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OCTOBER 1965/50¢

PF Reporter™

PHOTOFACT

the magazine of electronic servicing

1966 HIGHLIGHTS OF THE NEW TV RECEIVERS

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- Understanding Pads and Attenuators
- Latest Circuits for FM Stereo
- Sales Tips for New and Used TV
- And other regular departments

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New Model 712 — Sentinel 12 Dual Conversion 5-watt CB Transceiver. Permits 12-channel crystal-controlled transmit and receive, plus 23-channel tunable receive. Incorporates adjustable squelch & noise limiter, & switches for 3.5 watt P.A. use, spotting, & Part 15 operation. Transistorized 12VDC & 117VAC dual power supply. **$99.95 wired only.**

New Model 753 — The one and only SSB/AM/CW Tri-Band Transceiver Kit. 200 watts PEP on 80, 40 and 20 meters. Receiver offset tuning, built-in VOX, high level dynamic ALC. Unequalled performance, features and appearance. Sensationally priced at **$179.95 kit, $299.95 wired.**

New Model 3566 — All Solid-State Automatic FM MPX Stereo Tuner/Amplifier. No tubes, not even nuvistors. Delivers 112 watts IHF total to 4 ohms, 75 watts to 8 ohms. Completely pre-wired and pre-aligned RF, IF and MPX circuitry, plus plug-in transistor sockets. **$219.95 kit** (optional walnut cabinet $14.95), **$325.00 wired including walnut cabinet.** UL approved.

Model ST70 70-Watt Integrated Stereo Amplifier. Best buy of highest ranked stereo amplifiers according to independent testing. **$99.95 kit, $149.95 wired. ST40 40-Watt** Integrated Stereo Amplifier, **$79.95 kit, $129.95 wired. ST97** Matching FM MPX Stereo Tuner, **$89.95 kit, $139.95 wired.**

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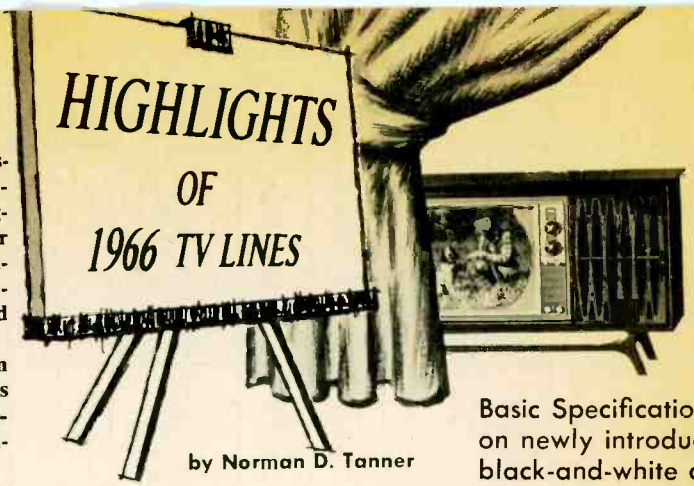
Circle 1 on literature card

HIGHLIGHTS OF 1966 TV LINES



The trend to small-screen personal portables, both transistorized and tube-type, is quite evident in most manufacturers' new lines. American companies are strongly challenging the imported transistor sets by developing lines of their own. Emphasis on large-screen receivers is presently diminishing; most are offered primarily as consoles or in combinations. The once-popular 21" picture tube is scarcely used in the new models.

Color receivers are being offered by virtually all American manufacturers, and are available in a number of CRT sizes ranging from 12" to 25". Look for more news of developments in color receivers and circuits in next month's (November) PF REPORTER.

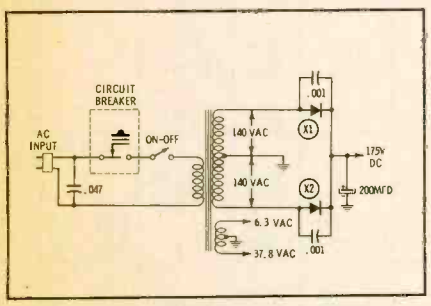
by Norman D. Tanner

Basic Specifications on newly introduced black-and-white chassis.

ADMIRAL

Admiral's '66 line of black-and-white receivers makes available a variety of picture-tube sizes. An 11" portable is the smallest, and the largest is a 25" console, while 13", 15", 17", 19", 21", and 23" models fill out the selection. The biggest news is the 15" and 17" receivers which incorporate square-cornered, flat-faced picture tubes. A 110° steelbond 15JP4 picture tube provides 103 square inches of viewing area. The implosion-proof CRT eliminates reflection problems and makes cleaning the tube much simpler as there is no safety glass to remove.

The *Terrace*, a 17" portable, uses



Admiral's G3 chassis and the CRT is a 114° steelbond 17ELP4. Another new portable, the 21" *Fireside*, is also a recent addition to the company's line.

Highlighting the big-screen black-and-white line is the transformer-powered G7 chassis used in the 23" and 25" models. This horizontal-mounted chassis has a three-stage high-gain IF strip — a 6U9 compactron functions in the first and second stages. Other compactrons used in this chassis are the 6U9 video output/sound IF amplifier, 6BF11 sound detector/output, 6JZ8 vertical multivibrator/output, and 38HK7 horizontal output/damper.

The low-voltage power supply (its schematic is shown here) uses two silicon diodes in a full-wave rectifier circuit. Notice this is not a full-wave doubler, but merely a simple full-wave rectifier with an output of 175 volts DC. The filament winding on the transformer is tapped; one section supplies 6.3 volts AC to all the tubes except the horizontal output. Its filament power is supplied by the 37.8 volt AC winding.

The C21-B12 and C12 chassis used in the 11" and 13" portables employ a series filament string and incorporate some interesting tube types. A 12AL11 serves as sound detector/output; the vertical multivibrator/output stage uses a 17JZ8, and a 33GY7 functions as horizontal output/damper; all these are compactrons. These same tubes are also used in the 21D20 and the G3 chassis.

The G4 chassis is another transformerless type with an interesting array of tubes. A 8BM11 (a compactron consisting of two pentodes) serves as the first and second video-IF amplifiers. These are followed by a 10LW8 which serves as video output/sound-IF amplifier. The sound detector/output is a 17BF11. Vertical sweep is obtained with a 17JZ8. The functions of horizontal output and damper are combined in one envelope — a 38HE7; the high-volatge rectifier is a 1AY2.

AIRLINE

This company's 1966 line includes four basic tube-type receivers, along with 6" and 9" transistor sets. The tube sets are available with 12", 16", 19", or 21" picture tubes. The 23" models have a completely new transformer-powered chassis. Sweep-output tubes are types designed to operate from a low B+ source voltage; thus, only one silicon rectifier is used in the power supply.

Three individual printed-circuit boards are used: one contains the video IF, sync, and AGC circuits; a second houses the audio section; and the third incorporates the vertical multivibrator and horizontal oscillator stages. The horizontal output, vertical output, and damper stages are located on the main chassis. Conventional tubes are used throughout. However, the 6BJ8 is worth mentioning; its triode section is part of the vertical multivibrator and the dual-diode section is used for horizontal AFC.

The 9" transistor receiver, Model GEN1966A, uses a 90° 230DP4 picture tube and has a total of 27 transistors, including the UHF oscillator and the three in the VHF tuner. Three 1DK29 high-voltage rectifiers are the only tubes used. This set may be operated from 117 volts AC or with a 12-volt rechargeable battery. When the set is AC operated, a bridge rectifier circuit supplies the negative 12 volts DC. Two fuses are used; a .5-amp in series with one side of the AC line provides protection when operating the receiver on AC and a 2-amp is used in the B+ line when the set is battery powered.

At press time, only limited information was available on the 6" transistor set, Model GEN-1686A, which also uses 27 transistors and three tubes. Here a 90° 150HB4 picture tube is used. This 6" set may be operated on AC or DC, and uses a rechargeable battery.

ARVIN

The 12" and 16" portables Model 65K28 and 65K38, respectively, are being offered again this year; these are imported carryovers from the '65 line. (Interesting features of these two receivers were given in PF REPORTER "Highlights" October 1964.) New this year are Models 66K48, a 19" portable, and 66K18, a 9" transistorized receiver.

The new 19" set uses a 114° A47-21W picture tube and has a transistorized UHF tuner. Three high-gain frame-grid tubes occupy the video-IF strip. A number of unfamiliar tube types (5GS7, 6LN8, 10DX8, 10GV8, 11BM8, 20AQ3, and 21KW6) are employed throughout the chassis.

Sweep-circuit adjustments include a tapped width coil and a horizontal linearity coil. The transformerless power supply uses two silicon diodes as a half-wave voltage doubler. A 4.7-ohm fusible resistor in the doubler supply is employed as a protective device.

A 9" transistor receiver Model 66K18 with a 90° A23-10W picture tube is being offered for 1966. This small-screen receiver has a total of 26 transistors, 13 signal diodes, 4 silicon diodes (as a fullwave bridge rectifier in the low-voltage power supply), and 3 tubes used in the high-voltage rectifier cir-

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CHASSIS NO.	CRT TYPES	DEG DFL	UHF TUNER	PWR XFM	B+ RECT	IF AMP	DC CPL	AGC	NL	HOR AFC	WIDTH CTRL	FOCUS	SOUND DET	PROTECTED CIRCUITS LINE	B+	FIL
ADMIRAL																
C21B12	11GP4	110	TR		one sil	2		P-N		CC		jumper	quad	FR 5.5		
C21C12	13AP4	110	TR		one sil	2		P-N		CC		jumper	quad	FR 5.5		
G21D20	15JP4	110	TR		one sil	2		P-N		CC		jumper	quad	FR 5.5		
G3	17ELP4, 19FBP4	114	TR		one sil	2		P-N		CC		jumper	quad	FR 5.5		
G4	19ENP4, 19EGP4, 21FUP4, 23FRP4	114 110	TR		one sil	2		P-N		CC		jumper	quad	ckt brkr		
G7	19EGP4, 21FUP4 23FRP4, 25HP4	114 110	TR	✓	*	3H		M-C	M	CC	coil	jumper	quad	ckt brkr		
AIRLINE																
GEN-1166A, 1266A	12BFP4	114	2DV4		one sil	2H		S-N		CC	coil	jumper	quad	fuse 1.6A		
GEN-1866A	16AUP4-J	114	2DZ4		HW dbl	3		*		T	pot	jumper	ratio	fuse 2A		
GHJ-1066A, 1366A	19ENP4	114	TR		one sil	2H		T-N		CC	sleeve	jumper	quad	ckt brkr		
GHJ-4836A; 46A,B; 56A,B; 76A,B; 96A,B; 14815A	23FMP4, 23GBP4	110	TR	✓	one sil	3		M-N		D		jumper	quad	ckt brkr		
ARVIN																
65K28	A31-12W	114	TR		one sil	2H		S		T	coil	NA	quad	fuse 1.6A		
65K38	AW40-12	114	TR		HW dbl	2H		M-C	M	CC	jumper	jumper	ratio	fuse 1.5A		
66K48	A47-21W	114	TR		HW dbl	3H		T-C		CC	coil	NA	ratio	FR 4.7		
CATALINA																
122-632	19DQP4, 19FDP4	114	TR		HW dbl	3		†		CC	sleeve	jumper	quad	ckt brkr		
122-640, 646, 648	23FMP4, 23GBP4	110	TR		HW dbl	3		†		CC	sleeve	jumper	quad	ckt brkr		
122-642, 644	23FCP4, 23FDP4	110	TR		one sil	2H		†		CC	sleeve		quad	ckt brkr		
122-652, 654, 656	23FCP4, 23FDP4	110	TR		one sil	2H		†		CC	sleeve		quad	ckt brkr		
CHANNEL MASTER																
6573	12AYP4	114	TR		one sil	2H		T-C		D		jumper	quad	fuse 2A		
CORONADO																
TV2-9368A	12BGP4	110	TR		one sil	2H		S-N		CC	sleeve		quad	FR 4.7		
TV2-9369A, 70A, 71A	12BGP4	110	TR		one sil	2		†		CC	sleeve	NA	quad	FR 4.7		
TV2-9372A, 73A	19EAP4, 19ENP4	114	TR		one sil	2H		†		CC	sleeve		quad	ckt brkr		
TV2-9374A	19DQP4, 19FDP4	114	TR		HW dbl	3		†		CC	sleeve	jumper	quad	ckt brkr		
TV2-9506A	23FCP4, 23FDP4	110	TR		one sil	2H		†		CC	sleeve		quad	ckt brkr		
TV2-9508A, 09A	23FMP4, 23GBP4	110	TR	✓	FW	2H		†		CC	sleeve	jumper				
TV2-9547A, 48A, 49A	23FMP4, 23GBP4	110	TR		HW dbl	3		†		CC	sleeve	jumper	quad	ckt brkr		
CURTIS MATHES																
TV-16	23FHP4	110	NA		HW dbl	2H	✓	P-N		CC	NA	pot	quad	ckt brkr		
TV-17	19EGP4 23FHP4	114 110	NA		HW dbl	3H	✓	P-N		CC	NA	pot	quad	ckt brkr		
TV-19	19EGP4	114	NA	✓	FW dbl	3H	✓	P-N		CC	NA	pot	quad	ckt brkr		link
DUMONT																
120780-A	16CEP4	114	TR		one sil	2H		T-C		CC			quad	fuse 1.2A		
120783-A, 810-A	19FJP4	114	TR		one sil	2H		T-C		CC			quad	fuse 1.2A		
120804-A, 805-A	19DRP4, 19EDP4	114	TR	✓	5U4GB	3H		T-C	T	CC	coil	jumper	quad		fuse .45A	link
120806-A, 807-A	23GFP4	110	TR	✓	5U4GB	3H		T-C	T	CC	coil	jumper	quad		fuse .45A	link
ELECTROHOME																
13T4E	19BSP4, 23ARP4 19AVP4, 19EUP4	110 114	NA	✓	*	*		P-C		S		jumper	quad	ckt brkr		link
14T4P	19BSP4, 23ARP4	110	TR	✓	*	*		P-C		D		jumper	quad	ckt brkr		link
15T4P	19BSP4, 23GXP4	110	TR	✓	*	*		P-C	M	S		jumper	quad	ckt brkr		link
16T4E	19BSP4, 23GQP4	110	NA	✓	*	*		P-C	M	D		jumper	quad	ckt brkr		link
16T4P	23GQP4, 23GXP4	110	TR	✓	*	*		P-C	M	D		jumper	quad	ckt brkr		link
EMERSON																
12P50	310JB4	NA	TR		one sil	3H		T-N		CC	jumper	jumper	ratio	fuse 2.3A		
120779, 780	16CEP4	114	TR		one sil	2H		T-C		CC			quad	fuse 1.2A		
120781, 782, 810, 811, 813	19FJP4	114	TR		one sil	2H		T-C		CC			quad	fuse 1.2A		
120804-A, 805-A	19DRP4, 19EDP4	114	TR	✓	5U4GB	3H		T-C	T	CC	coil	jumper	quad		fuse .45A	link
120806-A, 807-A	23GFP4	110	TR	✓	5U4GB	3H		T-C	T	CC	coil	jumper	quad		fuse .45A	link
GENERAL ELECTRIC																
AB	23DYP4, 23FVP4	114	TR	✓	FW dbl	3H		T-C		D	coil	jumper	quad	fuse 2A		#26 link
DB	19ECP4	114	TR		one sil	2H		T-N		D	coil		quad	fuse 1.5A		
SB	12BMP4, 16CFP4		TR		one sil	2H		T-N		D			quad	fuse 1.5A		
MAGNAVOX																
T914	23HGP4, 23HQP4	110	TR		one sil	3		P-N		CC		jumper	quad			
MOTOROLA																
TS-454	12BGP4, 12BKP4	110	TR		one sil	2		T-N		CC	capacitors	jumper	quad	FR 5		
TS-586	19DSP4, 19EFP4	114	TR		one sil	3		P-N	T	CC	capacitors	jumper	quad	ckt brkr	FR 5	
TS-588	23FSP4, 23GSP4, 23HLP4, 23GXP4	110	TR		HW dbl	3	✓	T-N	T	CC	capacitors	jumper	quad	ckt brkr		
TS-589	19EBP4, 21FVP4, 21FZP4	114	TR	✓	FW dbl	3	✓	T-N	T	CC	coil	jumper	quad	ckt brkr		
	23FSP4, 23GSP4, 23HLP4, 23GXP4	110														

