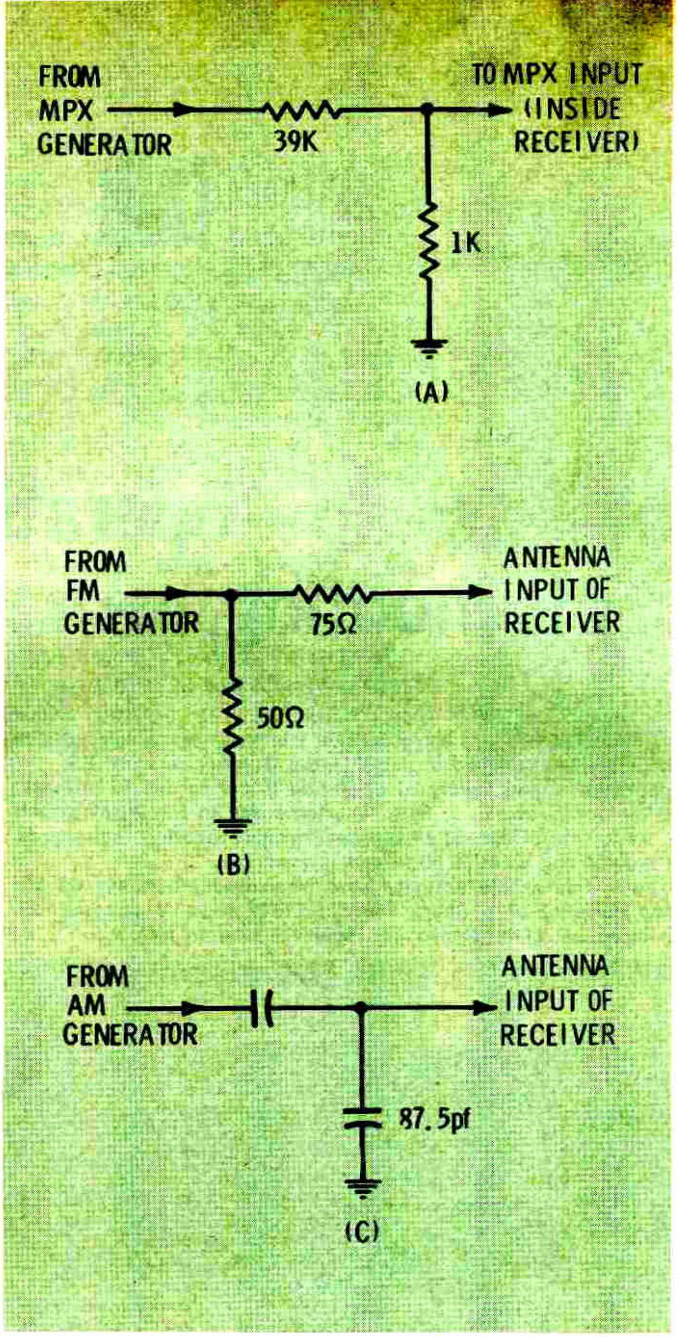


Fig. 13 Dummy loads required for servicing of Philco-Ford AM/FM auto receiver.

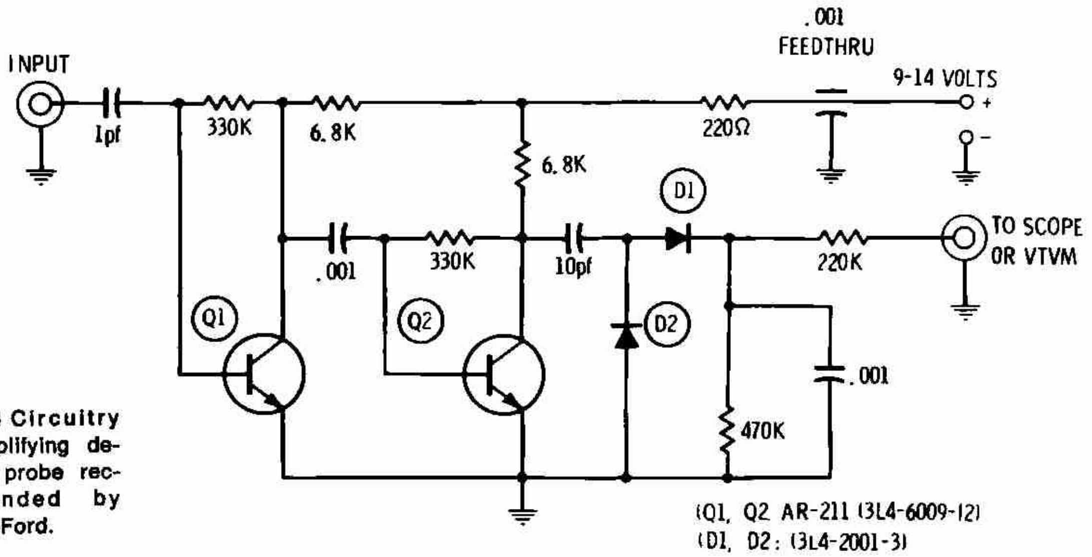


Fig. 14 Circuitry of amplifying detector probe recommended by Philco-Ford.

shoptalk

With Carl Babcoke
ES Technical Editor

Horizontal sweep—operation and troubleshooting, Part 2

How the horizontal sweep circuitry of a typical b-w television receiver produces horizontal trace and retrace was explained in detail in the October issue of ES.

In the following paragraphs, that theory of operation is put to use to interpret frequently encountered horizontal sweep trouble symptoms and to track down their most probable causes. As is true of almost all effective troubleshooting techniques, recognition of what is normal and what is abnormal is essential.

All defects analyzed in this article actually have been applied in the ES lab to the horizontal sweep circuitry of a Sears 456/528.51912 b-w TV chassis, the basic design of which is typical of most b-w TV receivers now in use.

Fig. 1 shows the schematic of the horizontal sweep section of the Sears b-w TV receiver. Also shown are the important waveforms and DC and peak-to-peak voltages. Use these normal waveforms and voltages for comparison in the following case histories.

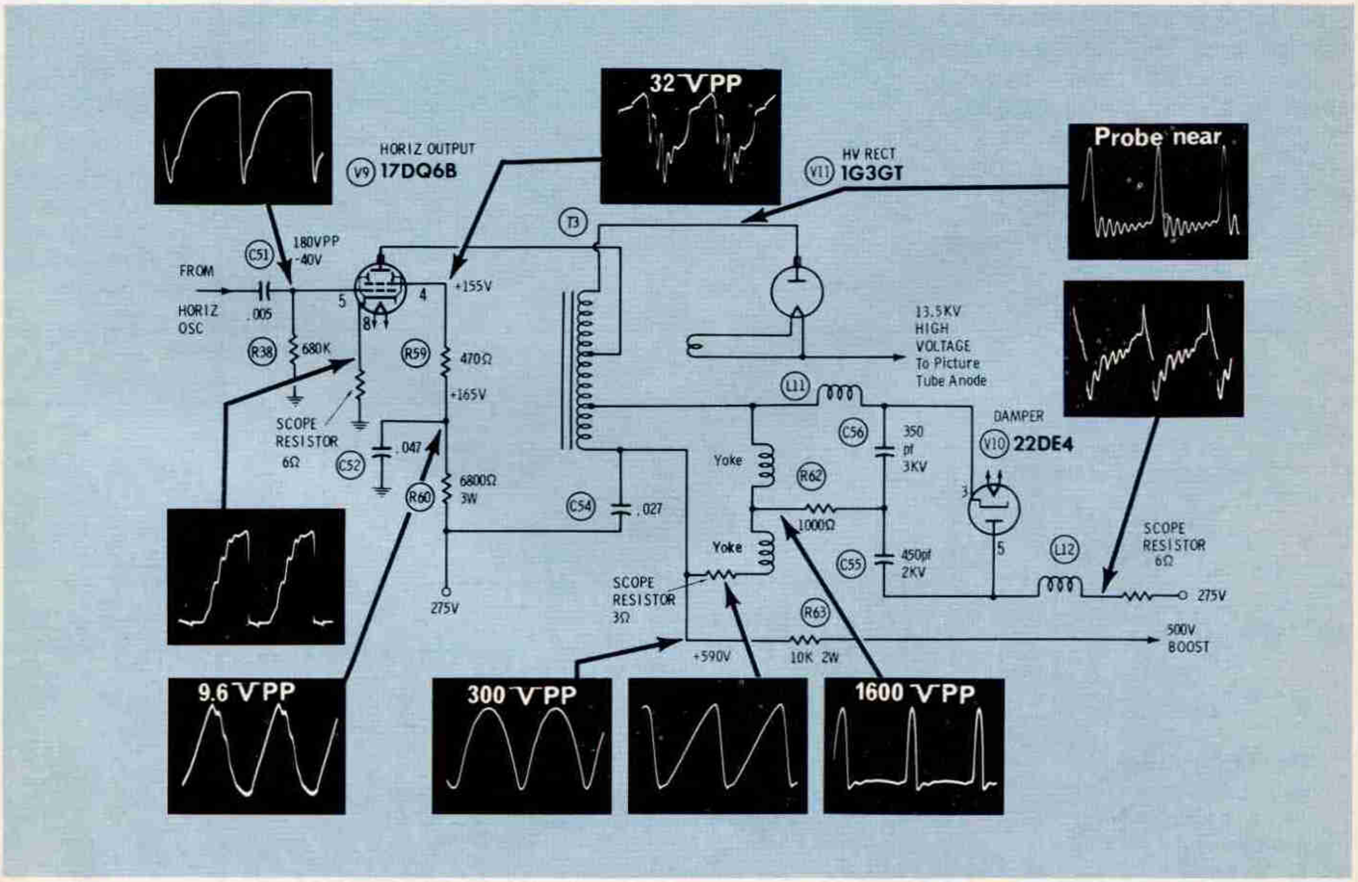


Fig. 1 Complete schematic of the horizontal sweep section of the Sears 456/528.51912 b-w TV receiver. Major waveforms, DC voltages and peak-to-peak AC voltages also are included.

Compression On The Right Side

The first symptom—compression of scanning on the right side of the picture—is shown in Fig. 2B. For comparison the crosshatch pattern normally produced by this receiver is shown in Fig. 2A.

The compression started about 15 minutes after the receiver was turned on. Also, a faint reddish glow could be seen on one corner of the plate of the horizontal-output tube.

Deflection of the right half of the screen is produced by the plate current of the horizontal-output tube. In this case, insufficient maximum tube current is indicated, because deflection does not extend to the extreme right side of the screen. Also, the compression indicates an abnormal leveling-off of the plate current (beam motion slowed down). Deflection in this area of the screen is affected most by conditions involving the screen grid and the control grid of the horizontal-output tube.

Voltage measurements revealed that the high voltage was down 2KV, boost voltage was down 40 volts, and the screen grid voltage was 30 volts low. The slight red area on the plate of the output tube indicated excessive plate dissipation. None of these readings was far enough from normal to point to any one specific component.

The control grid DC voltage was measured next. The normal voltage is –40 to –45 volts; in this case, the grid measured only –24 volts. The next step was to determine whether it was caused by insufficient oscillator drive or by some other defect.

Waveforms at the grid of the output tube and the cathode current, both of which are shown in Fig. 3, revealed clipping of the oscillator output. Weak oscillator tubes or other oscillator circuit defects are not likely to cause the sharp flat-topping of the grid waveform. The waveform of the output tube cathode current showed maximum current flow during about ⅔ of each horizontal cycle, whereas current normally is supposed to build up gradually during this same part of the cycle. If maximum current flows for a longer period of time, it dissipates more wattage. This additional power dissipation accounts for the slightly red horizontal-output plate.

Leakage of B+ through coupling capacitor C51 or a gassy horizontal-output tube which injects some positive voltage into the grid circuit are the two most likely causes of a picture that is narrow on the *right* side. In this case, C51 had a leakage of 330K ohms.

Use a crosshatch pattern

Raster defects can be interpreted quicker and more accurately if a crosshatch pattern is displayed on the screen. Crosshatch patterns produced by color-bar generators or by a flying spot scanner system, like that in B&K's Model 1077 TV Analyst, are acceptable.

One limitation of color-bar generator patterns: The horizontal blanking signal from a color-bar generator might not duplicate that produced by a TV station. Consequently, do *not* use a color-bar crosshatch pattern to evaluate final centering or width. Always use a station signal for final centering or width adjustments.

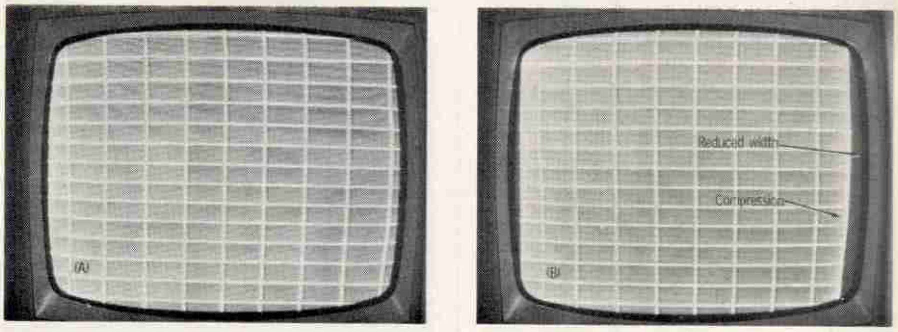


Fig. 2 Defects in the grid circuit of the horizontal-output tube mainly affect the right edge of the picture. **A)** The normal crosshatch pattern on the Sear b-w TV receiver used for these tests. Horizontal linearity is not perfect, and there is no linearity adjustment provided. **B)** The crosshatch pattern caused by 330K ohms of leakage across C51, the coupling capacitor between the oscillator and the grid of the horizontal-output tube. B-boost voltage, grid voltage, screen grid voltage and high voltage all were low.

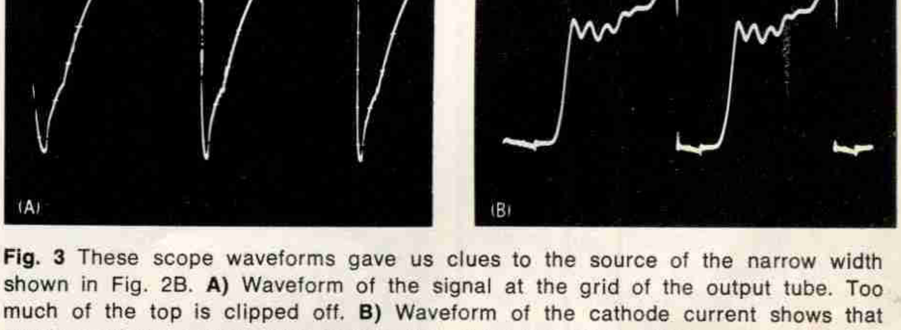


Fig. 3 These scope waveforms gave us clues to the source of the narrow width shown in Fig. 2B. **A)** Waveform of the signal at the grid of the output tube. Too much of the top is clipped off. **B)** Waveform of the cathode current shows that nearly maximum output tube current flowed for too much of the cycle.

Expansion Of Sweep On The Left Side

The left half of the screen is deflected by damper current, which provides a "negative" yoke current. Consequently, any compression or expansion of the linearity on the left side of the screen should be attributed to damper circuit action.

Slow movement of the CRT beam across the screen compresses the displayed pattern and produces a brighter image, because the phosphor is lighted for a longer time. The trouble symptom in Fig. 4A was produced by the opposite effect. The crosshatch pattern was stretched on the left side because the beam traveled too fast.

After the receiver was operated a few minutes more, the crosshatch became somewhat more normal. However, the stretching was still very apparent, as shown in Fig. 4B.

The yoke waveform (Fig. 4C), measured at R62, exhibited a very large negative-going pulse which indicated that the yoke circuit continued to ring too long. Because this pulse normally is clipped by the damper, to furnish deflection on the left side of the screen, a damper malfunction was indicated.

Both the symptom on the screen and the abnormal pulse on the yoke waveform pointed to the damper tube or the damper circuit. A weak, slow-heating damper tube was the cause in this case.