CHASSIS NO.	CRT TYPES	DEG DFL	UHF TUNER	PWR XFM	B+ RECT	IF AMP	DC CPL	AGC	NL	HOR AFC	CTRL WIDTH	FOCUS	SOUND DET	PROTECTED CIRCUITS LINE	B+	FIL
MOTOROLA (Cont.)																
TS-596	19EGP4 19AEP4, 19ENP4	114 110	TR		one sil	3		P-N	T	CC	capacitors	jumper	quad	ckt brkr	FR 5	
MUNTZ																
AS-5002	19ENP4, 19ETP4		TR	✓	FW	2		S-N		D			quad	fuse 2A		link
AS-5003	23GP4		TR	✓	FW	2		S-N		D			quad	ckt brkr		link
OLYMPIC																
NCP	23EZP4		TR		one sil	2H		T-C		CC		jumper	quad	ckt brkr	FR 5.5	
PACKARD BELL																
88-16, 16C	23EKP4, 23FLP4	92	TR	✓	FW dbl	3		P-C	T	CC	coil	pot	ratio	ckt brkr	FR 5.6	
88-18C	19DQP4, 19FCP4A, 19FDP4	114	TR		HW dbl	3		P-C	T	CC	coil	pot	ratio	ckt brkr	FR 5.6	
88-19	19DQP4, 19FCP4A	114	TR	✓	HW dbl	3		P-C		CC	coil	pot	ratio	ckt brkr	FR 5.6	
PHILCO																
16J26, J26A	19DUP4	114	TR		one sil	*		*	T	CC	pot	jumper	quad	ckt brkr		
16J27	19DUP4	114	TR		one sil	2H		T-N	T	CC	pot	jumper	quad	ckt brkr	FR 1.5	
16N35	23GWP4		TR		one sil	2H		T-N	T	CC	pot	jumper	quad	ckt brkr	FR 1.5	
RCA																
KCS136M	23BKP4, 23BLP4	114	TR	✓	FW dbl	3	✓	P-N		CC	coil	pot	quad		ckt brkr	link
KCS142XA	19DQP4	114	TR		HW dbl	2H	✓	P-C		CC	coil		quad	FR 5	ckt brkr	
KCS144	19DQP4	114	TR		HW dbl	3	✓	P-C		CC	coil		quad	FR 5	fuse .4A	
KCS148	19DQP4	114	TR	✓	FW dbl	2H	✓	P-C		CC	coil		quad		ckt brkr	link
KCS149	19DQP4	114	TR	✓	FW dbl	3	✓	P-C		CC	coil		quad		ckt brkr	link
KCS152	16AYP4, 16BGP4	114	TR		one sil	2H	✓	T-N		CC	pot	jumper	quad	FR .35	fuse	
KCS154	21FVP4	114	TR		HW dbl	3H	✓	P-C		CC	coil		quad	FR 5	ckt brkr	
KCS155	19DQP4	114	TR	✓	one sil	2H	✓	T-N		CC	capacitors		quad		ckt brkr	link
SEARS/SILVERTONE																
528.61620, 21	19ENP4	NA	TR		one sil	2H		T-N	*	CC	sleeve	pot	ratio	ckt brkr		
528.61680, 81	23HFP4	NA	TR		one sil	2		S-N		CC	sleeve	pot	ratio	ckt brkr		
528.61720, 21	23HFP4	NA	TR		HW dbl	2H		T-N	*	CC	sleeve	pot	ratio	ckt brkr		
528.70000, 01	19DQP4, 19DWP4	114	TR		one sil	2		S-N		CC	sleeve	jumper	ratio	ckt brkr		
528.70120, 21	19DQP4, 19DWP4	114	TR		one sil	2		S-N		CC	sleeve	jumper	ratio	ckt brkr		
562.10090, 91, 92, 93, 94, 95	16BFP4	NA	3DZ4		HW dbl	3		T-C		T	coil	jumper	quad	fuse 2.2A		
562.10110, 11	28OGB4	NA	TR		one sil	3		S-C		CC	jumper	jumper	ratio	fuse 1.9A		
SPARTON OF CANADA																
19P1	19XP4	114	TR		HW dbl	3		P-N	NA	S		NA	ratio		FR 9	
23P1, P2, P9	23FUP4	110	TR	✓	FW	3	✓	P-N	NA	S		NA	ratio	ckt brkr		
23P3, P4	23FUP4	110	TR		HW dbl	3		P-N	NA	S		NA	ratio		FR 9	
SYLVANIA																
B04	23BGP4	110	NA	✓	5BC3	2H	✓	T-C	*	CC	pot	jumper	quad	ckt brkr		#28 link
B05	19CVP4	114	NA		HW dbl	2H	✓	T-C	*	CC	pot	jumper	quad	ckt brkr		
B06	19CVP4	114	NA		HW dbl	2H	✓	T-C	*	CC	pot	jumper	quad	ckt brkr		
WELLS GARDNER																
T03, T04, T12, T21	19EAP4, 19ENP4, 23FCP4, 23FDP4	114 110	TR		one sil	2H		*		CC	sleeve		quad	ckt brkr		
T05	12BGP4	110	TR		one sil	2		*		CC	sleeve	NA	quad	FR 4.7		
T06, T07, T10, T13	19DQP4, 19FDP4, 23FMP4, 23GBP4	114 110	TR		HW dbl	3		*		CC	sleeve	jumper	quad	ckt brkr		
T14, T22	23GBP4, 23FMP4	110	TR	✓	*	2H		*		CC	sleeve	jumper	quad	ckt brkr		
WESTINGHOUSE																
V-2486	19FEP4 23HRP4	114 110	TR		one sil	2H		*		CC	jumper		quad	fuse 1.75A		
V-2487	19CMP4, 19FEP4 23HRP4, 23HSP4	114 110	TR		HW dbl	2H		P-C	T	CC	pot		quad	fuse 2A		
V-2490	12BLP4	110	TR		one sil	2H		*		CC		NA	quad	fuse 1.75A		
ZENITH																
14N26	21FXP4	114	TR	✓	FW dbl	3		M-C	M	CC	pot	pot	quad	ckt brkr		#24 link
14N29	19EZP4	114	TR		HW dbl	3		M-C	M	CC	pot	jumper	quad	ckt brkr		
14N31	19EZP4	114	TR		HW dbl	3		M-C	M	CC	pot	jumper	quad	ckt brkr		
14N32	19EZP4	114	TR	✓	FW dbl	3		M-C	M	CC	pot	jumper	quad	ckt brkr		#26 link
14N34	19EZP4	114	TR	✓	FW dbl	3		M-C	M	CC	pot	pot	quad	ckt brkr		#24 link

ABBREVIATIONS AND SYMBOLS—In any column, **CHECK MARK** indicate chassis has feature named; **ASTERISK** means "see text"; NA means data not available at press time. For individual columns—**UHF TUNER:** tube type given, if known; TR, transistorized. **B+ RECT:** one sil, one silicon rectifier; HW dbl, half-wave voltage doubler using two silicon rectifiers: FW dbl, full wave silicon doubler. **IF AMP:** Figure indicates number of stages; "H" indicates use of two or more tubes having substantially higher gain than the 6CB6. **DC CPL** means set has DC path or DC restoration in video drive circuit of CRT. **AGC:** First letter—M, multipurpose tube ('HS8, 'BU8, or similar); P, pentode keyer; T, triode keyer; S, simple (no tube). Second letter—C, has AGC potentiometer; N, no AGC adjustment. **NL** (noise limiter): M, part of multipurpose tube ('HS8, BU8, etc.); T, triode noise inverter; †see text for Wells Gardner. **HOR AFC:** CC, common-cathode dual selenium diode; CT, common-cathode dual diode plus triode section of tube (controlling sinewave or "Synchroguide" oscillator); S, two selenium diodes in series; D, dual diode sections of tube; T, triode used. **SOUND DET:** quad, quadrature circuit; ratio, ratio detector circuit. **FOCUS:** jumper, set has wire from CRT to select voltage; pot, has focus potentiometer; CRT base, focus jumper located on base of picture tube. **PROTECTED CIRCUITS:** figure following "fuse" is rating in amps; FR indicates fusible resistor and is followed by rating in ohms; "link" means short wire, of gauge indicated.

cuit. Two fuses—a .4-amp in the AC line and a 2-amp in the DC power path—are located in the power supply. Three transistors are used in the 40-mc video-IF strip. Separate amplifiers are used for RF and IF AGC voltages. This receiver may be operated from a 117-volt AC source or by ten dry-cell batteries. Along with the built-in antenna is provision for connecting an external 300-ohm antenna.

CHANNEL MASTER

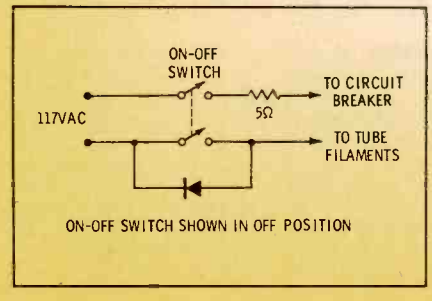
Latest introduction by this company is a 12" tube-type receiver, the Model 6573. This personal portable comes equipped with a built-in monopole antenna for VHF, a built-in UHF loop antenna, and an earphone jack. Only twelve tubes, including the two in the VHF tuner and the 12AYP4 picture tube are used. Two and three functions are combined within one tube envelope, by using compactrons. Among these compactrons are the 17BF11 audio detector/output, 17JZ8 vertical multivibrator/output, 8B10 AGC keyer/sync separator/horizontal AFC, and 33GY7 horizontal output/damper. The power supply is transformerless and uses a single silicon rectifier for the B+ supply; protection is provided by a 2-amp fuse in the 117-volt AC line.

CURTIS MATHES

Two CRT sizes used in three separate chassis make up this year's line. A 19" receiver is available with either the transformer powered TV-19 chassis or the series-filament TV-17 chassis. The transformer-powered chassis is only slightly changed from those used in previous years.

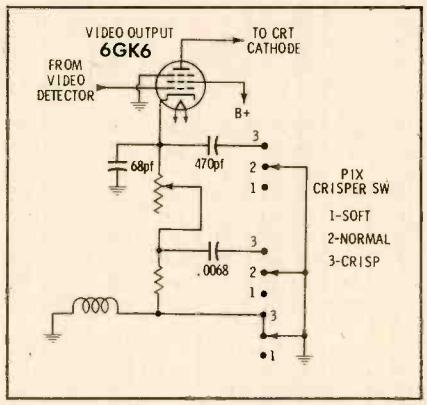
Chassis TV-16 and TV-17 are similar in that both are transformerless and use a 23FHP4 picture tube. However, TV-16 has only two video IF stages—a 4JD6 and a 4JC6 are used as the first and second video-IF amplifiers. TV-17 has three video-IF stages—it uses a 4BZ6, 5GM6, and 4JC6, in that order. Other tube differences are in the audio-output stage: a 12FX5 is used in TV-16, while a 6AQ5 serves the same purpose in TV-17. Both chassis use a 22JC6 as the horizontal output and a 17AY3 as the damper.

Some models using the TV-17 chassis are equipped with an "instant-on" circuit which supplies a reduced voltage to the tube filaments while the on-off switch is in the OFF position. The accompanying schematic shows how this circuit is arranged.



ELECTROHOME

A number of features highlight these five Canadian chassis used with 19" and 23" picture tubes. All are equipped with a swing-down vertical chassis which permits extensive troubleshooting without removing the chassis. Also, the majority of components can be substituted with the chassis in the lowered position. Other features include a full-wave bridge-rectifier circuit in the low-voltage power supply—all sets have a power transformer and use four silicons in the bridge rectifier circuit. Low-voltage protection is provided by a circuit breaker in series with the AC input. This breaker is preceded by a thermistor (17-ohm cold, 1.7 ohms hot) for added protection.



A four-stage solid-state video-IF strip is used throughout the entire line. PNP transistors in all four stages operate with a postive DC supply since the collectors are near DC ground potential. B+ dropping resistors are used to lower the 250-volt DC source to approximately 10 volts for the first three IF amplifiers and to 20 volts for the fourth IF stage.

Four controls are used in the vertical sweep circuit. Along with the HOLD and HEIGHT are linearity controls for shaping both the top and bottom of the picture.

A "spot-killer" switch is wired between B+ and one side of the brightness control. The switch opens when the receiver is turned off, removing DC voltage from the cathode of the picture tube and eliminating any lingering spot from the screen. Deluxe chassis 164TP has a "pix crisper" switch in the cathode circuit of the video-output tube. In the circuit diagram shown here the switch is in NORMAL position.

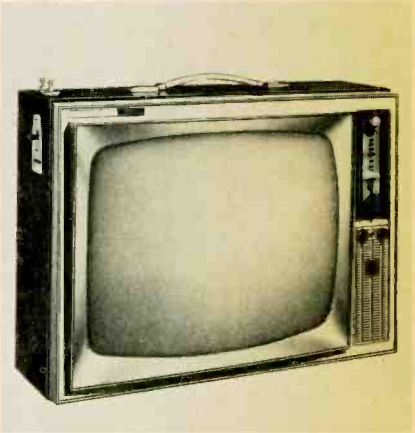
At present, all chassis are hand-wired; however, there is a good possibility that this manufacturer will switch to printed-circuit boards throughout the entire line before the end of 1966.

EMERSON

This year's line consists of 11", 12", 16", 19", and 21" receivers, using both tube- and transistor-type chassis. The biggest news is Model 11PO4A (shown here), a transistorized 11" portable. The only tubes found in this set are the 11JP4 picture tube and the 1X2B high-voltage rectifier. There are eighteen transistors on the main chassis board, three in the VHF tuner, and one in the UHF tuner.

The transistors function in the circuit in much the same manner as tubes do in tube-type receivers. Diodes are used as the damper, sound discriminator, horizontal AFC, and low-voltage power supply rectifiers. This power supply uses four diodes (two connected in each full-wave rectifier circuit) to develop four source voltages—three negative and one positive. A 1.2-amp fuse in series with the AC line provides protection in case of overload.

The AGC circuit employs an NPN transistor as AGC amplifier. Input signal to the base is varied by the AGC control. A LOCAL-DISTANT control is located on the antenna terminal board, but it functions independently of the AGC circuit. When the switch is in the local position, a 330-ohm resistor is placed in series with each side of the balanced 300-ohm line at the input to the tuner.



Model 12P50 is another portable, but this 12" set uses tubes. This receiver is electrically similary to other transformerless receivers. Several tube types in this one deserve comment. For example, a 17JZ8 serves as the vertical multivibrator/output, a 21GY5 is used as horizontal output, and a 17BR3 functions as the damper.

The remainder of the chassis shown in the large chart incorporate only minor modifications from those offered a year ago. A few new tube types are used, such as the 6LN8 sound IF amplifier/sync separator, 6LX8 AGC keyer/horizontal oscillator, 21KA6 horizontal output, and 20AQ3 damper.

GENERAL ELECTRIC

Three new chassis and four CRT sizes (12", 16", 19" and 23") are available for the coming year. 23" table models and consoles use the deluxe transformer-powered AB chassis. Compactrons are certainly in evidence throughout the entire '66 line. The AB

chassis has a single 6AR11 operating as the first and second video-IF amplifiers; a 6AF11 serves as video output/sound IF amplifier/sync separator. Audio detector/output functions are accomplished with a 6T10; and a 6B10 is the horizontal phase detector/multivibrator.

All 19" models use the DB chassis in which compactrons are even more numerous than in the AB. Seven tubes operate fifteen different stages. A 9BJ11 functions as first and second video-IF amplifiers; video amplifier/AGC keyer/sound IF amplifier operations are performed by a 14BL11; a 17BF11 is audio detector/output. For the sync-separator/vertical - multivibrator/vertical - output a 2329 is employed; an 8LT8 performs as horizontal phase detector/oscillator, and a 38HE7 serves as horizontal output/damper. The only single-purpose tube is the 1K3 high-voltage rectifier.

Receivers with 16" and 12" (pictured here) picture tubes use chassis SB which is quite similar to DB but uses several different tube types. For example, in the first and second video-IF stages an 11-BQ11 is used; a 33GY7 functions as hori-

zontal output/damper, and the high-voltage rectifier is a 1BC2.

All chassis use printed circuitry with practically all the small components mounted on the printed board. Chassis AB has two boards—the smaller board houses the sweep section, while the larger one consists of the video, sound, sync, and AGC circuits. DB and SB chassis use only one printed-circuit board.

MAGNAVOX

A 23" tube-type set and a 24" and 27" transistor console lead the field for Magnavox in 1966. Other models are available but contain only minor modifications of those introduced a year ago.

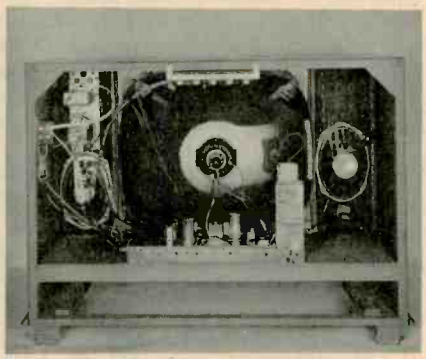
The tube-type receiver (T914 chassis) has a series filament string for its 16 tubes which include the VHF tuner and picture tube. 140 volts B+ is deve oped by a single silicon rectifier which is preceded by a 4.7-ohm, 5-watt wire-wound resistor (the only protective device in the power supply).

Some models using the T914 chassis incorporate the *Magnalux* circuit. This circuit varies brightness and contrast as room light changes. An LDR (light dependent resistor) which changes resistance according to variations in surrounding light controls DC voltage on the video-amplifier screen and on the picture-tube grid.

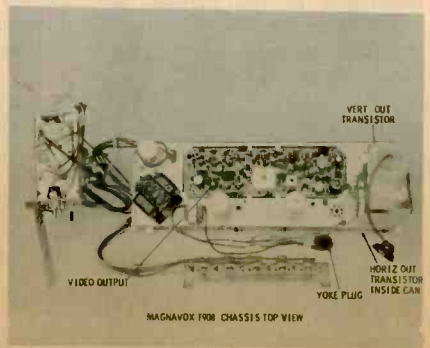
Magnavox is the first company to introduce a large-screen transistor receiver—chassis 1908. This chassis is used in the 24" and 27" models; the 27" picture tube is a 27ZP4, the 24" in a 24AHP4. With the exception of the CRT, the only tube used is the 1K3 high-voltage rectifier which supplies 18 kv to the anode of the CRT.

The total of 22 transistors includes three in the VHF tuner and UHF oscillator. In the main television chassis 18 transistors function in the following manner; three are used as video-IF amplifiers; and are followed by a video driver and the video output stages.

The sound section has a 4.5-mc IF amplifier, audio detector and driver, and single-ended audio output. AGC system consists of an AGC keyer(keyed in the



normal manner by a pulse from the horizontal output transformer) and AGC driver stages. AGC output is a positive DC voltage applied to the base of the second video-IF stage. Two transistors are used in the sync stages —one as a separator and the other as a splitter. Vertical sweep is obtained



from a blocking oscillator circuit followed by the driver and output stages. The horizontal blocking oscillator frequency is controlled by a pair of series-connected AFC diodes. The remainder of the horizontal circuit consists of the driver and output stages; a diode damper is used.

Input to the low-voltage power supply is 117 volts AC (the receiver cannot be operated by batteries). The power supply uses a power transformer and has a number of positive DC output voltages: 140, 110, 68, 14.5, and 12 volts. A circuit breaker between one side of the AC line and the primary winding of the power transformer provides protection. A separate 6.3-volt winding powers the picture-tube filament and pilot light.

MOTOROLA

This company has broadened its assortment of screen sizes, and now offers four different picture tube sizes in its 1966 line. The smallest of these is a 12" portable using the TS-454 chassis; other sizes use 19", 21", or 23" picture tubes. Only two chassis are new this year—TS-454 and TS-596. Other chassis are essentially modifications of previous models,

The TS-454 employs two horizontally mounted chassis boards and has eleven tubes (including the two used in the VHF tuner). Two of the tubes used are compactrons, a 17BF11 as sound detector/output and a 33GY7 as horizontal output/damper. The large printed-circuit board on the lower chassis contains the majority of small components. The upper chassis contains the filter capacitors, chokes, transformers, etc.

Chassis TS-596 is employed in 19" portables. This is a horizontally-mounted, hand-wired chassis containing 15 tubes; none are compactrons. There are some interesting tube types, however, such as the 21JV6 horizontal-output stage, 17BE3 damper, and 1S2 high-voltage rectifier. Five diodes are put to use in this chassis. One serves as the B+ rectifier (only one is necessary because the sweep-output tubes operate from a lowered B+ voltage). A germanium diode is used as the video detector; another diode is part of the vertical blanking network, and two others form the horizontal AFC circuit.

All this year's sets are equipped with a transistorized tuner, and pushbutton UHF tuning is provided on many models.

MUNTZ

Both new chassis have a power transformer and use a pair of silicon rectifiers connected in a fullwave rectifier arrangement. Chassis AS-5002 comes in the 19" portables, and AS-5003 is used in 23" consoles. These portables are available with a transistorized remote-

control unit and have a built-in monopole antenna.

Physically and electrically these chassis are quite similar; both have two vertically-mounted printed-circuit boards and the horizontal hand-wired portion of the chassis houses the low- and high-voltage power supplies and the horizontal-output section.