When the receiver was first turned on, the picture was stretched on the left side and the bottom and right side were reduced, as shown in Fig. 4A. The decreased current produced by the weak damper tube did not permit a full charge on C54, the boost capacitor. Conse-

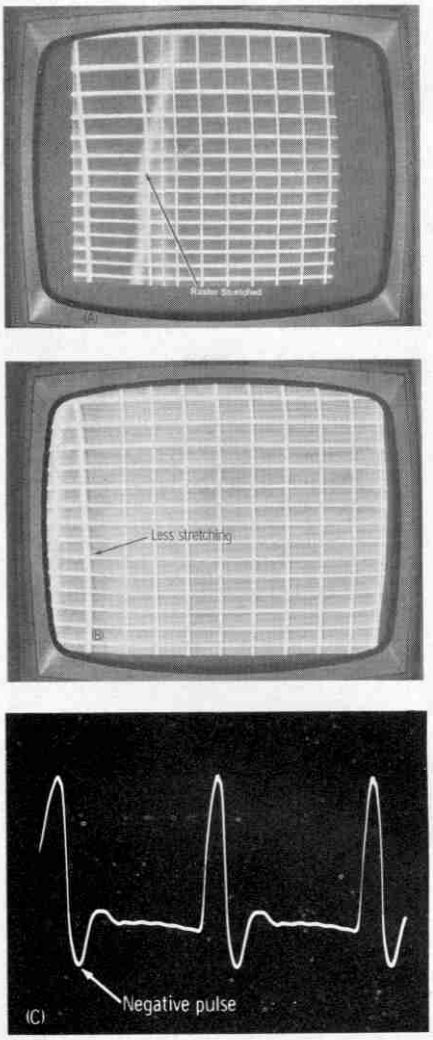
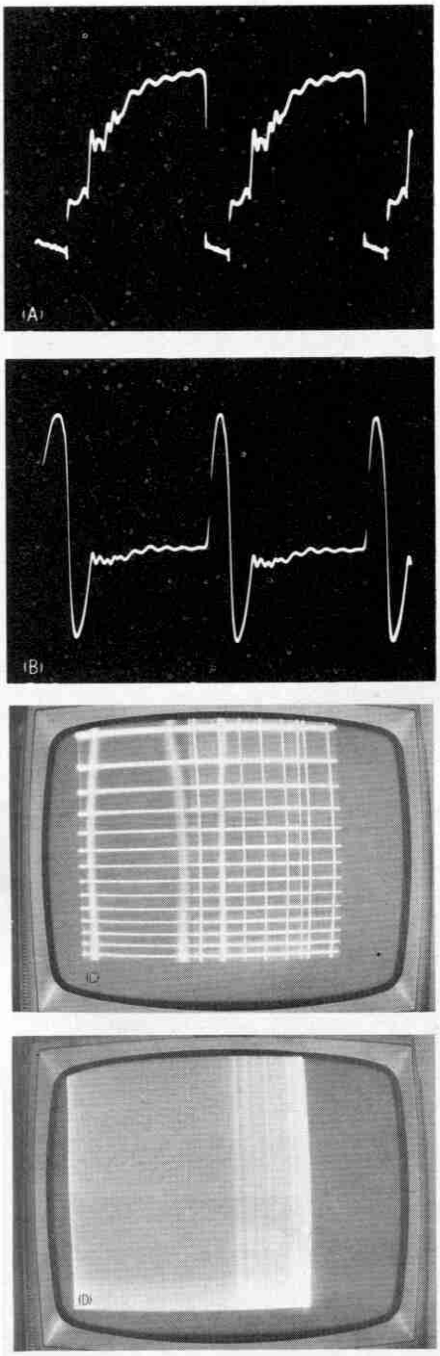


Fig. 4 Symptoms of damper defects are found on the left side of the picture. **A)** Extreme stretching of the linearity on the left side when the picture first lights up is caused by a weak damper tube. **B)** After a warm-up period, the stretching is reduced. **C)** Waveform of the yoke voltage shows that the negative-going pulse is not clipped off by damper rectification.



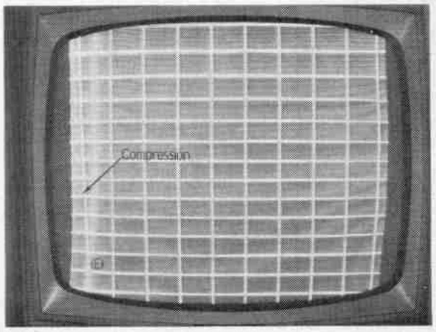


Fig. 5 A fast test for a shorted boost capacitor (C54) is to remove the damper tube and try to obtain a raster. **A)** The waveform of output tube current shows that plate current starts flowing much too soon, which will increase the tube power dissipation. **B)** Waveform of the yoke voltage shows *no* clipping of the negative-going pulse by the damper. **C)** This crosshatch pattern produced with the damper removed shows very poor linearity, verging on foldover in some areas. **D)** The blank raster shows the expanded and compressed areas as vertical lines. **E)** Leakage in C54, the B-boost capacitor, caused compression and loss of width at the left edge of the screen.

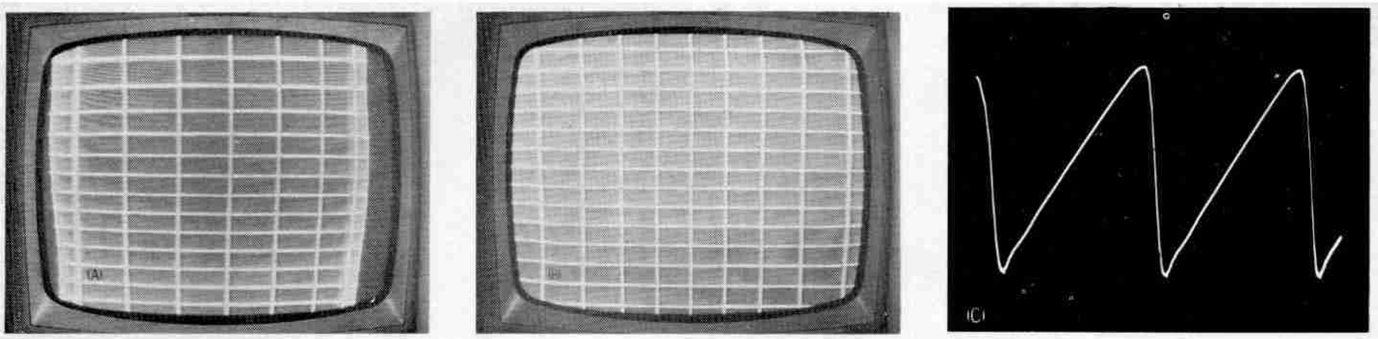


Fig. 6 The capacitance value of the B-boost capacitor (C54) is critical. **A)** Poor linearity produced by a value of .01 mfd. **B)** When C54 was .47 mfd, the crosshatch pattern showed expanded linearity, because of the wide-angle yoke used. **C)** This waveform of yoke current was more linear when a value of .47 was used instead of the normal value of .027 mfd.

quently, the voltage supplied the plate of the horizontal-output tube also was reduced, which, in turn, reduced the deflection on the right because the output tube could not conduct the normal amount of plate current required to produce a full raster. The height was decreased because the vertical oscillator plate voltage is supplied by the B-boost voltage, which, in this case, was below normal.

No High Voltage

As is always true, loss of high voltage eliminated the raster and, consequently, any visual symptoms. The DC voltage at the grid of the horizontal-output tube was only about two volts low, not enough to significantly affect the operation of the tube. The screen grid voltage was low, but not enough to kill the high voltage. The waveform produced by the cathode current (See Fig. 5A) revealed that plate current was flowing during too much of the cycle.

Very little pulse was present at the yoke. The B-boost voltage was only a few volts higher than the B+ supply voltage.

Symptoms at this point indicated that the yoke or high-voltage transformer might have shorted turns, the yoke capacitors might be shorted, or the boost capacitor might be shorted. In this case, an open yoke was not possible, because it would cause the boost voltage to be abnormally high. Nor was an open high-voltage transformer possible, because the cathode current waveform showed sufficient current to indicate the output tube had plate voltage. The yoke and transformer can be tested separately, or as a pair while still wired together, by ringing or impedance measuring or by use of a flyback tester.

A shorted B-boost capacitor (C54) can be tested in several ways. An ohmmeter test is the fastest. However, certain amounts of leakage in some capacitors would not be revealed by the low voltage applied by the ohmmeter, and, consequently, the results of such a test would not be conclusive.

One fast method of checking for shorts across that part of the circuit is to remove the damper tube (if the heaters are in series, use a clip lead to short across the heater pins) and notice if a distorted raster is obtained. Or use your scope to look at the yoke voltage. A yoke waveform similar to the one shown in Fig. 5B indicates sweep voltage but no damping action. Damping clips off the negative-going pulse.

In this case, after the damper was removed, the raster lighted up and displayed a crosshatch pattern (Fig. 5C) which was somewhat similar to the one caused by a weak damper tube. With the damper removed, the short circuit provides a path for normal B+ to enter. The boost voltage should be about the same as the supply voltage. The width is narrow because the tube plate voltage is low.