Chassis AS-5003 may use either a single tube (12HE7) as horizontal output and damper or use individual tubes for each function (2 6GT5 in the output stage and a 6AY3 as damper). Both chassis use a link for filament protection; a 2-amp fuse provides line protection for the AS-5002, while the AS-5003 uses a circuit breaker.

OLYMPIC

Three 23" consoles and a 23" TV-radio-phonograph combination using the NCP chassis are this company's latest introductions. All the other receivers have been introduced earlier as this company's "Models of the Month."

Physically, the new NCP chassis is virtually the same as those used previously. However some new tube types are being employed. The video output/sound-IF amplifier is a 15BD11 followed by a 17BF11 sound detector/output. A 17JZ8 functions as vertical multivibrator/output, and a 21JZ6 is used in the horizontal output stage. The damper is a novar 17BE3. For the AGC keyer, a 4AV6 triode is used, and the AGC control is part of its cathode circuit.

Resistor-capacitor packaged circuits are quite popular throughout the chassis. One is used in the sync-separator grid circuit; another serves as the vertical integrator; a third functions as the horizontal-AFC network; and the remaining two are used in the horizontal oscillator and output grid circuits.

B+ is derived from a single silicon rectifier. Power-supply protective devices include a circuit breaker and 5.5-ohm fusible resistor. The circuit breaker is in series with one side of the AC line and protects the series filament string. A 5.5-ohm resistor precedes the silicon diode and protects the B+ line.

PACKARD BELL

Four different chassis are being used in the new receivers. The 88-16 is being carried over from the 1965 models and the new chassis 88-16C differs only slightly from the 88-16. In the C version, differences are: use of a different tuner, absence of a picture-fidelity control, substitution of an illuminated dial for a computer dial, and absence of remote control adaptability. The 16 and 16C chassis are used with 23" picture tubes.

19" portables use either the transformer-powered 88-19 chassis or the series-filament 88-18C. Some models using the 88-19 chassis have the computer-type dial; some are equipped with remote control; and still others have a timer, which allows the customer to set times (up to three hours) for the receiver to turn off or on. The 88-19 is a vertically mounted hand-wired chassis and uses the same tube lineup as does the 88-16.

Chassis 88-18C is also vertically mounted but uses both hand wiring and printed-circuit boards. Two printed boards are used; one contains the video-IF and output stages, while the other consists of the sound-IF and output circuits. To our knowledge, this is the first time this company has used printed boards in its TV receivers. The circuitry in this tranformerless receiver is much the same as that found in sets using a power transformer. However, with a series-filament string, different tube types are necessary. In most cases, these tubes differ only in the filament-voltage requirements; one exception is the 12AL11 (compactron) used as the AGC keyer/audio output.

PHILCO

Three new Philco chassis have been introduced this year. Two of these are simply modifications of the ones used a year ago. Circuitry and tube complement is basically the same. The warmed-over 16J27 chassis is used in 19" compact models, and the other, the 16N35, is found in 23" table models and consoles. Both these chassis have the same tube lineup used in last year's 15J20 and 15J27 chassis.

An entirely new chassis, the 16J26 (A), is used in Philco's line of 19" portables. This chassis could be classified as a hybrid—it uses both tubes and transistors. Five transistors are employed, three of them in the video-IF stages.

Two transistors make up the AGC circuit (one as the AGC gate and the other as the AGC amplifier). This transistorized AGC circuit operates in much the same manner as an AGC keyer found in tube-type receivers. A video signal from the plate of the video output tube is applied to the base of the AGC gate, and a low-level keying pulse from the flyback is applied to the emitter of the same transistor. Conduction of the gate transistor is determined by the amplitude of the video signal. When the gate conducts, a positive voltage is developed at the emitter and applied to the base of the AGC amplifier, controlling the gain of the RF and first video-IF amplifiers.

Aside from the usage of these transistors, the circuits in this chassis are quite conventional. Some different tube types, however, are used; for example, a 17BZ3 operates as the damper, a 10BQ5 as audio output, and a 21J26 serves as the horizontal output.

RCA

Many of the chassis used last year are continued in this year's models with only minor modifications. Also three completely new chassis have been added. Two are tube-type (KCS154 and KCS 155) and one is transistorized (KCS153). All chassis except the KCS152 use new VHF tuners in which a 13-position wafer switch is used for the antenna, RF, and mixer sections—while the oscillator uses a turret (rotating-drum) system with individual coils for each channel.

Many new tube types are used in both the old and new chassis. The KCS152 and KCS155 chassis use an 11LQ8 as video output/AGC amplifier; a 15KY8 serves as vertical multivibrator/output; a 17BS3 functions as the damper; and the horizontal-output stage has a 22JU6. A 22JF6 performs as horizontal output in Chassis KCS154.

The KCS155 chassis has a power transformer but employs a series-filament string. AC voltage is applied to a tap on the autotransformer. One side of the transformer is connected to ground and the other side ties to the circuit breaker in series with the single silicon rectifier. The filament circuit is connected directly to one side of the AC line.

The chassis photo of the all-new 12" transistor portable using Chassis KCS153 compares its size to that of a tube-type receiver. A total of 27 transistors are employed including the four used in the UHF and VHF tuners. Although transistors are used throughout (except for the 2BJ2 high-voltage rectifier), the circuits operate in much the same way as in tube receivers. The video IF section uses three transistors as IF amplifiers; single transistors are used in the video amplifier and output stages. The sound section has two IF amplifiers followed by a ratio detector, driver and single-ended output. Single-stage circuits are used for the AGC, noise canceller, and sync separator. The vertical sweep circuit has four transistors functioning as: oscillator, buffer, driver, and output. A phase splitter, oscillator, driver, and output are used in the horizontal

section. The horizontal-output transistor is protected against excessive current by another transistor in a current-limiting circuit. Rounding out the transistor complement are the power-supply regulating units which supply nearly ripple-free DC voltage.

SEARS/SILVERTONE

Eight different chassis are used in the new line; five of these are assembled in this country and three (chassis with a 562 prefix) are imported. Three different American-made chassis are used in 19" receivers and two are used in the 23" models. Of the imported sets, two are tube-type and one uses transistors.

Chassis 528.61620 has some rather interesting circuit features. In the sound section a 12BA6 is used as the IF amplifier. The triode section of a 12AV6 is the audio amplifier, the diode section functions as half of the ratio detector, and a germanium diode is the other half of the ratio detector. A 50C5 is used in the audio-output stage. These three tubes, along with another 12AV6 used as the sync separator, are connected in an individual series filament string—all have a filament current rating of 150 ma. The remainder of the tubes receive filament voltage from a series 450-ma string.

Also, this .61620 chassis uses an NPN transistor as a noise gate. Video from the video detector is applied to the base of the transistor; the emitter is grounded and the collector is tied to the cathode of the sync separator. Thus, the sync separator is cut off by the noise gate whenever noise pulses are present in the video signal.

Chassis 528.61680, 528.70000, and 528.70120 are similar to the one just described except that they don't have a noise gate nor do they use a tube in the AGC circuit. 528.61720 is basically the same as .61620 but uses a 23" picture tube and has two silicon rectifiers in the power supply.

Chassis 562.10120 is completely transistorized except for the three 1D-K29 tubes used in the high-voltage rectifier circuit. This receiver will operate on either an AC or DC power source. The power-supply uses a bridge rectifier to develop the DC voltage when the set is operated from 117 volts AC. Circuitry is quite similar to that found in other imported transistor receivers.

SPARTON OF CANADA

The hand-wired 19P1 chassis is used in 19" portables. These sets are equipped with a built-in dipole antenna and earphone jack. The chassis uses 16 tubes including the VHF tuner and picture tube. A dual-selenium diode is used for horizontal AFC and two silicon rectifiers develop the B+ voltage.

The deluxe models (one is shown here) use the horizontally mounted 23P2 hand-wired chassis, equipped with a power transformer and circuit breaker. Silicon diodes are used as B+ rectifiers.

A transformerless chassis 23P3 is also available in some 23" sets The circuitry in this chassis is similar to that in the 23P3 except for the low-voltage power supply.

SYLVANIA

Two 19" tube-type, one 23" tube-type, plus one 19", and one 12" transistor chassis are found in this company's new line.

Both 19" tube-type receivers use a bonded picture tube and have a series-filament string. The horizontally mounted chassis has one large printed-circuit board with practically all the components, except the high- and low-voltage power supplies, mounted on the board.

The deluxe transformer-powered B04 chassis is used with 23" picture tubes. Some models are equipped with "Halo-Lite," a feature not unfamiliar in this company's earlier receivers. This chassis used a 5BC3 as the low-voltage rectifier, and to our knowledge in the only 1966 chassis using a tube in the low-voltage power supply. Again this year, a transistor noise gate is used in the cathode circuit of the sync separator tube in all three chassis.

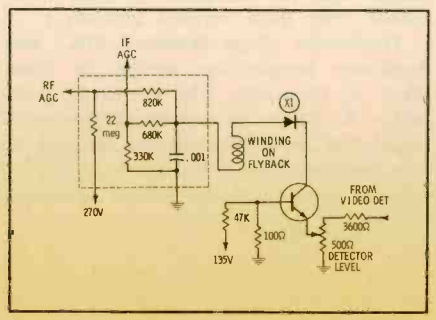
The 19" transistor receiver uses the AO1 chassis and has 23 transistors, and 2 tubes—the 1K3 high-voltage rectifier and 19CAVP4 picture tube. These receivers operate from 117 volts AC and use three silicon rectifiers in the power supply; two of the rectifiers supply positive 38 volts, and the third is used for the positive 135-volt supply. Two circuit breakers—one in series with one side of the AC line and the other in series with the positive 38-volt source—are used for protection against overload.

The 12" transistor, chassis AO2, operates from either AC or DC. It has 20 transistors and 2 tubes (a 1X2B high-voltage rectifier and 12BGP4 picture tube).

WELLS-GARDNER

Four general categories, including eleven different chassis with 12", 19", and 23" picture tubes, complete this private-label manufacturer's new line

A power transformer is used in deluxe chassis T14 and T22. Two silicon rectifiers, connected as a fullwave rectifier, supply B+. A circuit breaker is incorporated at the secondary winding of the transformer, from center tap to ground.



The T14 chassis has a "Quick-on" feature; the filaments receive reduced power when the receiver is turned off. Filament power can be disabled entirely, by turning the VACATION switch to the off position. These receivers are built with a horizontal chassis using two printed-circuit boards. The two-stage video-IF strip uses high-gain frame-grid tubes. A 6JD6 first video-IF amplifier is followed by a 6JC6 for the second stage.

A new AGC circuit using a transistor is found in the 19" and 23" models. This circuit is shown in the accompanying diagram. The detector level (AGC) control determines the amount of video signal applied to the emitter of the NPN transistor. Operation of this circuit is similar to keyed AGC circuits used in tube-type receivers.

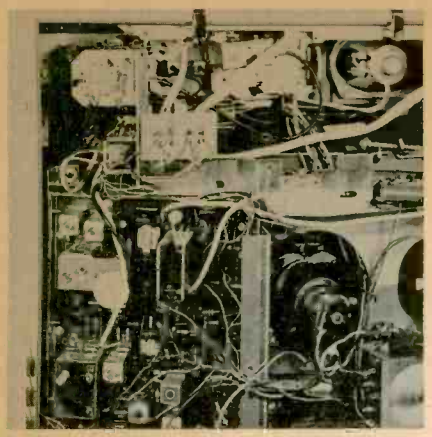
The 12" personal portable using the TO5 chassis is a transformerless receiver. It develops B+ with a single silicon rectifier. Overload protection is provided by a 4.7-ohm fusible resistor. Noteworthy tubes include the 17CU5 audio output, 17JZ8 vertical multivibrator/output. The horizontal output and damper are contained in the envelope of a 33GY7.

WESTINGHOUSE

New tube types, along with some other features, are found in this manufacturer's new line of receivers. However, the big news in an entirely new receiver called the *Jet Set*. Overall front and rear views and a rear shot of the printed board are shown in the accompanying photos. This 19" portable is transistorized, except for the 1K3 high-voltage rectifier, and has a changed appearance. The 114° 19CM-P4A picture tube is covered by a no-glare safety shield.

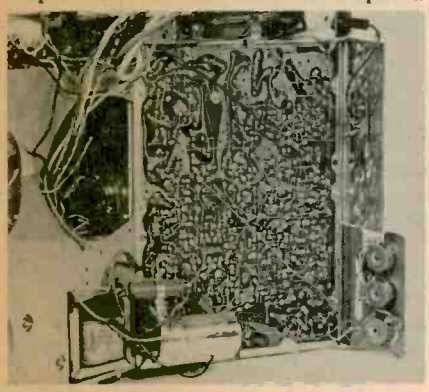
Chassis V-2486 is used in both 19" and 23" models— the 19" uses a bonded 19FEP4A picture tube and the 23" uses another bonded tube, a 23HRP4 Some models are equipped with the "Instant-on" feature and have a black-glass safety shield. The new tube types in this chassis are a 10LZ8 used as video amplifier/sync separator and the 21JZ6 horizontal output.

Both 19" and 23" models using the V-2487 chassis are available with bonded CRT's or safety glasses. These sets also



incorporate the Instant-on feature. The vertical output stage has a new tube—type 6HR5; this chassis also uses the 21JZ6 in the horizontal output stage.

The 12" portable uses the transformerless V-2490 chassis, which incorporates several noteworthy tube types. For example: the audio stage has a 17CU5; the video amplifier/sync separator is a 10LZ8; and the damper and horizontal output are in the same envelope—a



33GY7. Width is adjusted by grounding or ungrounding the lead emerging from the left-hand side of the high-voltage enclosure. (Maximum width is obtained with the lead grounded.)

A carryover from previous years in the V-2486 and V-2490 chassis is the manner in which the AGC is adjusted: a trimmer capacitor controls the keying pulse amplitude to the AGC tube.

Chassis V-2483 employs 27 transistors including three in the VHF- and one in the UHF-tuner circuits. Three are used as video-IF amplifiers; three more as video amplifier/output; the sound section has two IF amplifiers, a driver, and an output; individual transistors are used for AGC and noise canceller functions; the vertical circuit employs three transistors as ocillator, driver, and output; in the horizontal circuits there is an AFC amplifier, an oscillator, a driver, and an output; the remaining three are located in the regulated DC power supply There are 23 diodes used throughout the receiver.

The regulated power supply develops the three B+ source voltages—240 volts, 60 volts, and 12 volts. There are two fuses in the power supply: a 1¼-amp slo-blo in the AC line; and a 1-amp in the 60-volt DC circuit. This receiver has a built-in dipole antenna and a VHF-UHF matching network. Provision is also made for connecting an external VHF or UHF antenna.

ZENITH

Six new chassis are being offered for the coming year, but major attention is focused on only one of these—the hand-wired 12" transistor model. The five new tube-type receivers include four 19" portables and one 21" portable.

The 21" version (Chassis 14N26) and two of the 19" (Chassis 14N32 and 14N34) are equipped with a power transformer; also, a factory-installed remote control unit is available with the N26 and N34 chassis. Two transformerless 19" receivers (Chassis 14N29 and 14N31) are physically similar to the ones with a power transformer, but the tubes used are less conventional.

The 12" solid-state receiver, *Royal* 1290 (shown here), can be operated on either 117 volts AC or from any suitable 12-volt DC source. The CRT used in the IM30T20 chassis is a 12BRP4 with 92° deflection. Thirty transistors are used in this completely solid-state receiver—the only vacuum tube is the CRT. A number of diodes are found throughout the receiver; this includes one as a high-voltage rectifier to develop 12 kv for the CRT anode.

The 40-mc video-IF strip consists of four individual stages. Output from the video detector is applied to a video driver, then coupled to the video output stage. At the collector of the video output transistor, the signal is divided and applied to the sound IF, AGC, and sync sections, and to the cathode of the CRT.

Output of the single-stage sound-IF section is applied to the ratio detector. Audio signal from the ratio detector is coupled to the base of a common-emitter audio amplifier which is followed by a paraphase amplifier. The outputs are coupled through 10-mfd electrolytics to the base of the push-pull output transistors.

The vertical sweep circuit uses three transistors—one as a vertical blocking oscillator, another as driver, and the last as output. Along with the controls normally used in the vertical circuit, this receiver also has a vertical bias control. (It shouldn't require adjustment unless the output transistor is replaced. If it is necessary, adjust it for .6 volt on the emitter of the vertical output transistor; this setting must also be consistent with good vertical linearity.)

Horizontal phase detector, AFC, and oscillator circuits are similar to those used in tube sets. The oscillator transistor functions as a normal sine-wave oscillator; the oscillator coil is used as the horizontal hold. Oscillator output is applied to a horizontal driver; its output is transformer-coupled to the base of the output stage.

The negative 12-volt output of the power supply is derived from a bridge

rectifier circuit and kept constant by a three-transistor series regulator network. Protective networks include a circuit breaker in the AC line and a 2-amp fuse in the DC output. DC input from the battery is also fused by another 2-amp fuse.

The optional battery pack (B129) consits of two Z600 rechargeable batteries—each is a 6-volt unit. The batteries are charged automatically when the receiver is connected to the AC line and the on-off switch is in the OFF position.

OTHER U. S. BRANDS

Editor's Note: Complete information from these companies hadn't been received by press time. Here's what we know about them.

Andrea will maintain part of last year's chassis and offer them again this year; they will have a rectangular 25" color receiver, too.

Hoffman will build a line of '66 receivers to be marketed under their own brand name.

Setchell Carlson will continue to market its '65 line of black-and-white receivers for the coming year.

Sonora will feature a line of 19" portables and a few 23" consoles.

FROM JAPAN

Aiwa is offering an 11" tube-type portable which is carried over from their 1965 line.

Delmonico has a rather complete line for this year; it consists of a 4" transistor, 9" transistor, 12" tube-type, 19" tube-type, and a number of 23" combinations.

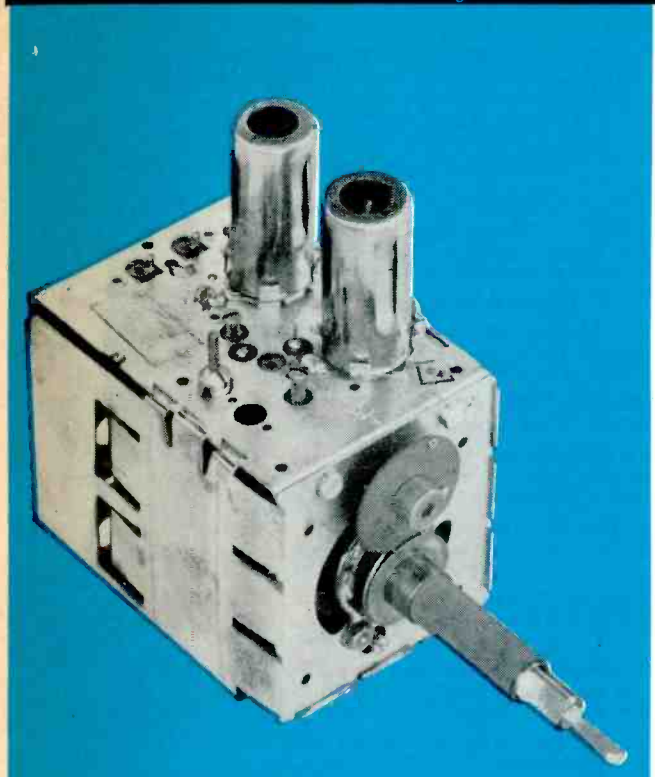
Hitachi's '66 line will consist of a 16" tube-operated receiver, a 12" transistor, and a 5" transistor.