Without damping, the linearity is stretched on the left and numerous white vertical lines, caused by slowing of the CRT beam, were present over the rest of the raster, as shown in Fig. 5D. This test does not prove that C54 is shorted, but it does prove that there is a low-resistance short circuit between the B+ supply and the yoke circuit.

The abnormal crosshatch pattern shown in Fig. 5E was caused by a high-resistance short in C54. In this example, the damper tube was plugged back in the socket. Diagnosis of this defect from the crosshatch pattern alone is not conclusive. Loss of width on the right, without any significant change of linearity, is caused by the reduced B-boost voltage, which reduces the maximum plate current of the horizontal-output tube. Lower plate current, when it is suddenly cut off by the grid waveform, produces a smaller voltage pulse and, consequently, less high voltage. The smaller voltage pulse, in turn, produces less deflection on the left side because there is less pulse for the damper to rectify.

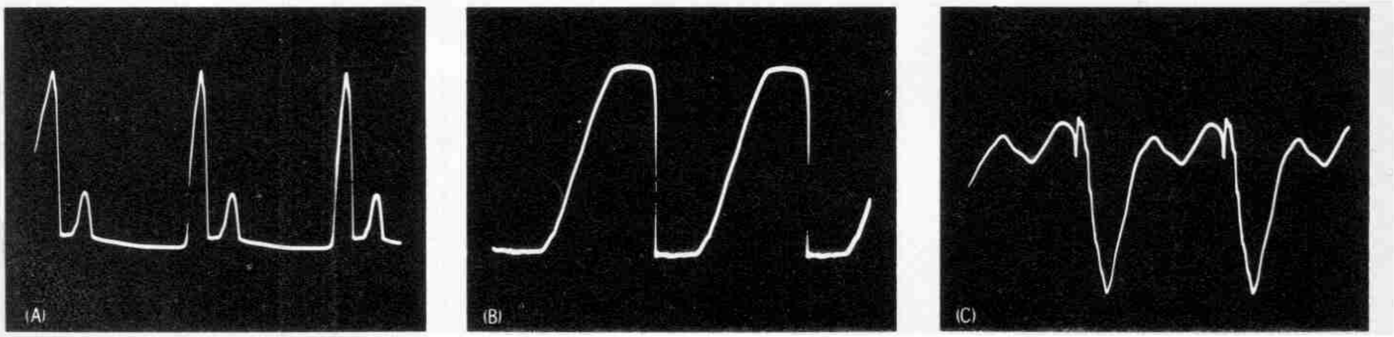
Incidentally, excessive brightness which causes an excessive load on the yoke pulse, also causes compression of the linearity on the left side of the screen. However, it does not affect the right side of the screen so much as that shown in Fig. 5E, and the compression on the left returns to normal when the brightness is reduced. (Compression caused by excessive 6BK4 high-voltage regulator current will not be affected by the brightness. Ground the grid of the regulator, to bias the regulator far beyond cutoff, then notice the compression.)

Changing the brightness level and noticing the effect on the raster or picture provides valuable diagnostic information. For example, if the entire picture becomes darker and larger both horizontally and vertically, at higher brightness settings, a weak high-voltage rectifier tube is likely to be the defective component.

Size of Boost Capacitor Affects Width And Linearity

The capacitance of the B-boost capacitor C54 in Fig. 1, is somewhat critical. If the original capacitor fails and a technician installs a .01-mfd unit to replace the original unit, the picture will be badly compressed at both the right and the left sides and expanded in the center, as shown in Fig. 6A. Also, the B-boost voltage will be low.

At the other extreme, a capacitor value of .47 mfd causes about 40-volts increase in the boost voltage, slight compression at the center and slight expansion of linearity at the two sides, as shown in Fig. 6B. However, the sawtooth waveform of yoke current (Fig. 6C) is more linear, showing that the expansion at the two edges of



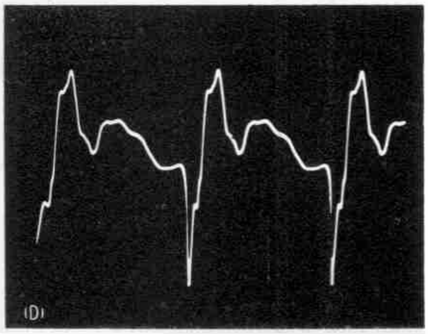


Fig. 7 An open B-boost capacitor elminated the high voltage and, consequently, the raster. Scope waveforms and voltage readings should be used to isolate this trouble. **A)** Yoke voltage waveform showed excessive ripple (extra pulse). **B)** The small sine waves which are apparently caused by damper action were missing from the horizontal-output tube current waveform. **C)** The waveform of yoke current cannot be analyzed easily because it is so distorted in comparison to the normal sawtooth. **D)** The B-boost waveform is also difficult to analyze. However, the 1300 volts PP is an indication of a defect in the associated circuitry.

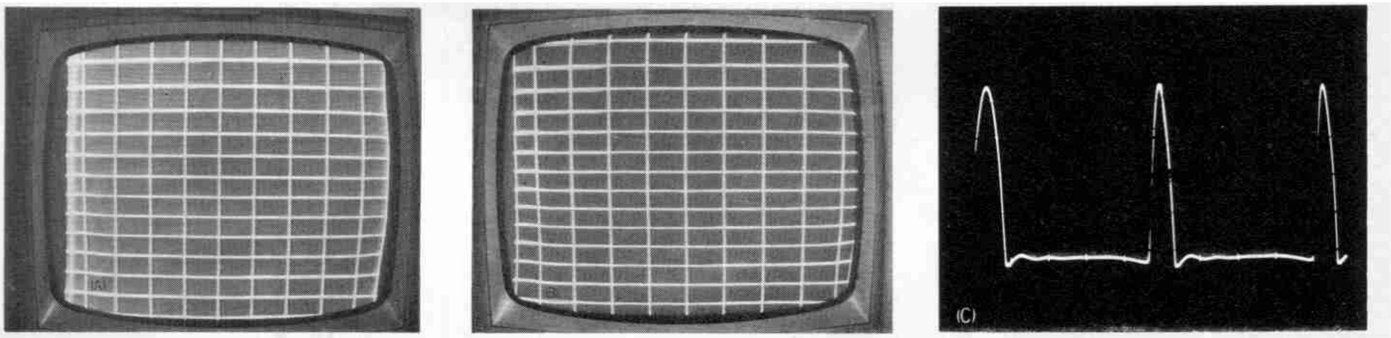


Fig. 8 Low screen voltage of the horizontal-output tube produces a loss of width at both the right and the left sides. **A)** Crosshatch pattern here shows loss of width without much change in linearity at both sides of the picture. **B)** Two shorted turns around the core of the high-voltage transformer narrowed the sweep by nearly the same amount as a reduction of the screen voltage. Closer examination shows, however, that the loss of width is mainly on the left side. **C)** The waveform of yoke voltage produced when there are shorted turns in the high-voltage transformer is only a slight change from normal.

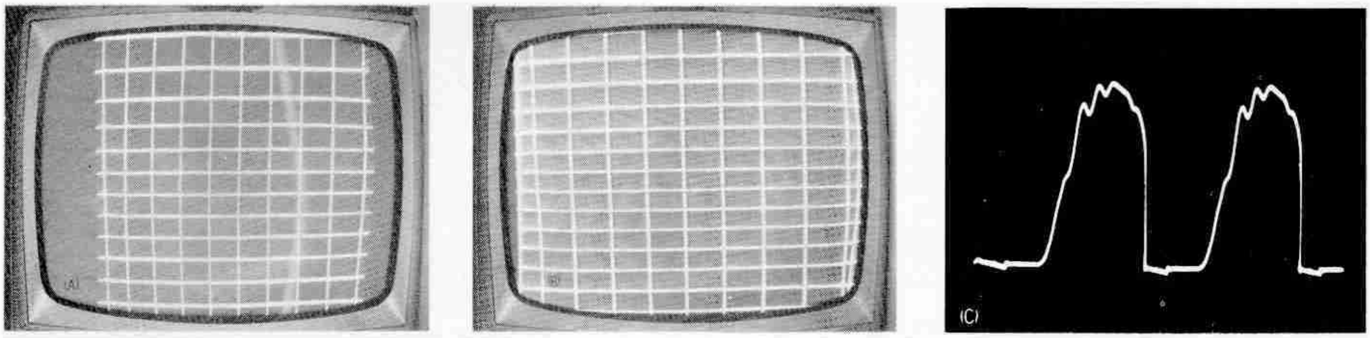


Fig. 9 Increased drive signal from the oscillator to the grid of the horizontal-output tube does not always produce more high voltage. **A)** Narrow crosshatch pattern caused by low oscillator drive. The DC voltage at the grid of the output tube was -30 volts and the high voltage was 4KV low. **B)** Surprisingly, excessively high drive produced nonlinearity, less width, and decreased high voltage. DC voltage at the output grid was -55 volts, and the high voltage was 3KV low. **C)** The waveform produced by the cathode current of the output tube shows that maximum plate current occurs too soon and is thus reduced by discharge of the B-boost capacitor before the tube current is cut off by the grid waveform.

the crosshatch pattern is the result of wide-angle deflection.