Panasonic by Matsushita additions include 9" transistor, 12" transistor, 19" transistor, and a 19" tube-type.

Sharp has three personal portables in its new line. The two tube-type receivers have 12" and 16" picture tubes; the transistorized set is a 6" model which uses 27 transistors and 3 tubes; it operates from either an AC or DC power source.

Sony's new line consists of three transistorized receivers. Along with their 5" set is a 9" and a 4".

TUNER REPAIRS



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FOR COMPLETE OVERHAUL

Includes ALL parts (except tubes)
ALL labor on ALL makes

24-HOUR SERVICE with FULL YEAR WARRANTY

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Circle 2 on literature card

A HOWARD W. SAMS PUBLICATION

PF Reporter™

PHOTOFACT

the magazine of electronic servicing

VOLUME 15, No. 10 OCTOBER, 1965

CONTENTS

ABOUT THE COVER

Our cover this month portrays only five of the many receivers being offered for the coming year. For an inside tour of these and the entire 1966 line of black-and-white TV sets, turn to our 8-page book section beginning on page 1.

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editor
Forest H. Belt

managing editor
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ass't to the editor
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associate editors
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photography
Paul Cornelius, Jr.

advertising sales offices
Hugh Wallace, advertising sales manager

midwestern
Paul N. Houston
PF REPORTER, 4300 West 62nd Street, Indianapolis, Ind., AXminster 1-3100

eastern
Gregory C. Masefeld
Howard W. Sams & Co., Inc. 3 West 57th Street, New York, N. Y., MUrray Hill 8-6350

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C. H. (Jake) Stockwell
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Indexed in Lectrodex.
Printed by the Waldemar Press Div. of Howard W. Sams & Co., Inc.

Have you tried KWIKETTE* connectors?

Not just another wire spring connector!

The 3-in-1 KWIKETTE is brand new and different... Copperweld wire inner core, a layer of flux, and an outer jacket of solder . . . all you need is heat!

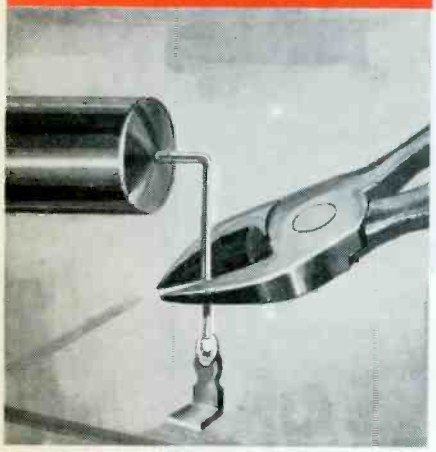
Makes one-handed soldering possible!

Ten times actual size

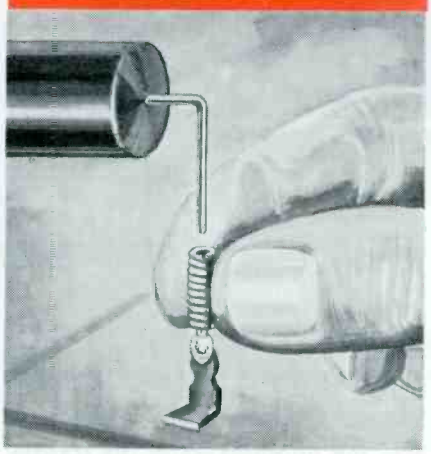
Once again, Sprague helps the TV-radio service industry by solving two increasingly serious problems . . . parts replacement in those "inaccessible" chassis nooks, such as crowded tube sockets, as well as soldering onto the delicate circuitry of printed wiring boards.

Mechanically sturdy and electrically reliable, the revolutionary KWIKETTE provides fast, expertly-soldered connections as easy as A-B-C!

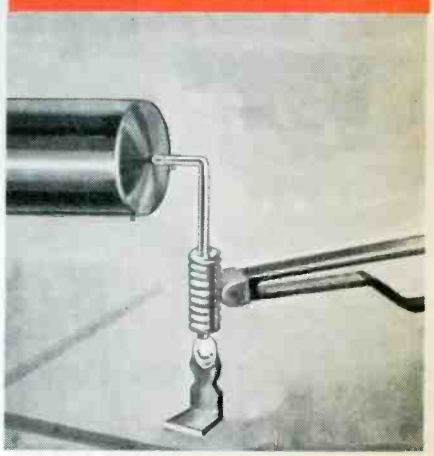
A Snip Lead



B Slip on KWIKETTE



C Apply Heat, Connection Made!



NOBODY ELSE HAS KWIKETTE CONNECTORS... YOU GET 'EM ONLY FROM SPRAGUE PRODUCTS!

KWIKETTES are now being packed with Sprague Atom® Capacitors *at no extra cost to you!* Whenever you need tubular electrolytics, insist on pre-packaged Sprague Atoms from your parts distributor and you'll automatically get your KWIKETTE component connectors . . . the biggest boon to the service technician since the soldering gun!

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SPRAGUE®
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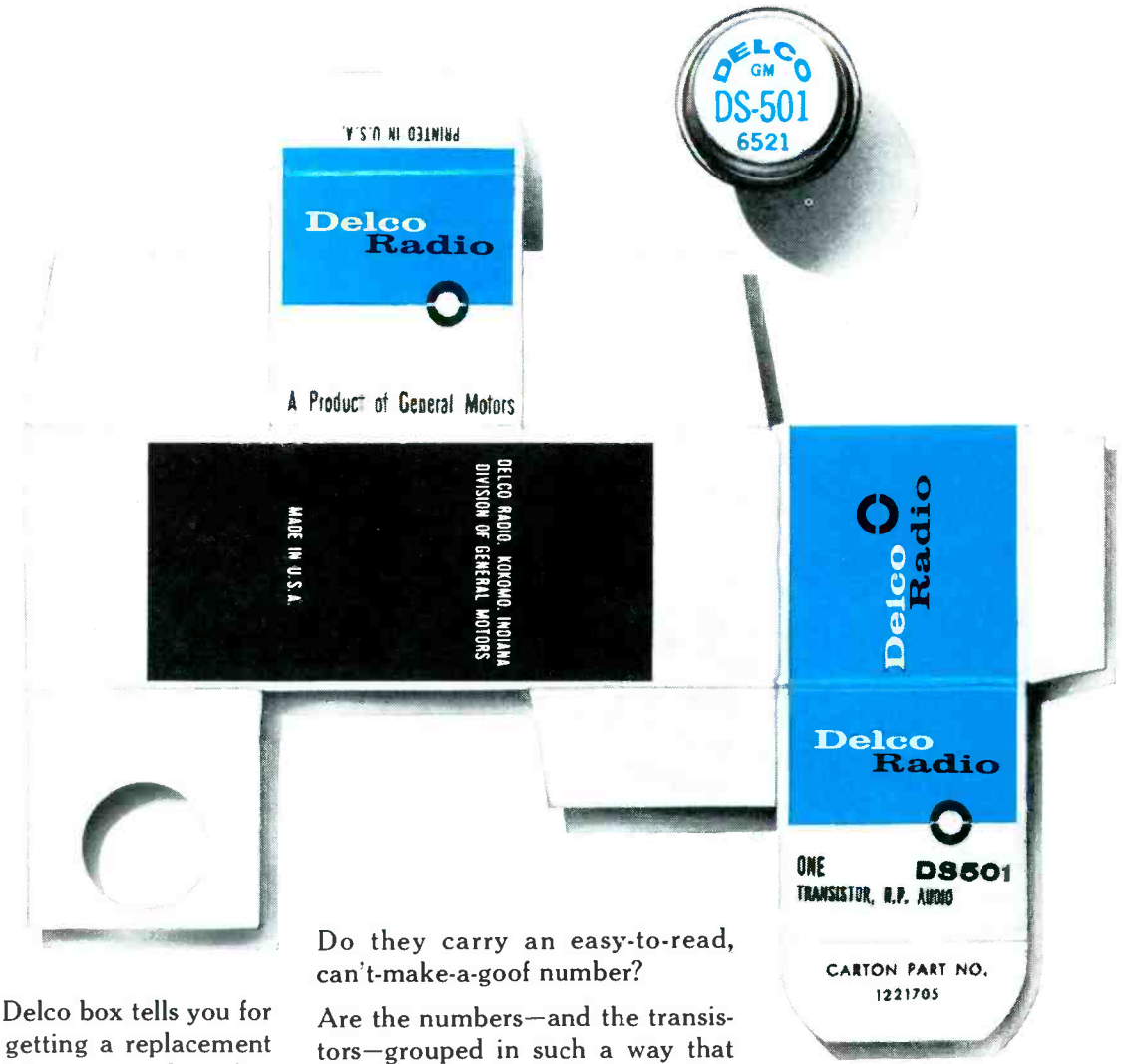
WORLD'S LARGEST MANUFACTURER OF CAPACITORS

65 4104 R1

Circle 3 on literature card

The cover gives you the whole story.



The United Delco box tells you for sure you're getting a replacement radio part of the same high quality as the original.

And it tells you who authored it, too. Namely, Delco Radio.

So, if you'd like to hang on to your reputation and customer goodwill, just ask yourself this next time you order transistors:

Do they come individually packed in a distinctive box? (Bushel buying is for potatoes, not transistors.)

Do they carry an easy-to-read, can't-make-a-goof number?

Are the numbers—and the transistors—grouped in such a way that you can service more car radios with fewer parts?

Is there a good chance that the parts are original equipment on nearly half of the car radios on the road?

Delco Radio transistors are all of these, and you can get them from your United Delco supplier. He handles the most widely advertised, merchandised and recognized name in the parts business—United Delco.

That's how your customers know a good part when they see it.

United Delco

DELCO RADIO, Div. of General Motors, Kokomo, Ind.

Circle 4 on literature card

Letters to the Editor

Dear Editor:

I would like to applaud the series of articles on square-wave testing. On the strength of the material presented, I have upgraded myself to a high-quality square-wave generator; used with a Hickok 770 scope, it shows most of the effects described in the "Advanced Service Techniques" articles. Unfortunately, a 30-mc scope is a bit beyond my budget (and needs) at the moment, but the day is coming when it will be an essential part of the equipment in any good shop.

If you'll pardon my reminiscing, it sounds very much like the days of 1935, when we were debating whether it would be wise to take the plunge and buy a scope (I did). Or about 1939, when a signal tracer became the last word in test equipment; I went for that one, too, and was never sorry.

In each case, I found that I had taken a great step forward. I feel the methods described in your new series (methods which have been used for ten years in certain fields) will be the next major step forward in rapid servicing methods.

FRANCIS C. WOLVEN

Saugerties, N.Y.

In initiating this series, Francis, we indulged in a bit of reminiscing, too. There was a period, up to as recently as three or four years ago, when it was difficult to convince many service technicians that they needed a scope of any kind. Finally, after years of teaching and dozens of articles, PF REPORTER *got the message across, and our mail now indicates that competent service shops include a good scope in their lineup of test equipment. Our SYMFACT feature, introduced in September 1962, helped clinch the need for a scope; SYMFACT has proved once and for all that some symptoms simply do not cause any noticeable change in DC voltages. In these days of tough competition, it is business suicide to try to repair television sets without a scope; you can't afford the time for cut-and-try methods.*

"Advanced Service Techniques" is a bit ahead of its time, we admit, but this is our way of helping serious technicians meet the changing technology that is so rapidly catching up with them.—Ed.

Dear Editor:

After reading Steve P. Dow's article "Keep It Clean" in the August 1965 issue, I thought I'd better send you some good safety advice. Mr. Dow mentions carbon tetrachloride ten times in cleaning phono and tape-recorder parts, and only once did he suggest that the technician "avoid breathing" this dangerous killer. You should pass along to your readers the contents of the National Safety Council booklet "Strange Killer."

MELVIN T. HYATT

Prairie Village, Kans.

You are so right, Melvin. The booklet points out that: "Carbon tet is one of the most toxic household substances known . . . It can be absorbed directly through the skin . . . Its most vicious hazard is its vapor, which a person can innocently inhale, a vapor more poisonous than chloroform . . . Only three thimblefuls of carbon tet will saturate the air to the danger point in a room 10′ x 10′ x 10′ . . . Safety and medical authorities say no one should ever use carbon tet in the home (or in the shop—Ed.) . . . Carbon tet in a glass bottle, if the bottle broke, could turn a room into a lethal gas chamber . . . Opening a couple of windows isn't "adequate" ventilation . . . The only safe place to use carbon tet is outdoors, with a stiff breeze blowing away the vapor. . . ." If you want the booklet, it is Stock No. 580.01 at the National Safety Council, Chicago 60611.

Seems like enough said. There are other less toxic substitutes on the market: perchlorethylene, trichlorethylene, methyl chloroform, and trichlorethane; all have cleaning powers similar to carbon tet. After all the years we've avoided carbon tetrachloride—cleaning hundreds of phono and tape-recorder mechanisms with safe, simple isopropyl (rubbing) alcohol—we'd strongly recommend that all our readers do the same.—Ed.

Dear Editor:

I took two years of your magazine, ending in 1960, and since then tried another well-known American publication. Looking back over my old copies of PF REPORTER, I'm completely convinced on one thing: in the TV service field, your magazine is easily the most informative and helpful to be found anywhere in the world. I would like to restart my subscription immediately.

GEORGE PETERSEN

Ayr, Australia

Music to our ears, George. The science of electronics troubleshooting apparent-

ly knows no national boundaries, for we've been getting letters like this from several other countries.—Ed.

Dear Editor:

I have been reading your wonderful publication for many years, and let me say here and now that no other publication on this green earth could hope to equal it. You have been pounding electronics into our heads these many years in such a simple, down-to-earth way that even an idiot can understand it . . . I know one who can. Your staff really knows their stuff and they know how to write for the technician.

BUT, for some, even this great writing and simplification doesn't hit home. When "servicemen" have to resort to changing parts without knowing whether they are faulty or not—they simply don't know what they are doing. If a set owner knew his set was in that sort of hands, he would run seven miles if need be to rescue it; and who could blame him!

I'm no expert, but I believe in using my head in servicing. I'm enclosing a pair of problems I'll bet half your readers can't find the solutions to. Want to let them try?

NAME WITHHELD

City, Too.

This is our month for bouquets. My friend you're on! Here, readers, are the problems:

(1) There are 46 components in an RC amplifier. If there are 12 more resistors than there are capacitors, what is the number of capacitors?

(2) A technician can wire a stereo amplifier in 3 hours. His helper can wire it in 4 hours. How long will it take them to wire it, working together?

Readers, is he right? You can solve them, can't you? The solutions are on page 102—Ed. ▲

"Remind me to notify" "PF REPORTER" of my address change."

The Electronic Scanner

news of the servicing industry

Study Shows Service Profits Up

Net income from appliance-radio-TV service operations jumped 54% in 1964 as compared with the previous year, according to a survey conducted by the **National Appliance & Radio-TV Dealers Association** among its members. Total net profit before taxes in 1964 was 5.89% of sales, while in 1963 this same profit figure was 3.81%. The improved profit apparently

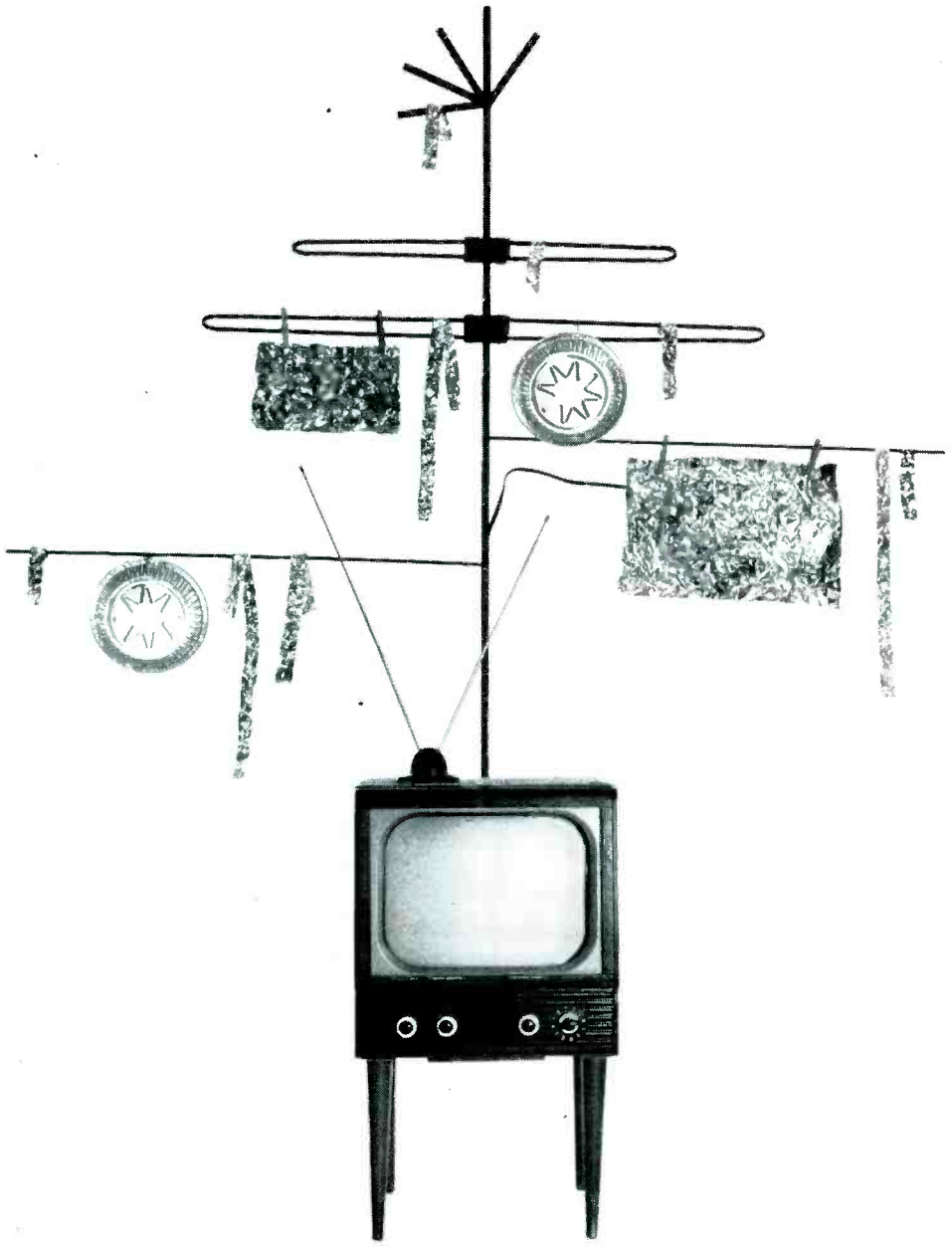
1964 OPERATING COST AND PROFIT RATIOS

Line No.	Item	Ratios(%)
1	Gross Sales	100.00
2	Returns, Adjustments, Allowances	0.00
3	Net Sales (Line 1 minus Line 2) (Includes: Parts, Labor, and Merchandise)	100.00
4	Cost of Parts and Labor Sold	57.67
5	Gross Margin (Line 3 minus Line 4)	42.33
6	Total Operating Costs (1 thru 15, below)	39.42
	(1) Proprietors/Partners/Executive Salaries	11.68
	(2) Other Payroll (Office Salaries, Wages, Commissions, Bonuses)	5.10
	(3) All Payroll Taxes	2.10
	(4) Other Taxes (except income) and Licenses	0.43
	(5) Occupancy Expense (Rent, Utilities & Heat, Maintenance	3.31
	(6) Advertising, Promotion, Publicity	1.67
	(7) Truck and Auto Expense (excluding depreciation)	4.63
	(8) All Depreciation (including Vehicle Depreciation)	2.96
	(9) Office Supplies, Stores, Postage	1.27
	(10)Telephone and Telegraph	1.20
	(11)Accounting and Legal	0.55
	(12)Travel and Entertainment	0.26
	(13)Dues, Donations, Collection Expense, Miscellaneous	0.98
	(14)Insurance (Employees and general)	1.80
	(15)Other Shop and Service Expense	1.48
7	Net Operating Profit (Line 5 minus Line 6)	2.91
8	Other Income (Bad Debt Recoveries, Interest Income, Other)	4.78
9	Total Income (Line 7 plus Line 8)	7.69
10	Other Expense (Bad Debt Loss or Provision, Interest Paid, Other)	1.80
11	Total Net Profit Before Income Taxes (Line 9 minus Line 10)	5.89
12	Federal and State Income Taxes	1.26
13	Net Income after Income Taxes (Line 11 minus Line 12)	4.63

stems from the fact that gross margins are up, because operating costs are also up. In 1964, the gross margin was 42.33% compared to 37.35% in 1963. However, operating costs took a big bite out of this increase; the 1963 figure was 36.07%, but in 1964 it rose to 39.42%. A rather interesting picture of the service business is reflected by these figures: The cost of parts and labor, measured as a per cent of total volume, is down; inasmuch as actual dollar costs of both parts and labor have been going up rather than down, the apparent conclusion is that service shops have been pricing their work more realistically than in the past. The chart shows tabulations of cost and profit ratios among NARDA members surveyed.

International Expansion

A major international expansion move by **BSR Limited** includes the construction of a greatly expanded facility in the United States. The new home is now under construction on an 18-acre site in Blauvelt, Rockland County, New York. Execu-



aerial view: do-it-yourself style

He's going to need a real antenna. So he'll be looking in the Yellow Pages. The chances are 9 in 10 he'll then take action. Will he see your ad?

When his wife sees his creation, this man will be joining the 21 million people who turn to the radio, television, and high fidelity headings of the Yellow Pages every year. (That's 33% of the entire market!)

When he does look in the Yellow Pages, chances are 9 in 10 he'll either call, write, or visit. (Every 100 references to the radio, television, and high fidelity headings of the Yellow Pages bring 93 calls, letters, or visits!)

That's action! With Yellow Pages ads you can expect that kind of action . . . a recent extensive national usage study — consisting of over 19,000 interviews—proved it.

Call your Yellow Pages man. He'll show you what the study learned about your business. And he'll be glad to help you plan your own Yellow Pages program. You'll find him in the Yellow Pages under "Advertising — Directory & Guide."

Advertise for action... **Yellow Pages**

Circle 8 on literature card

Congress DIDN'T GO FAR ENOUGH!

PUBLIC LAW 87–529; 76 STAT. 150

[H. R. 8031]

An Act to amend the Communications Act of 1934 in order to give the Federal Communications Commission certain regulatory authority over television receiving apparatus.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That:

Section 303 of the Communications Act of 1934 (47 U.S.C. 303)[34] is amended by inserting at the end thereof the following:

"(s) Having authority to require that apparatus designed to receive television pictures broadcast simultaneously with sound be capable of adequately receiving all frequencies allocated by the Commission to television broadcasting when such apparatus is shipped in interstate commerce, or is imported from any foreign country into the United States, for sale or resale to the public."

Sec. 2. Part I of title III of the Communications Act of 1934 is amended by inserting at the end thereof a new section as follows:

THEY SHOULD HAVE ALSO REQUIRED...

"—that all 82-channel television receivers* must use an 82-channel television antenna."

Of course, you can't take the law into your own hands—but you *can* take advantage of today's ready-made opportunities to sell an 82-channel antenna with each 82-channel TV set.

Our Antenna Research Laboratories in Champaign, Illinois knew what they were doing when they teamed the acclaimed Log Periodic concept of the University of Illinois Antenna Research Laboratories with our new antenna design advance—the capacitor-coupled electronic dipole. Proof is the fact that the JFD LPV-VU is America's No. 1 82-channel TV/FM antenna!

Who says you can't have everything you want in a TV antenna—VHF?... UHF?... FM Stereo?—with a *single* down-lead to boot!

MOST EFFICIENT PERFORMANCE EVER ON VHF, UHF, FM/STEREO FROM *ONE* ANTENNA USING *ONE* DOWN-LEAD!

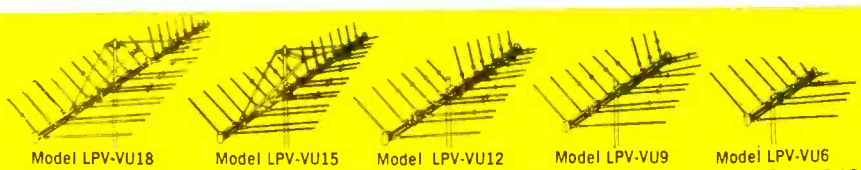
- *Cap-electronic* dipole design makes more elements resonate on channels 7 to 13 with a corresponding increase in gain.
- *Higher mode* operation in UHF band achieves higher gain on channels 14 to 83—and FM stereo.
- *Narrower* beamwidths . . . higher front-to-back ratios step up ghost rejection . . . intensify color.
- *Patented frequency independent* design maintains peak performance characteristics regardless of channel or band tuned.
- Includes 3-way splitter so single down-lead can be tied into individual VHF, UHF and FM system inputs.

REMEMBER — AN 82-CHANNEL TV SET IS NOT AN 82-CHANNEL TV RECEIVER UNLESS IT HAS AN 82-CHANNEL TV *ANTENNA!*

*Lest we forget—every *color* set is also an *82-channel* set requiring a color-perfect antenna. In fact, many color TV shows are broadcast on UHF channels.

JFD

SEE YOUR DISTRIBUTOR OR WRITE FOR BROCHURE 806



Model LPV-VU18 Model LPV-VU15 Model LPV-VU12 Model LPV-VU9 Model LPV-VU6

JFD LPV-VU LOG PERIODICS for channels 2 to 83 and FM/Stereo.

JFD ELECTRONICS CORPORATION
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JFD Electronics-Southern Inc.
Oxford, North Carolina
JFD International
64-14 Woodside Ave., Woodside 77, N.Y.
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Circle 9 on literature card

Brighter, Smaller Picture Tubes

Improved phosphors, including a Europium red "rare earth" phosphor, are now being used in all **Radio Corporation of America** color-television picture tubes to provide brighter and more vivid pictures. The company has completed the conversion of facilities at plants in Lancaster, Pa., and Marion, Ind., for manufacturing all 25″, 21″, and 19″ color tubes with the improved phosphors.

The new tubes, known as "Hi-Lite" tubes, utilize improved green and blue sulfide phosphors and a red "rare-earth" Europium phosphor. These phosphors are applied by an advanced slurry screening process, developed by the company.

Sample commercial quantities of a 90°, rectangular 19″ color-television picture tube are now being made available to the nation's set manufacturers. This tube is currently in pilot production at the company's plant in Lancaster, Pa. The short length of the tube will permit reduced cabinet sizes as well as new innovations in styling. The tube has the following approximate dimensions: minimum screen area is 180 square inches, minimum screen size is 12.2″ x 15.6″, and tube length is 18″—about 7.2″ shorter than the 70° round 21″, color tube.

The 19″ tube utilizes the three-gun, shadow-mask principle and is designed to use the same basic components (deflecting yoke, purifying device, radial-converging device, and lateral converging device) that were developed for RCA's 90° rectangular 25″, color tube.

Establishes Consumer and Distributor Products Division

A Consumer and Distributor Products Division has been established by **International Resistance Company** to market other manufacturers, products as well as its own through consumer and electronic distributor outlets. The new division will concentrate on marketing high-quality products of other manufacturers under the manufacturer's label, a joint label, the IRC label, or a private label.

Speaker Phasing Standards

A definite method to insure proper phasing of loudspeakers is set forth in **EIA** Standard RS-233-A. In summary, speakers conforming to this standard will have a + mark, a green dot, or both on the right-hand terminal when the speaker is viewed from the back and the terminals are on the bottom. Should the terminals be spaced so it is not clear which is the left or the right terminal, the coded terminal shall be the positive terminal. The application of a positive DC voltage to the + terminal will cause the speaker diaphragm to move forward, away from the speaker housing. For a 3.2-ohm voice coil, 1.5 volts DC is recommended. Higher-impedance speakers should have a voltage applied which will provide approximately the same amount of voice-coil movement. If the speaker cone is so stiff that sufficient motion is not possible with a reasonable voltage, a DC millivoltmeter or microammeter with the meter positive terminal connected to the speaker + terminal will indicate an upscale movement at the instant the speaker diaphragm is moved away from its housing.

If the speaker terminals are on the enclosure, the terminal that causes the cone of the lowest-frequency speaker to move forward will be coded to correspond with that on the speaker. Speaker systems with cables, plugs, or other connections to the speaker will be suitably marked by the manufacturer.

Consolidated Operation

The eastern manufacturing, warehousing, and office facilities of **Alpha Wire** have been consolidated into a new 140,000-square-foot plant complex at 711 Lidgerwood Avenue in Elizabeth, New Jersey. The company has set up new wire-extruding lines, improved cabling equipment, installed modern quality-control apparatus, and greatly increased its coaxial-cable manufacturing capacity. ▲

Caribbean TV Subsidiary

Production of the first television sets to be manufactured in an independent Caribbean nation began recently in Trinidad and Tobago. The TV sets are being manufactured by **General Telephone & Electronics Export Corporation**, a GT&E International subsidiary, and will be sold under the brand name of Sylvania Electric Products, Inc. Both Sylvania and GT&E International are subsidiaries of General Telephone & Electronics Corporation.

The manufacturing facility is located about 20 miles from the center of Port of Spain, the capital of Trinidad and Tobago. The plant initially will produce table models with 19" and 23" picture tubes and consoles with a 23" tube.

Test Equipment Company Bought

All the outstanding stock of Jackson Electrical Instrument Company of Dayton, Ohio, has been acquired by **Mercury Electronics Corporation**, Mineola, N. Y.

Jackson has designed and built electronic test equipment for the radio and television servicemen for over 30 years. The combined new activity will give both companies broader base and scope. The combined research capabilities of the two companies will be utilized in the development of components and peripheral items to give the electronic technician a broad range of products.

U. S. TV Stations

A recent release by TELEVISION DIGEST reports that 678 TV stations (541 VHF, 137 UHF) are now operating in the U. S. Commercial stations now total 575 (482 VHF, 93 UHF) while noncommercial (educational) stations make up the other 103 stations, of which 59 are VHF and 44 are UHF. There are 30 VHF and 73 UHF commercial stations, plus 7 VHF and 23 UHF noncommercial stations which have been granted construction permits but are not yet on the air.

MATV

Market Arrives...Tremendous Volume

The demand for Master Antenna TV installations has entered a totally new phase . . . one which goes far beyond the already big market for commercial applications and reaches to millions of newly created multiple set homes.

Color TV . . . as well as increasing FM multiplex popularity is the big reason why. Every homeowner who buys a color set instantly becomes a prospect for a residential MATV installation to operate two, three, or more receivers with maximum quality reception from one antenna.

The Home MATV Market is Here Now!

This potential...

plus the vast Commercial MATV Market...

enables Channel Master to reduce prices drastically.

New Channel Master mass production techniques on the same precision-quality, commercial-grade MATV components designed for big building applications have resulted in equipment price reductions that average *25% and more* per installation. For MATV installing companies this means more volume and profit from highly competitive commercial jobs. For radio-TV service dealers it means an opportunity to get started in a totally new, high-income business meeting the booming demand for residential master antenna system.

Contact your nearest Channel Master Distributor. **CHANNEL MASTER** Ellenville, N.Y.

Circle 11 on literature card

Compare Color Generators

look at the rest . . . and you'll buy the best, new B&K model 1245

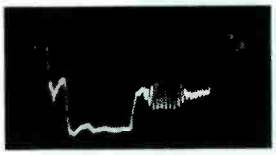
The all solid-state B&K Model 1245 Color Generator duplicates the waveforms transmitted by a color TV station.

Adherence to these waveforms makes it easy to converge the color tube, check sync and make other raster adjustments . . . and the color generator with station quality signal will be able to sync next year's sets. Generators with compromise waveforms do not give you this obsolescence protection.

Here are oscilloscope photographs from the outputs of two typical competitive color generators, one transistorized and one tube type, and the B&K Model 1245. The detailed analysis with each photograph shows a few of the reasons why you'll save time and effort with B&K.

COLOR **CROSSHATCH**

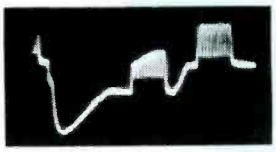
STANDARD STATION SIGNAL



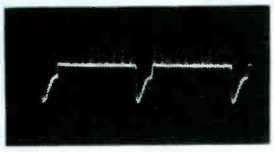
One horizontal sync pulse with its color burst.

Two lines showing horizontal sync pulse with black and white tv signal.

TRANSISTORIZED B&K MODEL 1245

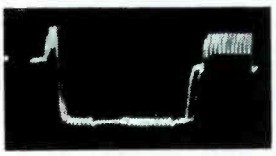


Good duplication of station signal including back porch. If the set won't sync, the set is defective.

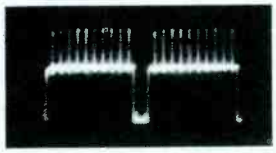


Well defined back porch on horizontal sync pulse permits accurately setting color killer and almost eliminates need to adjust brightness and contrast.

TRANSISTORIZED GENERATOR A

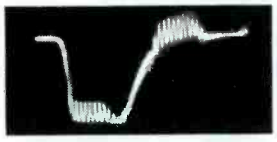


No back porch causes unstable color sync. Burst amplitude compression may permit sync on wrong color bar.

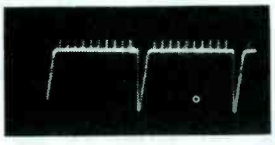


Square wave horizontal sync pulse with no back porch and poor dc coupling forces adjustments of brightness, contrast & fine tuning to obtain usable pattern.

GENERATOR B

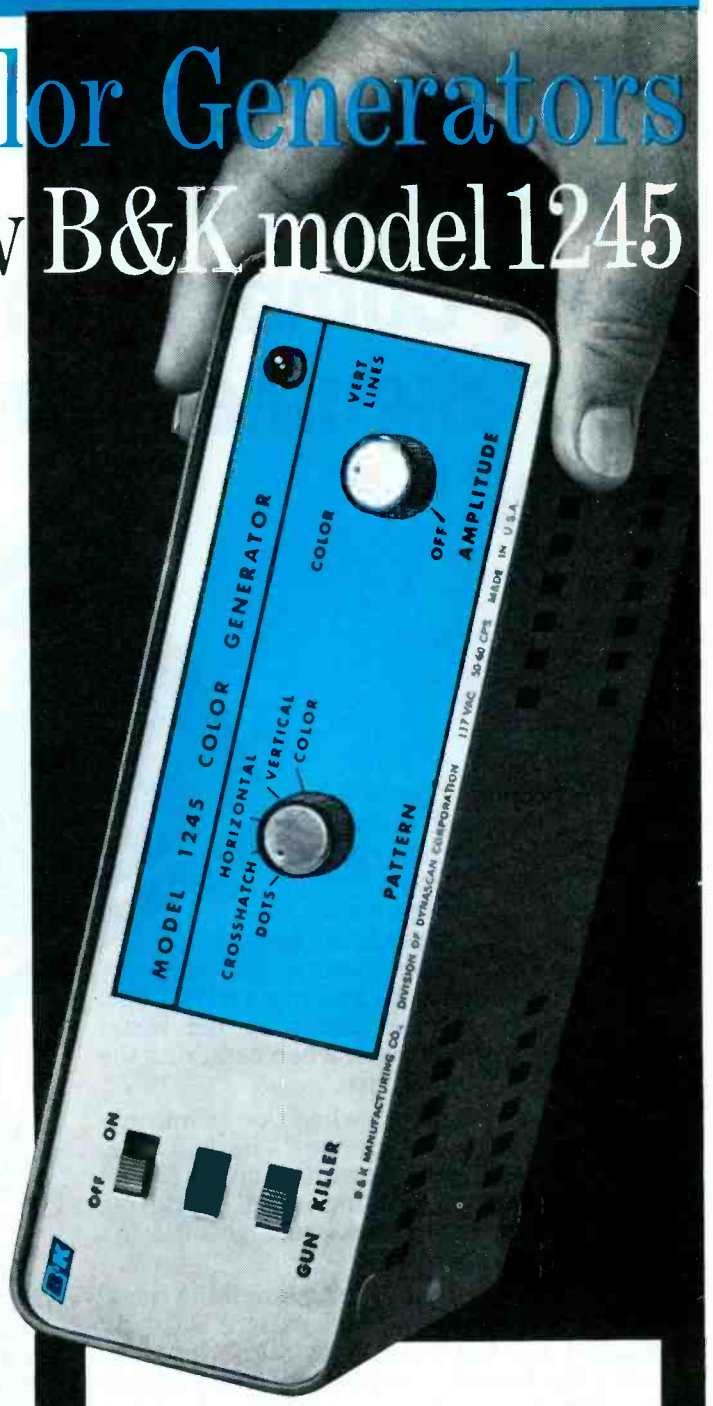


No back porch; color information on top of sync-pulse makes sync difficult on some sets.



Complete absence of any back porch necessitates readjustment of brightness, contrast and fine tuning to obtain a usable pattern.