The Effects of An Open Capacitor

An open boost capacitor (C54 in Fig. 1) eliminates the high voltage and radically distorts the associated waveforms. For example, the yoke waveform at R62 (Fig. 7A) exhibits a second, smaller positive-going pulse. This extra pulse is probably the next cycle of ringing, which is not damped out because the damper circuit is not peak reading when C54 is open.

The waveform produced by the cathode current of the horizontal-output tube, shown in Fig. 7B, does not have the normal, small sine waves on it when C54 is open. This suggests that the small sine waves are produced by the damper action.

The yoke current waveform (Fig. 7C) is not recognizable as a distorted sawtooth. Compare it with the normal waveform at this point in Fig. 1.

The waveforms in Figs. 7A, B and C do not provide any good clues about where or what the defect might be. However, the fourth waveform, shown in Fig. 7D, is a helpful one. Not so much because of the shape of the waveform, but because of the amplitude, which is 1300 volts PP, compared to the normal parabolic waveform of 300 volts PP. C54 effectively is also an input filter capacitor. And, as we all know, an open input filter capacitor in a power supply causes excessive hum and reduces the DC voltage. Filtering produces sawteeth from pulses, and sine waves from sawteeth. The waveform in Fig. 7D shows no filtering.

The Effects Of Low Screen Voltage

Low screen voltage on the horizontal-output tube causes loss of width on both right and left sides, as shown in Fig. 8A. The symptoms are the same regardless of whether the low screen voltage is caused by an increase in the dropping resistor or by leakage in the bypass capacitor. High voltage and B-boost voltage are decreased also.

Low screen voltage reduces the maximum plate current that can flow through the horizontal-output tube. The smaller this current (most of which flows through the yoke coils), the less deflection is obtained at the extreme right edge of the picture. Also, the smaller this tube current is when it is suddenly stopped by the trailing edge of the grid voltage waveform, the less intense is the ringing, which is the power that causes retrace. Less amplitude of ringing produces less pulse during retrace; consequently, the high voltage and B-boost voltages are reduced.

Less pulse during retrace also produces less width on the left side of the screen because there will be less "negative" yoke current derived from rectification of this smaller voltage pulse.

Shorted Turns

The effects of shorted turns vary, because one turn can be shorted or dozens of turns can be shorted together. Many shorted turns in either the yoke coils or the high-voltage transformer completely eliminate the high voltage and most of the deflection, producing a black raster. The yoke waveform will be very small and the B-boost voltage about equal to the B+ supply voltage.

Shorted turns in the horizontal coils of yokes often sufficiently heat small areas of the yoke so that it can be tested by placing the fingers against it and checking for "hot spots". After operating the receiver for about 5 or 10 minutes, turn off the power, pull out the yoke enough for an examination and feel with your fingers to detect any areas which are hotter than others. If the defect is obvious, such as one turn snagged against another so that the insulation of the wire is removed, a permanent repair by wire dress might be possible.

Shorts involving only two or three turns produce symptoms that are very similar to those produced by excessive CRT or DC shunt regulator current. Deflection on the right side of the screen will not be reduced very much, because most of the current from the output tube continues to flow through the yoke. However, because the shorted turns act as a low-value resistor in parallel with the inductances, the amplitude of the ringing pulse, which supplies the power during retrace, will be significantly reduced, and with it, the large voltage pulse. Because deflection on the left side of the screen is accomplished by "negative" yoke current produced by damper rectification of this voltage pulse, the width will be reduced on the left side of the screen. High voltage and B-boost voltages also will be decreased.

Fig. 8B shows the reduction of width on the left side of the crosshatch pattern when just 2 turns of wire were wound around one leg of the high-voltage transformer core and then shorted together. The yoke voltage waveform, shown in Fig. 8C, is not changed significantly by this condition.

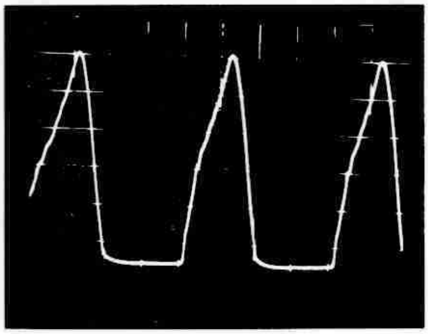


Fig. 10 Many technicians test the condition of the yoke by measuring the B-boost voltage with and without the yoke connected. High B-boost with the yoke disconnected and B-boost the same as B+ with the yoke connected indicate that the yoke has shorted turns. Notice carefully that an open yoke produces higher B-boost than is obtained with a normal yoke. The waveform of yoke voltage when a yoke coil is open shows a much broader pulse than normal.

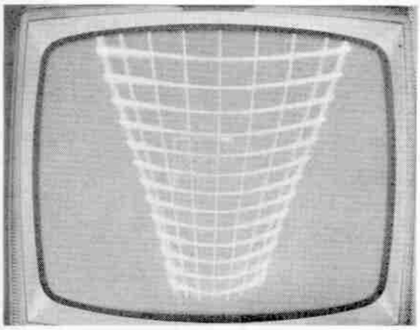


Fig. 11 A trapezoidal pattern indicates that only one coil of a series-connected yoke has deflection power.

Truths And Fallacies About Horizontal Drive

One of the myths in the TV servicing business is that the larger the drive voltage applied to the grid of the output tube, the higher the high voltage becomes. As with many myths, there is only a grain of truth in this one.

Fig. 9A shows the effect on the crosshatch pattern when the AC grid drive was lowered until the DC grid voltage was –30 volts. The width is reduced on both sides, but there is no foldover or any drastic change in linearity. B-boost voltage and high voltage were both low, also.

When the amplitude of the drive signal was increased so that the voltage at the output grid was –55 volts, or 15 volts high, the crosshatch shown in Fig. 9B was produced. The linearity is compressed at both the right and left sides. The high voltage was down about 3KV, and the screen grid voltage was down about 10 volts. From this, it can be seen that, with more drive, less high voltage was produced. This explodes the myth.

To produce acceptable horizontal sweep, the sawtooth waveform applied to the grid of the horizontal-output tube must possess the following characteristics:

1) The positive tip of the sawtooth must achieve an amplitude that will permit the output tube to draw sufficient current;
2) The negative-going tip of the sawtooth must be sufficiently negative to completely cut off the output tube current;
3) The trailing, or negative-going side of the sawtooth must be steep enough to turn off almost instantly the plate current; the steeper the trailing side, the quicker the output tube is cut off;
4) The shape of the leading, or positive-going, side of the sawtooth must provide a linear increase of output tube current, to produce acceptable linearity on the right side of the screen.

In the previous example in which the amplitude of the sawtooth was increased, the first three characteristics were satisfied, but the excessive amplitude caused the output tube current to increase at too fast a rate, and tube current saturation occurred too soon, as indicated by the rounded top of the waveform produced by the output tube cathode current, shown in Fig. 9C. The plate current reached saturation and began to decrease before it normally would have been cut off by the negative-going side of the sawtooth. This action occurred possibly because the screen grid capacitor discharged and consequently, the screen voltage decreased, or it might have been because the boost capacitor, C54, discharged. Regardless of the specific cause, the premature decrease of output plate current caused the CRT beam to slow down before it reached the right edge, causing compression of the raster along the right edge of the screen.

The width on the left side was reduced also because the plate current decreased before retrace began. Because less current was interrupted, the amplitude of the ringing pulse produced by the collapsing field was decreased, less voltage pulse was generated during retrace, and, in turn, less damper current was available to produce deflection at the left side of the picture.

Effects Of An Open Yoke

An open winding in the horizontal section of a deflection yoke can cause some unexpected symptoms. Because no horizontal deflection will be produced, the raster will consist of one vertical line, if there is enough high voltage to light the CRT phosphors.

In one such case, the high voltage was very low (5KV) but the boost was high (700 volts at the transformer), even though both voltages are developed by rectification of the positive-going voltage pulse generated by the retrace cycle. This can happen because rectification by the high-voltage rectifier occurs only at the most positive-going tip of the retrace voltage pulse. The amplitude of this pulse determines the amount of high voltage.

Damper rectification occurs over several cycles of ringing, and this rectification takes place on the negative side of the voltage waveform.

The waveform of the voltage applied to the open yoke coil is shown in Fig. 10. The amplitude of the pulse is less than half the normal value. This is the reason for the reduced high voltage.

One of the fast tests made by many technicians to reveal shorted yokes is to disconnect the yoke (open circuit) and notice what effect this has on the B-boost voltage. This is a good test so long as it is realized that the B-boost voltage normally increase far above normal when the yoke opens. In the Sears chassis, the B-boost is normally 590 volts at the low end of the transformer winding. When the yoke is opened, the boost voltage increases to over 700 volts. When the yoke has many shorted turns, the boost voltage is 30 or 40 volts above the damper supply voltage.

Shorted Turns In Only One Yoke Coil

Fig. 11 shows the trapezoidal crosshatch pattern that was produced when just one of the two horizontal coils in the yoke was shorted out with a test lead. Brightness was low, and even a slight increase in brightness caused "blooming" of the entire raster (both vertically as well as horizontally).

A trapezoidal picture is *always* caused by an unbalance in the amount of deflection power applied to the two coils. However, in color receivers, such an unbalance can happen because of an open in the pincushioning circuit. This occurs more often in the vertical circuit than in the horizontal. Many transistorized horizontal sweep circuits operate the two horizontal yoke coils in parallel. In these sets, an open coil causes a trapezoidal picture. A coil with shorted turns reduces the width.

Causes of And Cures For Yoke Ringing

By yoke "ringing" we usually mean an effect produced on the left side of the raster such as that shown in Fig. 12A. The speed of the CRT beam varies and causes alternate dark and light vertical bars. Also, the individual horizontal scanning lines are bent up and down in a sine-wave type of ripple.

This effect cannot occur in receivers in which the yoke coils are connected in parallel. When they are in series, the two horizontal yoke coils do not receive exactly the same voltage. The coil nearest the cathode of the damper receives more of the ringing voltage that occurs between horizontal pulses, and *electrostatic* deflection causes a vertical bending of the scanning

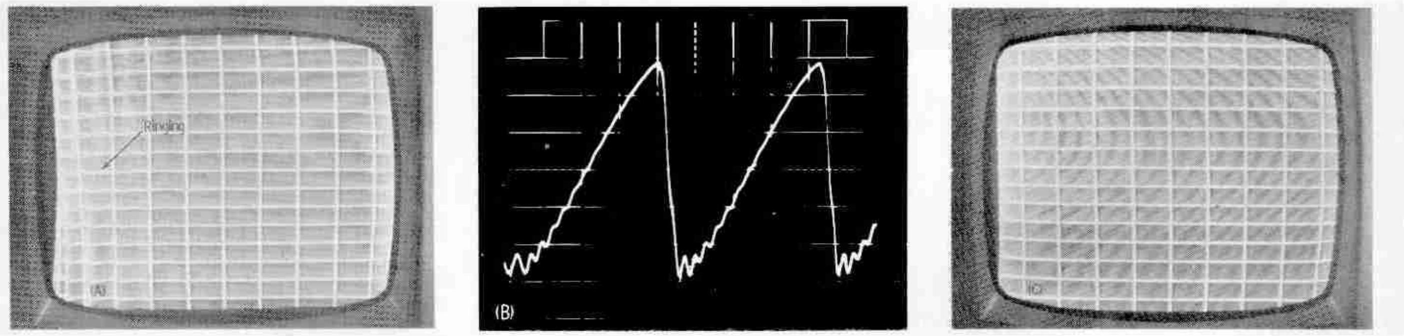


Fig. 12 Yoke "ringing" is produced by unbalance of the high frequencies applied to the two horizontal yoke windings. **A)** Crosshatch pattern caused by removal of C55 and C56, which were across the yoke. The horizontal scanning lines might be bent into a sine wave on the left side of the picture, or the change in speed of the beam might cause rounded, vertical white and black bars. **B)** Ringing is evident at the bottom of this sawtooth of horizontal yoke current. Five or more ringing bars can be seen. **C)** All the yoke ringing was removed by adding a 103-pf capacitor across the yoke coil which is electrically nearest the damper tube cathode. This capacitor is not necessary in the original circuit, which was equipped with a capacitance voltage divider consisting of C55 and C56, to equalize the frequency response.

lines. Normal deflection is by magnetic force, and it is applied at right angles, whereas electrostatic deflection is not.

Many of the older TV receivers use a small capacitor in parallel with the yoke coil which was wired nearest to the cathode of the damper tube. Because this capacitor passed more of the high-frequency content of the sweep circuit voltages on to the second yoke coil, the two coils act the same; in other words, their deflection action is balanced.

Replacing a defective yoke with a general-replacement type often causes some degree of "yoke ringing". The secret in eliminating the effect of the ringing is to provide the optimum size of the capacitor which parallels the "hot" coil. Try the next two sizes both higher and lower than the original value, to find the best compromise.

In the Sears chassis used to produce the illustrations in this series, yoke ringing is eliminated by C55 and C56, which operate as a capacitive voltage divider. (Any capacitive voltage divider provides flat frequency response.) R62 (1000 ohms) is provided to complete the voltage divider connection, and yet provide an acceptable amount of tolerance of component values. If the balance between capacitors and yoke coils is correct, this resistor has little current flow through it and remains relatively cool during operation. However, an open condition or serious leakage in either C55 or C56 unbalances the circuit and causes the resistor to burn open or its value to be changed. Keep this in mind, because other circuits which have a 4.7K-ohm resistor in the yoke operate in the same way.

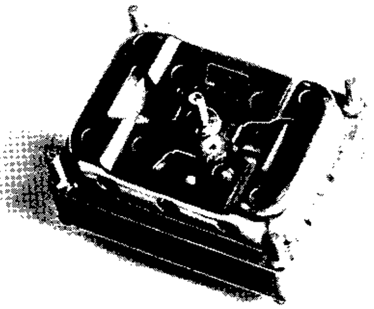
To test the validity of these statements, we rewired the Sears yoke circuit by removing C55, C56 and R62, and then added various sized of high-voltage ceramic capacitors across the "top" winding until the ringing was eliminated, as shown in Fig. 12C. In this case, the optimum size was 103 pf, as measured on a capacitance bridge. ▲

audio systems report

Four-Pole Replacement Motor For Turntables and Recorders

An AC hysteresis synchronous 4-pole replacement motor reportedly designed for use in record players, cooling fans and tape recorders has been introduced by Weltron.

The 117-volt, 60-Hz motor reportedly operates at 1800 RPM with a current load of 160 mA.



The motor features minimum vibration and noise, plus stable speed, according to the manufacturer.

The 70-912 reportedly is designed for use in such brand names as: National, Panasonic, CBS, Columbia, Mastercraft, Electro, Shin-ai and Weltron.

Model 70-912 sells for $16.45.

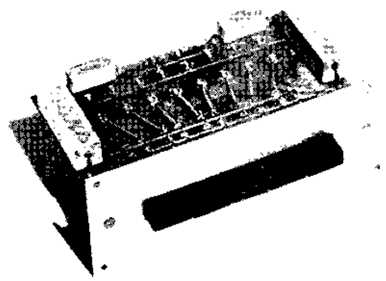
Circle 80 on literature card

Pushbutton Speaker Selector

A new five-pushbutton stereo speaker selector switch has been introduced by GC Electronics.

Connections from the selector switch to both the amplifier and the controlled speakers is via screw terminals at the back of the chassis. The printed circuitry reportedly prevents damage from shorts; the resistors allow line load balancing for one to five speaker pair connections and no-load protection, according to the manufacturer.

The switch and its resistive elements reportedly can handle power levels up to 55 watts rms per channel with 8-ohm speakers and one speaker pair in operation; power handling its 23 watts rms per channel with five stereo pairs (8 ohms) in operation.



The wall-mounted unit, Model 30-5002, sells for $29.95. The wood console cabinet, Model 30-5004, sells for $39.95. ▲

Circle 81 on literature card

ELECTRONIC SERVICING . . . the country's only magazine devoted 100% to the ELECTRONIC SERVICING industry . . .

productreport

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

Repair Kit for Plastics

Plasti-T-Pair, a plastic repair kit for soluble plastics which reportedly can be used as a cement or plastic putty, has been introduced by Chemtronics, Inc.