See your B&K Distributor for a demonstration or write for Catalog AP22.



For the first time, with the no-compromise waveforms from the B&K Model 1245, it is possible to accurately set the color killer threshold control with a color generator.

The miniature size and convenience of the Model 1245 match its performance. It provides crystal-controlled keyed rainbow color bar display, and dot, crosshatch, horizontal line and vertical line patterns as well as gun killer controls that will work with any picture tube. Size only 2⅞ x 8½ x 8⅞". Net $134.95.

B & K MANUFACTURING CO.
DIVISION OF **DYNASCAN** CORPORATION
1801 W. BELLE PLAINE AVE. · CHICAGO, ILL. 60613
Canada: Atlas Radio Corp., 50 Wingold, Toronto 19, Ont.
Export: Empire Exporters, 123 Grand St., New York 13, U.S.A.

Circle 12 on literature card

The new Amphenol 860 Color Commander cuts alignment time in half!

Ever finish a convergence job to find the raster off center. Lose convergence when you re-centered? Can't happen with the Amphenol Color Commander, battery-powered, solid-state color generator. A special, single-crossbar pattern consists of one horizontal and one vertical line, crossing just where the center of the raster should be. No need to guess when centering the raster with this new pattern.

See dots before your eyes when you want only one to start static convergence? The 860 gives you that single dot, right at center screen. You'll be switching back to this important dot during dynamic adjustment to make sure you haven't gone off the track.

Even the old patterns offer something new. Line spacing in the cross-hatch pattern is rigidly maintained for the 4:3 aspect ratio. You can rely on it for linearity, height, and width adjustments. The pattern gives you finely etched line width at normal brightness levels. What good is perfect convergence at reduced brightness if you lose it when the set's readjusted for normal viewing? This special crosshatch also eliminates receiver fine-tuning error. Among the 860's nine (most generators have only 5 or 6) are: multiple-dot, single vertical line, single horizontal line, vertical lines only, and horizontal lines only.

Finally, the Color Commander's unique color bar pattern (just three bars: R—Y, B—Y and —R—Y)simplify color adjustments. You can get a rapid, overall check of color circuits. Then adjust color demodulator phase or pre-set the hue control and check its operating range. In each step, you know precisely how the color bars should look and how they should change during adjustment.

A new timing circuit eliminates instability and loss-of-sync problems. Silicon transistors maintain built-in precision and stability indefinitely. RF output is on channel 3 or 4, switch selected. An attenuator simulates weak-signal conditions. It has gun killer circuit. Uses 9 penlight cells. Weighs 3½ lbs. in compact leatherette carrying case. $149.95. Optional AC power supply, $19.95.

AMPHENOL CRT COMMANDER, MODEL 855. Solid-state. Checks all black-and-white or color CRT's with the same techniques used by tube manufacturers. Rejuvenates where others fail. Versatile 5-socket cable accommodates 7 different sockets. With CRT chart, $89.95.

See the new Color Commander test instruments at your Amphenol distributor.

Amphenol®
DISTRIBUTOR DIVISION
amphenol corporation
2875 S. 25th Ave., Broadview, Ill. 60155

Circle 13 on literature card

The move's on to

JERROLD

Coloraxial™

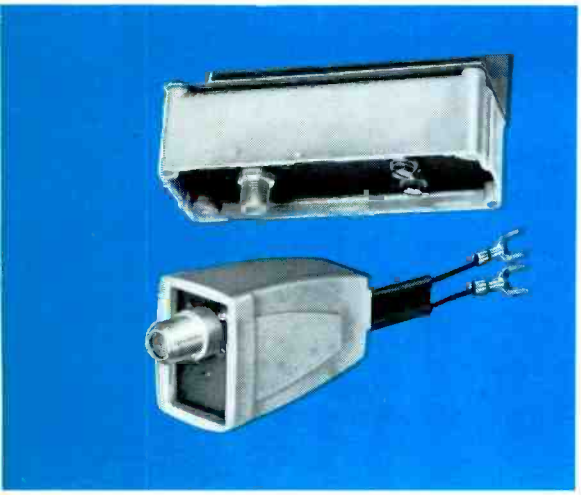
best for color . . . best for black-&-white . . . best for FM . . . best for business

The days of twinlead are numbered. Spurred by Jerrold's introduction of Coloraxial, both the TV trade and the public are moving unmistakably towards this revolutionary shielded coaxial antenna system—not only for great color TV, but for black-&-white and FM stereo too.

And, starting this Fall, a big national advertising program in TV Guide will have your customers asking even more for the perfection in reception that only Coloraxial offers.

So important is 75-ohm Coloraxial in your future that Jerrold now offers a wider line than ever of Coloraxial products to meet every reception need from metropolitan to deepest fringe areas. On these pages are described a complete range of Coloraxial antennas with 75-ohm output; matching transformers for converting existing 300-ohm antennas to Coloraxial operation; Coloraxial Powermate preamplifiers; and 50- and 75-foot lengths of Coloraxial cable complete with screw-on fittings. One of the easiest—and most profitable—jobs you can do is install a Coloraxial reception system.

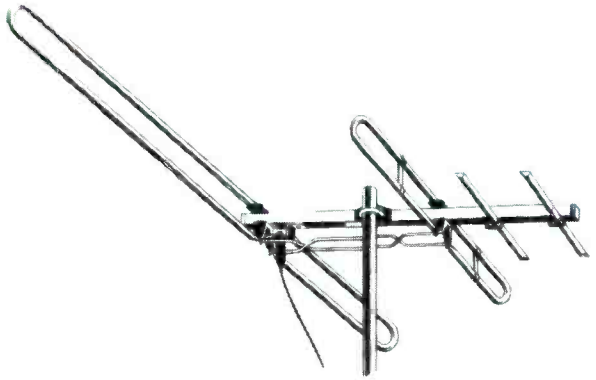
There's a pocket-size Jerrold Blue Book waiting for you at your distributor's. It's yours to use in figuring installed Coloraxial prices for your customers. The Jerrold Blue Book is just one part of a big five-part program your distributor has ready to help you sell Coloraxial installations this Fall. Talk to him now.



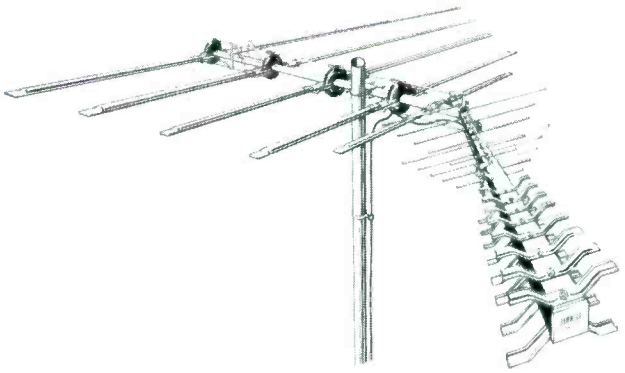
COLORAXIAL MATCHING TRANSFORMERS AND KITS Model TO-374A mast-mounting transformer converts any existing 300-ohm outdoor antenna to 75-ohm Coloraxial operation. Model T378 mounts on set to match it to 75-ohm coax. Available separately or as a set in Kit Model CAT-2.

COLORAXIAL SHIELDED CABLE Here's the heart of every Coloraxial installation—the reason for it all. Coloraxial is the highest-quality shielded RG-59/U cable, factory sweep-tested and complete with screw fittings and a weatherboot for the outdoor connection. Models CAB-50 and CAB-75 contain 50 and 75 feet of cable respectively. Model K-CAB-50 contains 50 feet of cable and one each of Model TO-374A and T378 matching transformers.

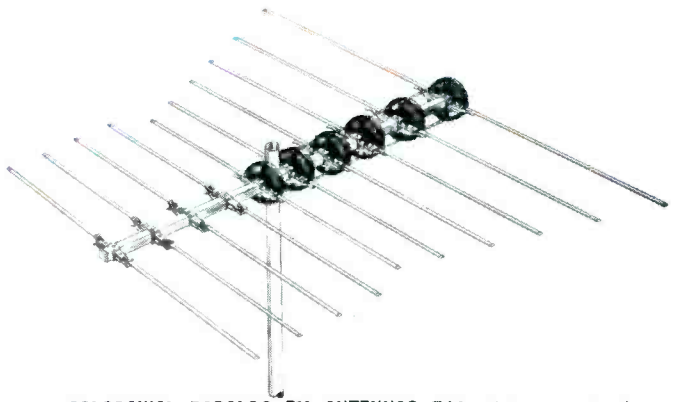
COLORAXIAL POWERMATES The coaxial versions of the transistor antenna amplifier that set an industry standard, made "fringe area" a thing of the past. Model SPC-103 has two transistors, Model SPC-132 "De-Snower" has five transistors in two-stage preamp-postamp. Both Powermates are pre-matched to antenna and receiver, making separate matching transformers unnecessary.



COLORAXIAL COLORGUARD ANTENNAS AND ANTENNA KITS Like all the antennas shown here, Coloraxial Colorguards are already equipped with 75-ohm output to coaxial downlead. Three models (CAX-16, 17, and 18) for metropolitan and suburban reception areas. Model CAX-16 is also available in kit form with 5-foot mast and trimount, CAB-50 cable with fittings and weatherboot, and set-mounting T378 matching transformer—everything you need for a complete Coloraxial installation.

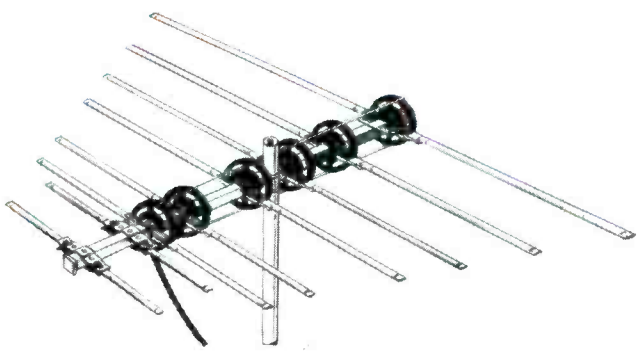


COLORAXIAL PATHFINDER VHF/UHF/FM ANTENNAS The first all-channel antennas with 75-ohm output and individual orientation of VHF and UHF sections in one hinged unit. All the flexibility of separate antennas without splitter losses. You have a choice of five PATHFINDER models, PXB-30, 45, 50, 70, 90.

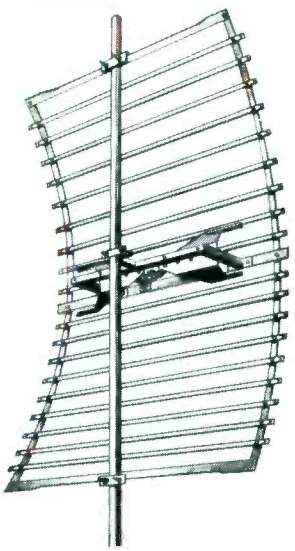


COLORAXIAL PARALOG FM ANTENNAS FM stereo needs Coloraxial too! So the outstanding Paralog FM antenna line is now offered also with Coloraxial 75-ohm output. Three models, FMPX-8, 10, and 16.

COLORAXIAL Stratophonic FM YAGI AND KIT This fine five-element yagi antenna, pre-matched to 75-ohm Coloraxial operation, keeps stereo signals in, keeps interference out. Model FAX-5, available also in kit form with mast, trimount, 50 feet of cable with fittings and weatherboot, and set-mounting matching transformer —everything you need for a complete Coloraxial stereo installation.



COLORAXIAL PARALOG TV ANTENNAS The full line of seven renowned high-gain Paralog log-periodic VHF antennas is now available pre-matched to 75-ohm Coloraxial cable. In the wide range of Paralogs (Models PAX-40, 60, 100, 130, 160, 190, and 220) you can choose the perfect antenna for metropolitan to deepest fringe reception.



COLORAXIAL PARACYL UHF ANTENNAS These five famous all-band UHF antennas, now available with 75-ohm Coloraxial output, feature an extended-resonance driver which assures effective operation over the entire UHF band (Ch. 14 to 83). Models JUX-1, 2, 3, 4, 5.

JERROLD ELECTRONICS CORPORATION

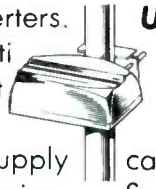
Distributor Sales Division ■ 15th & Lehigh Ave., Philadelphia, Pa. 19132

JERROLD

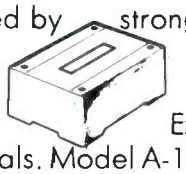
Circle 14 on literature card

Don't install half a tv system!

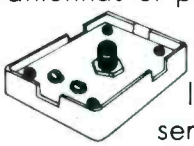
The all-channel and color TV era is here. Most sections of the country will have both UHF and VHF channels. Only all-channel TV sets are now being sold. All three TV networks are increasing their color TV programming — so, if you're installing a TV system, it makes sense to put in a color approved all-channel system. Here are the Blonder-Tongue all-channel, color approved products that will do the job most effectively, at a down-to-earth price. ***All-Channel UHF/VHF Amplifiers*** The world's first channel 2 to 83 amplifiers provide superior color or black and white TV reception on all channels when used with any all-channel TV receiver, or with sets equipped with UHF converters.



U/Vamp-2 mast-mounted UHF/VHF Amplifier. Mounts near antenna to achieve optimum signal-to-noise ratio. Unique 2-transistor circuit provides power to turn fuzzy pictures into sharp clear ones and handle strong local TV signals without overloading. Built-in FM filter reduces overload caused by local FM stations. Remote AC power supply can be installed anywhere indoors. Rugged, weatherproof, cast aluminum amplifier housing. Separate antenna inputs (300-ohm) for UHF and VHF. Built-in, low-loss UHF/VHF splitter, no additional unit is required to separate the signals at the TV set or UHF converter antenna terminals. $49.95 list. ***V/U-All-2 indoor UHF/VHF Amplifier.*** Installs easily anywhere in the home. unique two-transistor circuit provides excellent gain and low noise figure for one or two TV sets. For two-set operation, it provides an excellent impedance match, necessary isolation between sets plus an increase in antenna signal power. Single 300-ohm input accepts signals from both UHF and VHF antennas. A two-transistor circuit and a built-in filter minimize overloading caused by strong local stations. Patented 300-ohm stainless steel stripless terminals. $42.50 list.



All-Channel Couplers—Color-approved, channel 2 to 83 couplers capable of delivering full-power signals to all-channel sets, only VHF sets and FM, too. Excellent interset isolation, low-loss, patented 300-ohm stainless steel stripless terminals. Model A-102 U/V two-set coupler. $3.75 list. Model A-104 U/V four-set all-channel coupler. $5.85 list. Model A-107, UHF-VHF antenna coupler combines UHF and VHF antennas or provides separate VHF and UHF outputs from a common line or a single antenna.



Model MT-283 UHF/VHF indoor/outdoor matching transformer. High quality color-approved unit matches 300-ohm antennas to 75-ohm coax downlead (or 75-ohm terminals at set). Superior rejection of interference. Minimum insertion loss. "Jiffy Mount" provided for quick mast mounting. Connectors: Patented stainless steel stripless terminals (300-ohm); BTF connector (75-ohm). Solderless male connector supplied. $6.75 list.

Cablematch U/V—All-channel, indoor matching transformer covers channels 2 to 83. Matches 75-ohm to 300 ohm impedance or reverse. Ideal for matching TV set inputs to a 75-ohm distribution system. Low insertion loss. Connectors: two spade lugs (300-ohm) and patented, solderless Autoplug supplied for RG-59/U cable (75-ohm). $4.50 list. ***TF-331 U/V All-Channel, 300-ohm Outlet Plate.*** Fits standard AC receptacle boxes. Designed to allow 300-ohm distribution systems to terminate at wall outlets for easy connect, disconnect. Patented 300-ohm stainless steel stripless terminals. $3.35 list.

In addition to all-channel TV products, Blonder-Tongue provides a complete line of VHF (300-300Ω twinlead, & 75-Ω coax) and UHF system products. Blonder-Tongue, and only Blonder-Tongue, makes them all. Don't install half a system. Insist upon a system to meet all your customer's requirements, now and in the future. Insist on the top-rated line from the leader in all-channel products. Write for free booklet "How To Plan A Color Approved Home TV System".

BLONDER-TONGUE

9 Alling Street, Newark, New Jersey 07102

home TV accessories • closed circuit TV • community TV • UHF converters • master TV

Circle 15 on literature card

FREE!

From now through December 15, 1965

Get a Color-TV TEST Picture Tube with every RCA WR-64B Color Bar/Dot/Crosshatch Generator you buy

Yes! You read right!

From now through December 15, 1965—with every purchase of an RCA WR-64B Color Bar Generator—you get a FREE color-TV TEST picture tube for use in your color-TV test jig. This is a 21-inch 70° round color-TV TEST picture tube, electrically guaranteed six months from first installation date. These tubes will have minor mechanical (not electrical) defects... they're not quite good enough to go into a new TV set but perfectly adequate for testing purposes.

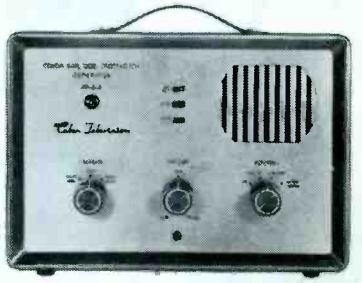
How to get your FREE Color Test Tube

Simply buy an RCA WR-64B Color Bar Generator—*THE* essential color-TV test instrument—between now and December 15, 1965. Fill out your warranty registration card and attach the red identification label on the WR-64B carton. Send them to RCA, Test Equipment Headquarters, Bldg. 17-2, Harrison, N.J. We send you the tube (either from Lancaster, Pa. or Marion, Ind.) freight charges collect. To allow for postal delay, we will honor cards received up until December 31st.

Don't miss out on this never-before offer. You've got to have a color-bar generator anyway—so be sure you buy it now—at the regular price—while you can get a FREE color test tube.

$189.50*

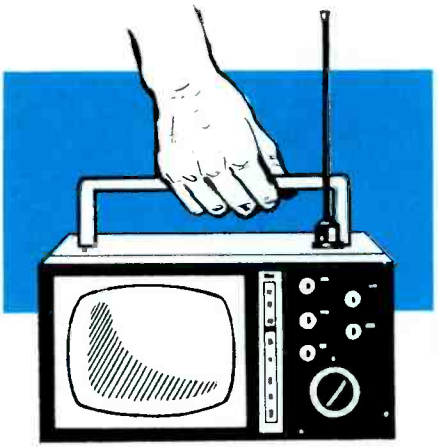
Optional distributor resale price; subject to change without notice. Price may be higher in Alaska, Hawaii and the West.