It is a two-part compound consisting of a powder and liquid solvent. It reportedly can be mixed and then poured or brushed onto a repair as a liquid plastic cement, or it can be mixed and let to set for a few minutes to be molded onto the repair area as a plastic putty.

As a cement, it is fast setting and waterproof, with no clamps or pressure needed to secure binding, according to the manufacturer.

When used as a plastic putty, it reportedly can be molded and formed into any shape; after it dries, the hardened plastic can be sanded and varnished to blend in with the original surface.

Plas-T-Pair is packaged with a dropper and mixing cup, and is available in junior ($.89) and large ($1.85) sizes.

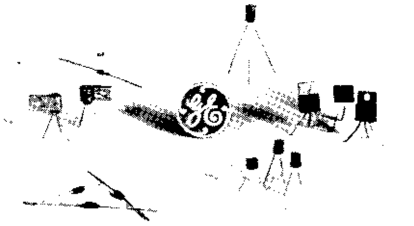
Circle 70 on literature card

New Renewal/Replacement Semiconductors

The addition of fourteen new entertainment semiconductors to its renewal-replacement line for service dealers has been announced by General Electric's Tube Products Dept.

New types reportedly include three Zener diodes, one variable-capacitance silicon diode, one fast-switching diode, one field-effect transistor, and eight other conventional bipolar transistors.

The zener diodes (GEDZ-33, 39 and 47) reportedly are rated at one watt, with voltage ranges from 33 to 47 volts.



The variable-capacitance silicon diodes (GE-90) reportedly can be used in automatic frequency control circuits and have a tuning ratio of 2.6 and are at rated 20 volts.

The fast-switching diode (GE-300) can be used in switching, detection, clipper, gating, blanker and damping applications, according to General Electric.

The field-effect transistor (GE-FET-2) reportedly is for use in VHF amplifiers in FM mobile communications equipment and TV; it is rated at 30 volts.

Circle 71 on literature card

Miniature Drivers

Seven new miniature drivers with pocket clips have been introduced by Vaco Products Co.

Each driver reportedly is $3\frac{9}{16}$ inches long, to allow tuning and instrumentation work in close areas. Handles are break-proof and shockproof, according to the manufacturer.

Included are: ¼ inch nut driver, ($1.00), 5/16 inch nut driver, ($1.00), 11/32 inch nut driver, ($1.00), No. 1 Phillips driver ($1.00). ⅛ inch regular driver,

($.70), 7/64 inch Allen type driver, ($.85), and ⅛ inch Allen type driver, ($.85).

Circle 72 on literature card

TV Tuner Cleaner/Lubricant Kit

A new "tuner care" kit, which consists of a can of tuner degreaser and a can of a combination lubricant/cleaner, has been announced by Injectorall.

The degreaser, called Royal Clean, reportedly dissolves dirt, grease and oil without leaving a residue and will not affect plastics.

The lubricant/cleaner, called Royal Lube, is a foam spray which reportedly cleans the tuner contacts and continues to lubricate them when they are rotated.

Included in the tuner care kit are a 16-ounce can of Royal Clean and an 8-ounce can of Royal Lube. The price of the kit is $4.98. ▲

Circle 73 on literature card

GET COMPLETE DETAILS
about the products advertised or described in this issue
Use Free Reader Service Card.
Be sure to include your name and address

advertisers' index

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.

EQUIPMENT FOR SALE

Sam's TSM 1-69, 71-73, 80, 84, 90, 95. $50.00 all; $1.25 each. Jones TV, 2710 Classen, Oklahoma City. 12-71-1t

SERVICE SHOP FOR SALE

TV Sales and Service Business For Sale—owner leaving state, located 11 yrs. in modern shopping plaza in south suburb of **Chicago**—fully equipped—**Sams** from 1st issue to date, including all **Riders** from 1 thru 13—gigantic building program in progress—present population 8,000, projected to 20 to 25,000. **Utility** bill pm't **Agency** and **Postal** sub station, plus bulb exchange, as traffic builders. For more info write **Sauk Plaza TV, 7 Sauk Plaza, Sauk Village, Ill. 60411** or call 312-758-4288 from 9 to 5.

EQUIPMENT WANTED

Wanted: Sams Photofacts No.'s 200 to current. Please contact G. Edwin Marston, Radio and TV Repair, Harrison Road, Norway, Maine 04268.

Catalogs literature

ANTENNAS

100\. *Vikoa, Inc.* — is making available a 64-page, illustrated catalog covering their line of wire and cables and IDS-MATV equipment. Hardware, accessories, connectors and fittings and an index also are included.

101\. *Jerrold Electronics Corp.*—Catalog S, titled "Systems and Products for TV Distribution," lists specifications of this manufacturer's complete line of antenna distribution products, including antennas and accessories, head-end equipment, distribution equipment and components, and installation aids.

AUDIO

102\. *Arista Enterprises, Inc.*—announces their 58-page needle and cartridge catalog. The needle cross reference reportedly has up-to-date cross references of all major needle marketers, in addition to cross reference sections of phonograph manufacturers' needle and cartridge numbers.

103\. *Bell P/A Products Corp.*—new 6-page catalog gives detailed specifications and descriptions of the company's broad line of commercial sound components and special purpose sound system products.

104\. *GC Electronics*—has made available a 52-page, two-color catalog, (FR-71-A) featuring 350 items for the music listener and hobbyist. Included in the booklet are a variety of TV antenna installations, acoustic-suspension loudspeaker systems, speaker switching devices, stereo headphones, microphones and accessories.

105\. *Jensen Manufacturing Div.*—has issued an 8-page catalog, No. 1090-E, which describes applications of 167 individual speaker models. Special automotive, communications, intercom and weathermaster speakers, plus a complete line of electronic musical instrument loudspeakers are featured.

AUTO ELECTRONICS

106\. *Littelfuse, Inc.* — has released a new 32-page, 1971 automotive replacement fuse guide for passenger autos, sports cars, trucks, and taxi cabs. Fuse descriptions and circuits they protect are included.*

CABLE

107\. *Columbia Electronic Cables*—has published a 92-page wire, cable, and cord-set catalog No. CEC-MC-571 which includes technical data concerning comparison charts of different types of insulating materials, copper wire specifications, estimating charts, and ampere ratings.

CAPACITORS

108\. *Cornell-Dubilier Electronics*—has issued an 80-page cross-reference, 1972 catalog for location of single, dual, triple, and quadruple section replacement electrolytics.

COILS

109\. *J. W. Miller Co.* — announces a new 92-page radio and TV replacement coil cross reference guide for known domestic and foreign color and black and white TV sets, home and car radios. Over 22,000 replacement coils for 327 manufacturers names reportedly are listed.

COMPONENTS

110\. *Arco/LDP div. of Loral Corp.* — has published a new cross-reference guide and price book for its miniature aluminum electrolytic capacitors. The four-page publication includes specifications for the Arco/LDP line of Miniature Arcolytics, cross-references them by part number with similar products of other capacitor manufacturers.

111\. *Essex International, Inc.*—announces their 24-page SC-5 RBM Standard Controls Catalog listing over 450 electrical/electronic relays and contactors.

112\. *General Electric Tube Department*—has released a new 60-page Entertainment Semiconductor Almanac, No. ETRM-4311G. The almanac contains approximately 24,000 cross references from JEDEC, or OEM part numbers to GE parts numbers for universal replacement semiconductors, selenium rectifiers for color TV, dual diodes, and quartz crystals.*

113\. *Loral Distributor Products*—has made available a 24-page electrolytic capacitor replacement guide. The catalog features replacement products by the original manufacturers part number.

114\. *Precision Tuner Service*—announces a new tuner parts catalog, including a cross reference list of antenna coils and shafts for all makes of tuners.

115\. *RCA Distributor Products*—introduces a 72-page "SK Series Top-Of-The-Line Replacement Guide" (SPG-202L) which cross-references over 20,000 semiconductor device numbers. In addition a Solid State Quick Selection Replacement Chart (1L1367) listing 79 entertainment SK-Series devices is included. Price of this catalog is $.35.

116\. *RCA/Solid-State Division*—announces a revised edition of the Power Transistor Directory, which reflects new product programs, as well as new product data. All product matrices have been updated to include the latest commercial types as well as preliminary data on developmental types, including RCA power transistors, both silicon and germanium. The Index of Types has been expanded to include DT types as well as JEDEC (2N-Series) types and RCA 40-K series types. Copies are $.40.*

117. *Semitronics Corp.* — has a new, revised "Transistor Rectifier, and Diode Interchangeability Guide" containing a list of over 100 basic types of semiconductors that can be used as substitutes for over 12,000 types. Include 25 cents to cover handling and postage.

118. *Sprague Products Co.*—has announced a 40-page manual which lists original part numbers for each manufacturer, followed by ratings, recommended Sprague capacitor replacements, and list prices. More than 2,500 electrolytic capacitors are included.*

119. *Stancor Products*—pocket-size, 108-page "Stancor Color and Monochrome Television Parts Replacement Guide" provides the TV technician with transformer and deflection component part-to-part cross reference replacement data for over 14,000 original parts.

120. *Sylvania Electric Products, Inc.* — a 73-page guide which provides replacement considerations, specifications and drawings of Sylvania semiconductor devices plus a listing of over 35,000 JEDEC types and manufacturers' part numbers. Copies are $1.00.

121. *Workman Electronic Products, Inc.*—has released a 32-page, pocket-size cross reference listing for color TV controls. 105 Workman part numbers are listed in numerical order with specifications and illustrations of the part.*

122. *GTE Sylvania, Inc.* — has published an interchangeability guide listing 191 commonly used color TV picture tubes which can be replaced with 19 GTE Sylvania Color Bright 85® types.

MISCELLANEOUS

123. *Alco Electronic Products, Inc.*—an 8-page catalog describing handcrafted, machined aluminum, control knobs.

124. *Allied Radio Shack's*—new 132-page, 1972 Electronic Parts & Accessories catalog reportedly lists thousands of hard-to-find electronic items. Exclusive Allied, Realistic, and Radio Shack brand products are listed, as well as the complete line of Knight-Kit and Science Fair Kits.

SEMICONDUCTORS

125. *GTE Sylvania, Inc.* — announces a revised semiconductor guide which reportedly gives replacement information for more than 41,000 solid-state devices. The 73-page catalog, ECG 212D, provides characteristics and outline drawings of the 124 components in the Sylvania ECG semiconductor line. The catalog is $1.00.

126. *Motorola* — announces release of the new HEP HMA-07 semiconductor cross-reference guide and catalog. Replacements are reportedly listed for over 30,000 semiconductor device numbers. A product catalog plus 168 new hobby, dealer and industrial M.R.O. devices are also included.*

SERVICE AIDS

127. *Kester Solder* — has released an 8-page brochure presenting the company's full line of soldering products. Presented are: "44" resin core solder, acid-core solder, solid-wire, bar solder, TV-radio solder, and Metal Mender.

128. *Chemtronics*—announces a new 12-page, 1971-1972 catalog of products, including: tuner sprays, circuit coolers, insulating sprays, contact and control sprays, lubricants, tape head and record cleaners/accessories, cartridge tape head cleaners and conditioners, electronic glues and cements, solder, and spray paints.

TV ACCESSORIES

129. *Telematic* — introduces a 14-page catalog featuring CRT brighteners and reference charts, a complete line of test jig accessories and a cross reference of color set manufacturers to Telematic Adapters and convergence loads.

TECHNICAL PUBLICATIONS

130. *Howard W. Sams & Co., Inc.* — literature describes popular and informative publications on radio and television servicing, communications, audio, hi-fi industrial electronics, including their 1971 catalog of technical books about every phase of electronics.*

131. *Sencore, Inc.* — Speed Aligner Workshop Manual, Form No. 576P, provides 20 pages of detailed, step-by-step procedures for operation and application of Sencore Model SM158 Speed Aligner sweep-marker generator.

132. *Sylvania Electric Products, Inc., Sylvania Electronic Components Div.* — has published the 14th edition of their technical manual, which includes mechanical and electrical ratings for receiving tubes, television picture tubes and solid-

state devices. Price of this manual is $1.90.

133. *Tab Books*—has released their Spring, 1971 catalog describing over 170 current and forthcoming books. The 20-page catalog covers: schematic/servicing manuals, broadcasting; basic technology; CATV; electric motors; electronic engineering; computer technology; reference; television, radio and electronics servicing; audio and hi-fi stereo; hobby and experiment; amateur radio; test instruments; appliance repair, and transisfor technology.

TEST EQUIPMENT

134. *Dynascan Corp.* — announces a new 24-page 2-color catalog of B&K Precision Test Equipment. A total of 21 instruments are reportedly presented; from a Mutual Conductance Tube Tester to a new DC to 10 MHz Triggered Sweep Oscilloscope.

135. *Eico* — has released a 32-page, 1971 catalog which features 12 new products in their test equipment line, plus a 7-page listing of authorized Eico dealers.*

136. *Information Terminals* — has introduced a new brochure featuring the M-100 Tension Monitor, the M-200 Torque Tester and the M-300 Head and Guide Gage.

137. *Leader Instruments Corp.* —announces the 1971 Catalog of Leader Test Equipment. Test equipment included is the LBO-301 portable triggered-sweep oscilloscope, LSW-330 new solid-state post injection sweep/marker generator, and the LCG-384 miniportable, solid-state battery operated color-bar generator.*

138. *Lectrotech, Inc.* — announces the 1972 catalog, "Precision Test Instruments for the Professional Technician". It contains specifications and prices on sweep marker generators, oscilloscopes, vectorscopes, color bar generators and other test equipment.

139. *Mercury Electronics Corp.* —14-page catalog provides technical specifications and prices of this manufacturers' line of Mercury and Jackson test equipment, self-service tube testers, testers, test equipment kits and indoor TV antennas.

140. *Tektronix, Inc.* — has announced a 4-page brochure describing the 54 Series oscilloscope manufactured by Tektronix English subsidiary, Telequipment.

141. *Triplett Corp.*—announces a 6-page, two-color brochure featuring four new portable, battery-operated, FET Volt-Ohm-Milliameters and accessories.

142. *Triplett Corp.*—announces a 2-page, 2-color data sheet for Model 6028, a 2¾ digit VOM. Data sheet gives DC volts, AC volts, ohms AC and DC current ranges plus construction information, price and accessories.

143. *Tucker Electronics Co.*—features a catalog listing their new and reconditioned electronic test equipment. Their inventory reportedly includes over 10,000 pieces of equipment manufactured by over 250 different companies.

TOOLS

144. *Chapman Manufacturing Co.* — offers a pamphlet containing their line of tools and tool kits. Kit No. 6320, the Midget Ratchet is featured along with other available tool kits.

145. *Ideal Industries* — introduces a 2-page, 4-color brochure announcing their new Heat Gun. Performance characteristics applications, operating features, specifications and ordering information reportedly are included.

146. *Janel, Inc.* — announces a three-color catalog on precision hand tools used primarily in miniature and micro-miniature electronic assembly and production applications.

147. *Jensen Tools and Alloys*—has announced a new catalog No. 470, "Tools for Electronic Assembly and Precision Mechanics." The 72-page handbook-size catalog contains over 1,700 individually available items.

148. *Xcelite, Inc.* — Bulletin N770 describes this company's three new socket wrench and ratchet screwdriver sets.*

*Check "Index to Advertisers" for additional information. ▲

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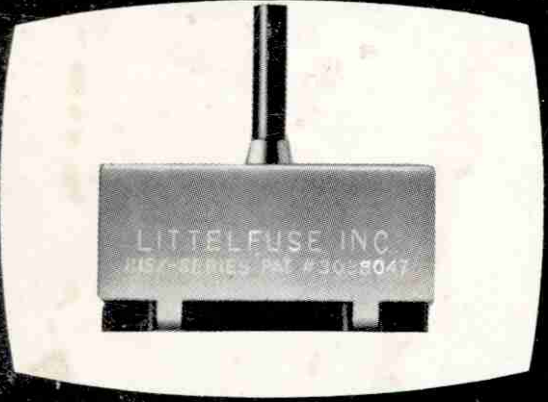

Standard Catalog Part No.	Hold Rating (Amps.)	Standard Catalog Part No.	Hold Rating (Amps.)
815.650	.490	8152.75	1.92
815.800	.600	815003	2.1
815001	.650	8153.25	2.2
8151.25	.930	815004	2.5
81501.5	1	81504.5	3
8151.75	1.2	815005	3.25
815002	1.4	815006	3.9
8152.25	1.5	815007	4.14
81502.5	1.65		

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