RCA WR-64B Color Bar/Dot/Crosshatch Generator

RCA ELECTRONIC COMPONENTS AND DEVICES, HARRISON, NEW JERSEY

The Most Trusted Name in Electronics



making money with TINYVISION RECEIVERS

It can be done if you know how to repair them quickly.

by Edward F. Rice

Let's face it, transistorized TV is here to stay and the number of different models is increasing. If you have not already encountered one of these chassis on your service bench, chances are you will soon. Because of the physical nature of the chassis, troubleshooting must be based upon theory rather than the *cut and try* technique (aside from repairing intermittent circuit boards). In this sense, your experience with transistor radios will aid greatly, but the new circuitry must be studied and some new servicing routines must be worked out.

Waveforms provide the most reliable analysis. Voltage analysis is difficult because very small voltages must be measured at inaccessible places, and some voltages depend on signal conditions. As in transistor radios, ohmmeter readings are often unreliable because of multiple low-impedance paths throughout the circuitry and the presence of semiconductor junctions which may be activated by the ohmmeter battery.

Because these sets are portable and the transistors usually are soldered in, only limited repairs and adjustments are done in the home. Parts are often guaranteed, or of such small cost that they do not contribute greatly to the profit from repair of these receivers. So, successful servicing of these receivers will require special bench techniques which allow the technician to complete the job in a minimum of time. A few reliable tests are needed that: apply generally to all models; can be made quickly without butchering the chassis; do not depend on absolute accuracy of the instruments; or do not require familiarity with the variations due to signal conditions. Some of these tests will be presented in this article along with brief descriptions of some unique circuitry and a check list of general rules for service bench.

Sweep Circuit

Techniques for maintenance of the RF and IF circuits of transistor TV are basicaliy the same as those

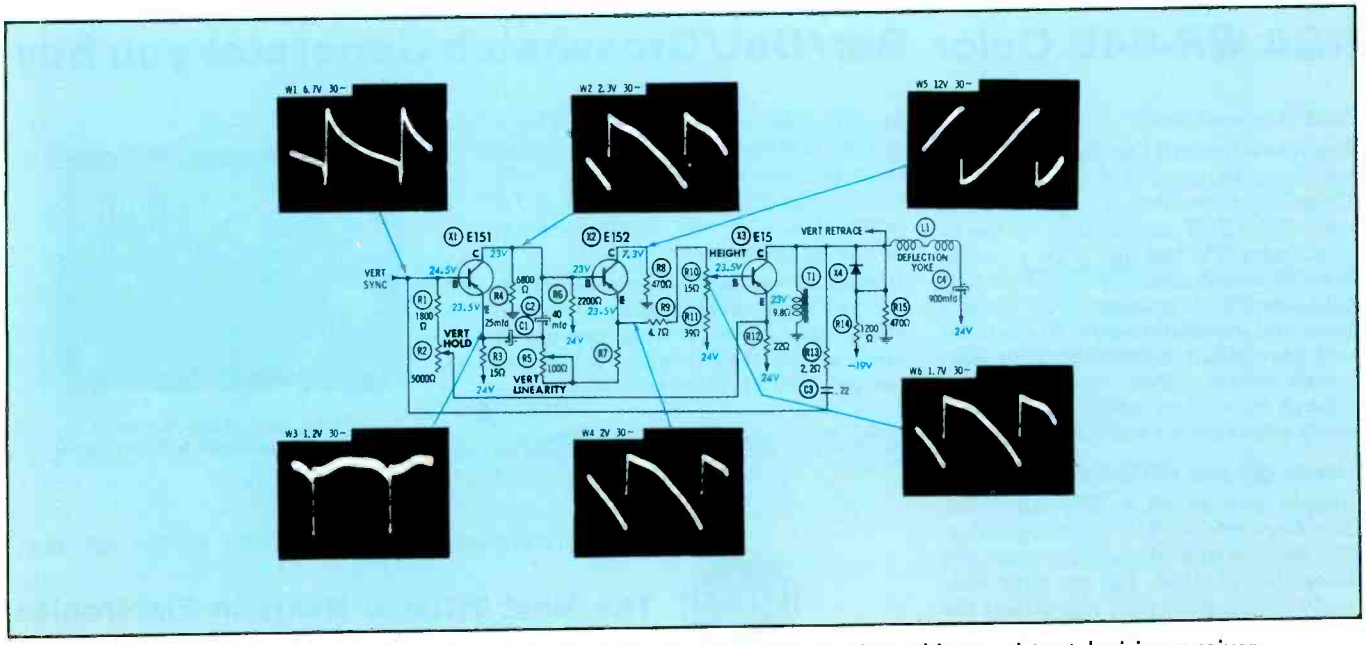


Fig. 1. Schematic diagram shows typical three-stage vertical sweep circuit used in transistor television receiver.

for transistor AM and FM radio circuits although alignment is more complex. Transistorized sweep circuits are more complicated; often, it will take more than a rapid glance to determine how the circuit works. Also, although vacuum-tube circuits have become standardized, there is still much diversity in circuit design for transistorized sweep systems.

Vertical Sweep

The appearance of a thin line on the screen will localize the fault to the vertical section. But there are often several transistor stages in this section and it is necessary to identify the faulty stage before unsoldering anything. Fig. 1 is the vertical section of Emerson chassis 120771. As an example, let's see how it works and how you could track down failures.

The base of XI (Fig. 1) is reverse-biased through R1, R2, and R12; the negative vertical-sync pulse from the sync amplifier drives X1 into conduction, which discharges C1 and C2, thus cutting off driver X2. With no current flow through X2, the base bias of X3 rises to 24 volts (the source voltage) and current flow ceases from ground through T1, X3, and R12.

Vertical damper X4 conducts as T1's magnetic field collapses, which prevents damage to X3 and keeps the negative spike from exceeding −5 volts. Simultaneously, C4 is charging rapidly and the resulting current flow causes the sawtooth to retrace. C3 charges from its −5 volts clamp potential to 24 volts, thus XI is driven into cutoff at the end of the retrace pulse from T1. As C2 charges, conduction increases via X2, R7, and R5. The waveform fed to X2's base is a linear, not an exponential sawtooth. As X3 conducts, C4 discharges through the yoke and X3, providing a linear sweep.

Features of this circuit immediately suggest importance to the troubleshooter. Knowing what you do about the horizontal damper used in tube-type circuits should lead you to check this diode first when there is no vertical deflection in a transistorized TV. An ohmmeter should reveal a 100:1 ratio of reverse to forward resistance. Or, one lead can be clipped from the circuit board; then by bending little hooks on the ends of the leads of a new

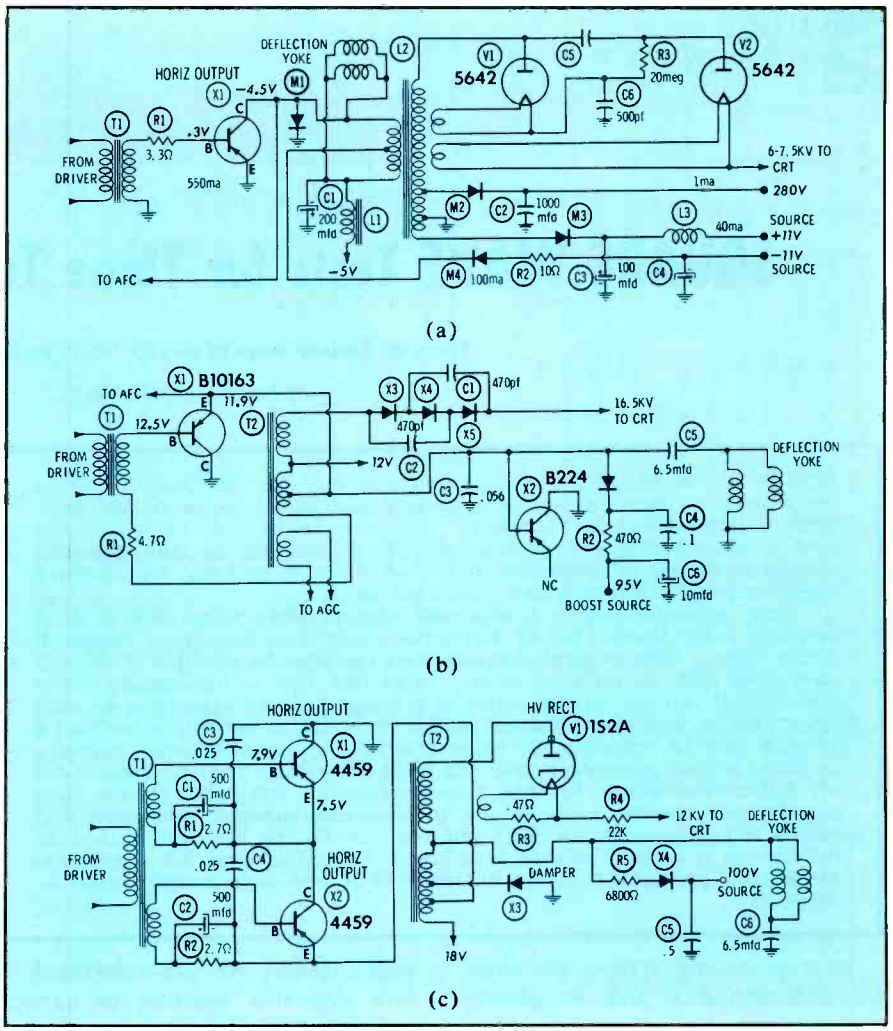


Fig. 2. Transistor horizontal-output stages similar to vacuum-tube types.

unit, you can substitute it temporarily. If the diode is open you are also likely to find a damaged output transistor.

If the damper is okay and there is no vertical deflection, the faulty stage must be located by signal tracing with an oscilloscope. Start by viewing the 60-cps sawtooth at the base of X1 and (if there is a sawtooth there) move through each stage toward the yoke until the signal disappears. The old method of substituting a 60-cps signal at various points and watching for deflection on the screen is not convenient in transistorized sets as it is in the tube-type because you must control the amplitude of the test signal very carefully to avoid damaging transistors; furthermore, you may not be able to hook up the CRT very easily after the chassis is removed from the cabinet (or the cabinet from the chassis as the case may be).

Shorted turns in the choke (T1) could cause linearity problems, and this part must be checked in addition to the regular suspects in the feedback circuit which are found defective in so many cases of poor linearity in tube-type sets.

Another cause of poor linearity that would not occur with tubes is transistor leakage. This causes a change in the operating point and produces clipping and saturation which can distort the sweep waveform. Leakage will also change the cut-off characteristics of a transistor, and this affects the vertical size and sometimes the sync.

Horizontal Sweep

Different kinds of horizontal output circuits are shown in Fig. 2 and 3. The one in Fig. 2A uses a voltage doubler to supply the high-voltage to the anode of the CRT—a circuit that brings back memories to some of us who have been around the servicing business for a decade or more.

Basic operation of this circuit (from the Philco 10AT10 chassis) is similar to that of standard vac-

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ADVANCED SERVICE TECHNIQUES

SQUARE WAVE Tests for Three Terminal Networks

More on modern ways to service future equipment.

by Robert G. Middleton

Fifth in a series of articles on square-wave testing, this installment continues the analysis of three-terminal RC networks that started in the August issue. That "Advanced Service Techniques" feature described tests in RC circuits used as differentiating and coupling networks. In this one, the same principles are applied to tests of integrating circuits which are so packaged that ordinary capacitance-bridge and ohmmeter checks are useless.

These techniques require a wideband triggered-sweep scope such as those described in the March 1965 PF REPORTER article "Learning About Triggered-Sweep Scopes." Measurement of square-wave rise time, for example, is virtually impossible with an ordinary service scope that uses a free-running sweep generator. If you can arrange access to a triggered-sweep scope from an electronics lab or television broadcast station, it would be helpful to familiarize yourself with its operation. By experimenting with substitution-box networks or actual printed components, you can make theory and practical applications of square-wave testing become more meaningful. Integrated circuits have already been demonstrated for use in home-entertainment equipment, and testing techniques such as these will one day be the practical method of determining if a circuit module is defective. Articles to come will describe to the practical principles of testing RC networks of even more complex nature.—*The Editor.*

In a preceding article, we studied differentiating and integrating circuits and the waveforms they normally produce when excited by a square wave. We are now prepared to make more detailed evaluation of what happens to a square wave when there are defective components in these RC circuits. Inasmuch as certain defects occur commonly, *their* effect is what we'll first consider. Resistors usually either open or increase in value, and capacitors usually become leaky or open.

When capacitors and resistors are assembled as partial or complete circuits, especially in printed or integrated combinations, it is difficult if not impossible to disconnect components for individual tests. Hence, we are interested in how defective resistors or capacitors affect the square wave response of the entire network. These networks have an input end and an output end. In a TV receiver, for example, the input signal is applied to one end and the output signal is taken from the other. However, we will find that square wave tests are often greatly facilitated if we pass the square wave signal backward through the network.

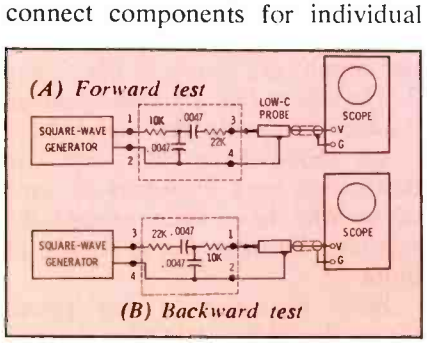

Fig. 1. Square wave passed in the opposite directions checks resistors.

Testing Resistors

Forward-backward tests are often very helpful in localizing defective resistors. For example, Fig. 1 shows a standard printed-circuit integrator. We can check this unit either as shown in A or B. Let's apply a 6-volt peak-to-peak 5-kc square wave as in A; this is normal operation. The output waveform is illustrated in Fig 2. If the 10K resistor is of the correct value, the output amplitude is reduced to 5.4 volts peak-to-peak. But suppose the 10K resistor has doubled in value. In such a case, the output amplitude is related inversely to the change in resistance value.

It is helpful to review briefly the action of an integrating circuit, to see why the 6-volt peak-to-peak square wave is reduced to 5.4 volts. In Fig. 1B the 10K resistor and the .0047-mfd capacitor shunting it form an integrating circuit. The 22K resistor, the .0047-mfd capacitor, and the high impedance of the 10w-C probe form a coupling circuit with a very long time constant; therefore they have no noticeable effect on waveshape or amplitude —output waveshape and amplitude are determined by the integrating circuit time constant ($RC = 10{,}000 \times .0047 \times 10^{-6} = 47$ usec).

Fig. 3 shows that after five time constants the voltage across the shunt capacitor will equal input voltage. The time constant in Fig. 1A is 47 usec, so it takes 5 x 47 or 235 usec for the output voltage to rise to the value of the input voltage. This much time is not permitted by a 5-kc square wave; one cycle lasts only 200 usec, and a half-cycle lasts only 100 usec. In other words, the output voltage can rise and fall in Fig. 3 for only approximately 2.1 time constants. We see from the curve that the output voltage must be about 88% of the input voltage. The universal time-constant chart in Fig. 3 can be used to determine how much output voltage to expect at an integrator output at any chosen square-

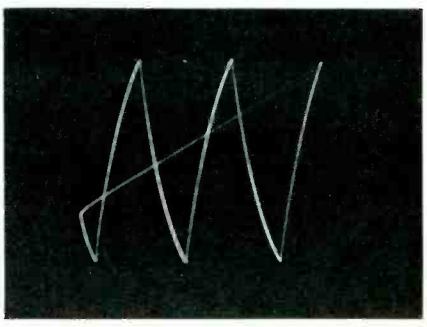

Fig. 2. Integrated 5-kc square wave from 3-terminal network of Fig. 1.

wave frequency.

Now, consider the 22K resistor in Fig. 1A. If this resistor doubles value, there will be practically no change in the reproduced square wave because the 22K resistor feeds into a low-C probe. The probe has an input resistance of 10 megohms and an input capacitance of 9 pf. This is a very high impedance, and even large variations in the value of the 22K resistor have little effect; the output waveform remains virtually unchanged.

Therefore, a "backward" test is made to check the 22K resistor, as shown in Fig. 1B. Now, the 22K resistor feeds into a substantial capacitance, and if the resistor is off-value, the result can be seen as an abnormal output amplitude. As before, a 5-kc square wave at 6 volts peak-to-peak is applied. The time constant of this circuit is determined by both capacitors; since the charge path is from the square wave generator, through the 22K resistor and the two series capacitors back to the generator. Total capacitance is .0024 mfd (.0047 mfd/2), and the time constant is: RC = 22,000 x .0024 x 10^{-6} = 52 usec. Voltage is divided equally across each capacitor as loading by the scope is negligible. Using a 5-kc square wave will allow the capacitors to charge for approximately two time constants, and the output voltage will equal 1/2 x 85% x 6 volts = 2.55 volts. If the 22K resistor doubles in value, the output of this circuit would drop to 1.8 volts.

This is a quick and easy way to find out whether the 22K resistor is defective or not because its value cannot be measured with an ohmmeter. But, with this square wave test, the output amplitude is inversely related to the change in resistance value. You can rely on output amplitude for a definite test. It is much easier to note the amount of vertical deflection than to look for comparatively small changes in waveform curvature.

Capacitor Analysis

Next, let's consider what happens when the series .0047-mfd capacitor in Fig. 1 becomes leaky. A leakage test can be made at any square-wave frequency; 5 kc will be satisfactory, as before. Simply switch the scope from AC to DC operation. If the capacitor is not leaky, the pattern stays put on the screen. On the other hand, if the capacitor has appreciable leakage, the pattern will shift vertically on the screen. The shift is caused by the DC component in the square-wave signal. There are other methods of checking for leakage, but it is instructive to analyze the pattern-shift method.

Of course, not all square wave generators have a DC component; if the generator is of the type which has a large capacitor in series with the output, the DC component is blocked. In such a case, a DC component must be provided. One method is shown in Fig. 4. Connect a semiconductor diode in parallel with the generator output; Then, if a 6-volt peak-to-peak square wave is applied, there will also be a 3-volt DC component. A slight amount of leakage in the .0047-mfd series capacitor in Fig. 1 will produce a substantial vertical shift in the pattern when the scope is switched to DC response.

On the other hand, suppose the .0047-mfd capacitor is open. In such a case, there will be no pattern on the screen; only the horizontal base line will appear. Of course, the same "no output" symptom could be caused by an open 22K or 10K resistor. A "no output" symptom can also be caused by a shorted .0047-mfd shunt capacitor in Fig. 1. In any of these cases, the printed integrator unit does not pass the square wave test and must be rejected.

Of course, complete shorts are less common than leakage. Hence, let's see what effect leakage or an open in the shunt capacitor has on the output square wave. Serious leakage in the shunt capacitor attenuates the output; this defect will result in rejection of the unit through earlier tests. A 6-volt peak-to-peak input will not produce a 2:55-volt output, but only 1 volt, .5 volt, or even zero volts for a complete short.

Then suppose the shunt capacitor in Fig. 1 is open. In such a case, a 5-kc square-wave test does not give the waveform shown in Fig. 2; instead, the square wave feeds through at full amplitude.

We find that a few square-wave tests evaluate very thoroughly the resistances and capacitances in Fig. 1, without disconnecting a single component. This is a great convenience in ordinary printed circuits and is essential for testing integrated circuits which cannot be "divided up" without destroying them. In factories today, square-wave tests at incoming inspection save excessive lost time in production. Techniques such as this will become more important to maintenance of electronic equipment as miniaturization continues. In the future, an entire television circuit may have only input, output, and power-supply terminals; square wave analysis and similar tests may be the only way to determine if the circuit is functioning.

Another Practical Test

Fig 5 shows another standard printed-circuit integrator. This is a

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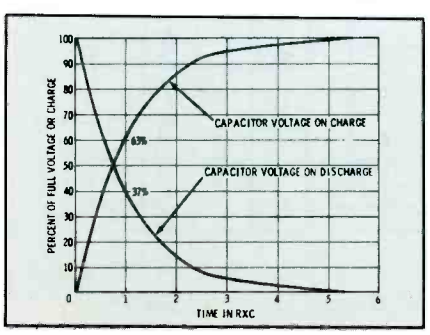

Fig. 3. Graph shows charge and discharge percentage vs time constant.

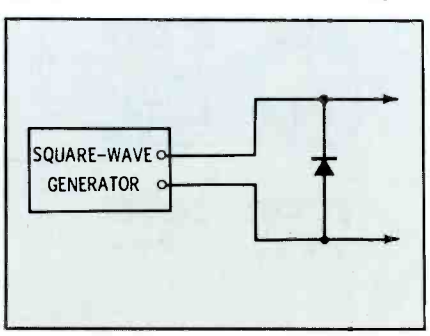

Fig. 4. Diode produces DC component from generator with output capacitor.

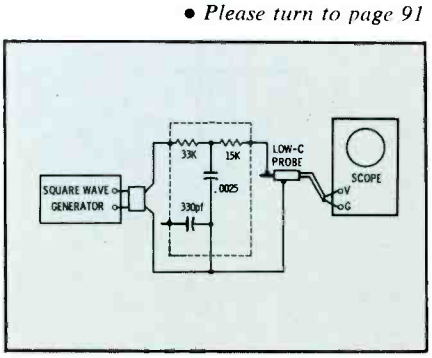

Fig. 5. Capacitor value can be determined by rise time of square wave.

understanding Pads & Attenuators

You can even make your own, in an emergency.

by Harry J. Abramson

An attenuator is a resistive network used to control signal level while maintaining a particular impedance at its input, its output, or both. It always produces a loss; in other words, it attenuates the source voltage to some lower value. They are used very commonly in audio circuits and sometimes in RF circuits.

Attenuators may be fixed or variable. The fixed resistor types are commonly called *pads;* the variable potentiometer types, *attenuators.*

The most familiar attenuator is the volume control. This type reduces output without any attempt at matching the impedance of the input or output circuits. In low impedance circuits, however, it is necessary to reduce the outputs and keep the circuits reasonably matched to avoid unnecessary power losses and distortion.

Variable Attenuators

Two common attenuators which do attempt to match circuit impedance are the "L" and "T" pads. They derive their names from the shape of their circuit configuration —Fig. 1. Other less well known attenuators are the "H," "O," "U," and "P" types.

The variable "L" pad consists of two controls, generally wirewound, on a common shaft with the contact arms tied together externally. As one unit increases in resistance, the other decreases, thereby maintaining a constant impedance in one direction—usually the source. The "T" pad has three control sections and works much in the same manner, but it maintains impedance in both directions.

For most audio systems, the "L" pad will suffice because, with it, the amplifier sees a constant load regardless of speaker volume setting.

Attenuator Characteristics

The two most important considerations for selecting attenuators for audio circuits are: (1) *impedance*—the resistance of the control should match the output impedance of the amplifier and (2) *power rating*—especially important since any power not used in the speaker must be dissipated in the control; the power rating of the control must therefore equal the output of the amplifier. If the speaker rating is unknown, the attenuator should have at least a 15-watt audio rating.

Other attenuator characteristics

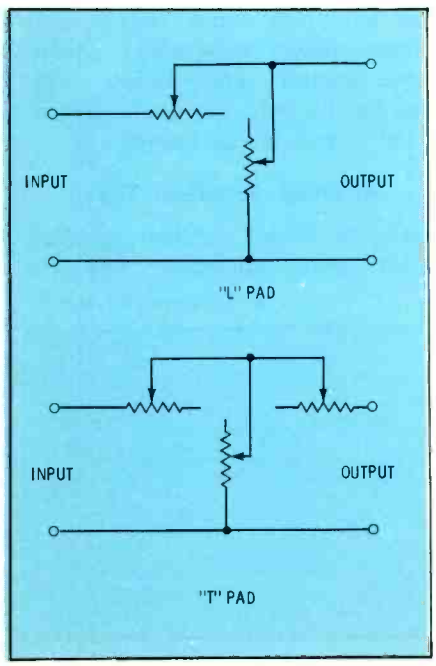

Fig. 1. Simplest forms of resistive pad.

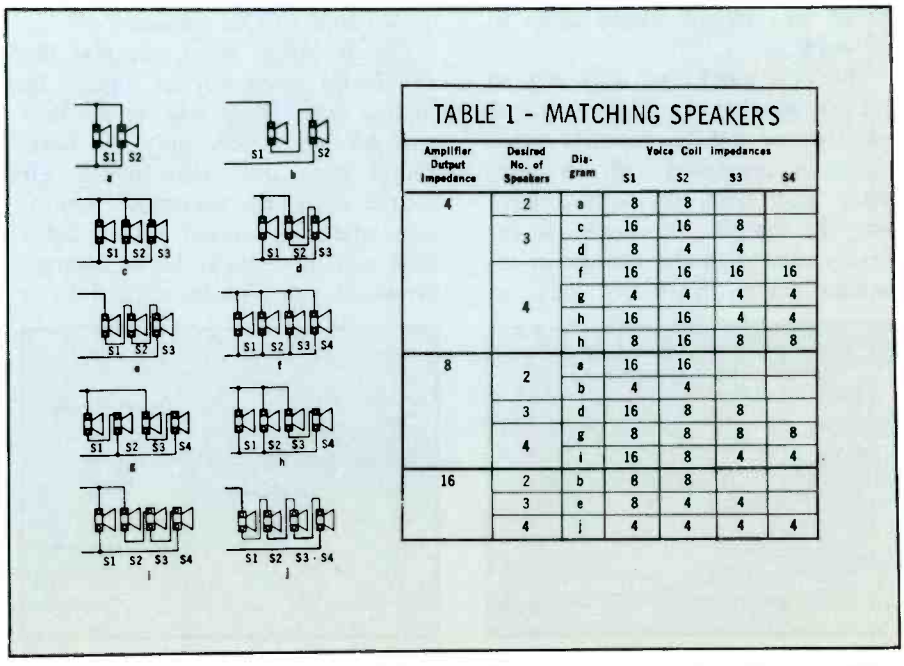

Fig. 2. A number of connection combinations for proper speaker impedance match.

to consider are:

1. *Insertion Loss*—When the control is set for minimum attenuation, little loss should be introduced into the circuit. This is especially important in low-level circuits, where insertion loss should not exceed .5 db.
2. *Constant Impedance*—The attenuator should be within +20% of its nominal impedance value at any level setting.
3. *Frequency Response*—An audio attenuator must have a frequency response flat from 20 cps to at least 20 kc to prevent frequency distortion.
4. *Noise*—Where attenuators are in low-level circuits, such as with microphones and preamps, their inherent noise must be less than —150 db; otherwise, objectionable scratching sounds occur whenever the control is rotated. Noise is of little significance in speaker circuits where the control is generally left at one setting.

Attenuator Applications

"L" and "T" pads let the listener enjoy the convenience of remote speaker operation without a loss of audio quality. The volume level of a speaker in a group can be changed without affecting the volume level of others. To distribute the output of a music system to various points, it is first necessary to determine how the speakers must be connected to obtain maximum output and fidelity. This can be done by selecting speakers with voice coil impedances that combine to provide the required total impedance for the amplifier.

An attempt should be made to use speakers of the same impedance, so you will have equal power distribution. For example, a 16-ohm speaker will have to dissipate twice the power as an 8-ohm speaker on the same line. Also, series connections should be avoided if possible since an open circuit in any one speaker will cause those in series with it to become inoperative.

Fig. 2 shows various ways of connecting speakers in series, parallel, or series-parallel, and Table 1 gives the required voice coil impedance of each speaker to obtain any particular impedance match.

Matching of impedance cannot be overstressed. For example, an upward mismatch of four times the proper load produces a power loss of 50%; a downward mismatch will not only introduce excessive power loss but will also affect low-frequency response.

The "P" pad speaker control is an inexpensive form of attenuator which can be assembled from spare parts in an emergency situation. It consists of a single wirewound potentiometer, shunted by a 5-watt resistor, with characteristics comparable to its more sophisticated dual-pot counterpart—the "L" pad.

Fig. 3 shows the pictorial and schematic diagrams, and Table 2 lists the component values for common speaker impedances.

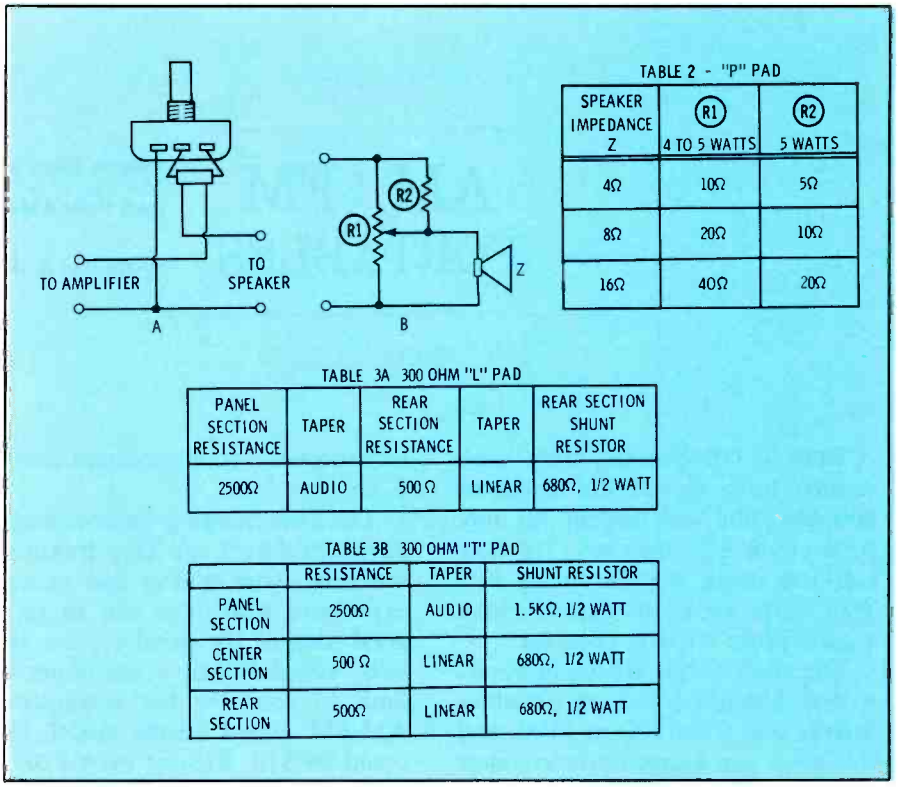

TABLE 2 - "P" PAD

SPEAKER IMPEDANCE Z	R1 4 TO 5 WATTS	R2 5 WATTS
4Ω	10Ω	5Ω
8Ω	20Ω	10Ω
16Ω	40Ω	20Ω

TABLE 3A 300 OHM "L" PAD

PANEL SECTION RESISTANCE	TAPER	REAR SECTION RESISTANCE	TAPER	REAR SECTION SHUNT RESISTOR
2500Ω	AUDIO	500Ω	LINEAR	680Ω, 1/2 WATT

TABLE 3B 300 OHM "T" PAD

	RESISTANCE	TAPER	SHUNT RESISTOR
PANEL SECTION	2500Ω	AUDIO	1.5KΩ, 1/2 WATT
CENTER SECTION	500Ω	LINEAR	680Ω, 1/2 WATT
REAR SECTION	500Ω	LINEAR	680Ω, 1/2 WATT

Fig. 3. A simple attenuator that you can make from available components.

RF Attenuators

"L" and "T" pads have other applications besides as audio attenuators. They can be used as TV-signal attenuators to (1) reduce overloading in strong signal areas, (2) diminish crosstalk interference caused by nearby or powerful stations, (3) minimize buzz due to high-level signal, (4) prevent mismatch of antenna to set, and (5) simulate fringe-area signals for service work.

The 300-ohm "L" and "T" pads can be assembled easily and inexpensively by ganging 1/2-watt carbon-composition control sections. Ganged controls are available in several manufacturers' lines of replacement controls.

Fig. 4A shows the parts and wiring necessary for "L" pad; Fig. 4B, the "T" pad. Their schematic drawings are shown in Fig. 5.

These controls have fairly constant impedance characteristics and linear attenuation from 0 to 70 db. Their maximum power dissipation is 1/4 watt.

A simple and even less expensive

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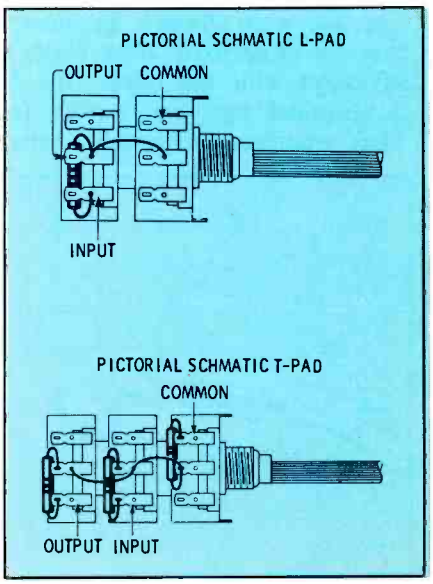

Fig. 4. Pads for 300-ohm balanced line.

keep

AM/FM PORTABLES

working

They're more profitable than their AM-only brothers.

by Thomas R. Haskett

Since its introduction, many servicemen have viewed the transistor portable radio with disdain. "It only costs about $9," they say, "so how can you make a profit fixing it?" Well, there are shops that do make a *good* profit on such cheapies.

The point of this article, however, is that AM-FM transistor portables usually cost from $20 to $100, and this gives you a much greater range for profit. The presence of the FM band makes the owner less likely to think of the radio as a toy, and he is more inclined to get it fixed rather than throw it away and buy another. This is true of multiband sets, also, which often cover longwave or shortwave bands in addition to AM and FM broadcast.

Merchandising Your Services

Some shops find it good business to establish a minimum or estimate charge on these radios. It works this way: A customer brings his set to you for an estimate. You try new batteries for free, but if this doesn't fix it, you tell him an estimate will cost $5, even though he doesn't have the radio fixed. If he elects to go ahead with the repair, the $5 is absorbed by your service fee. Thus, whatever the trouble (batteries excepted), your minimum charge is $5.

The *limit charge* is another useful device to attract and keep transistor business. After you've had enough experience with these sets to get a good idea of the usual repairs and bills, you establish a maximum or limit to your fee for a transistor AM-FM. Based on the model, this could be $10, $15, or even $20.

You might also find it wise to set up a flat rate for all such sets. Customers are impressed by such a policy, for it convinces them you are being fair and not overcharging them.

Factory-warranty service can also be a profitable venture, and you would do well to investigate the chances of taking on such business. Here the factory pays you a flat rate plus all parts (either on an exchange, direct-replacement, or reimbursement basis.)

General Transistor Procedures

It makes good sense to have one department in your shop that does nothing but transistor service. This could be one man or six; but when they do this day in and day out they become expert at it, fix the sets faster, and raise the profit rate for the shop. It requires some break-in for a "tube man" to get used to transistors, and the break-in is faster if he does nothing but transistor work.

Of course, you know the major differences in transistor and tube radios: smaller voltages; less or no heat; no rectifiers, batteries instead; smaller in size; and more rugged than tube sets. Transistors are often thought to be heat sensitive, but aren't as bad as some think—it depends on the transistor. (One manufacturer made a surprising demonstration: A transistor radio was turned on and tuned in to a station; a technician applied the flame from a cigarette lighter to a transistor. The radio went dead, then the flame was removed. After a few minutes'

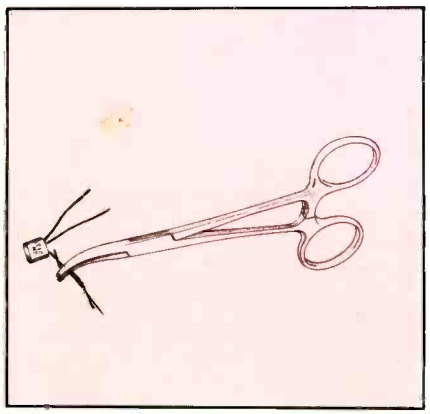

Fig. 1. Heat sink for transistor work.

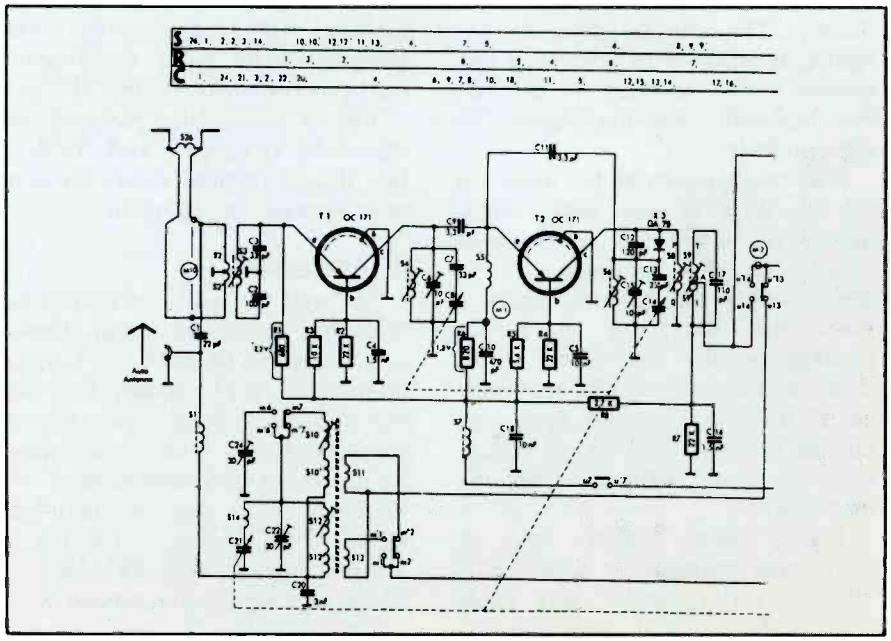

Fig. 2. Schematic as you see it with some imported AM-FM portable radios.

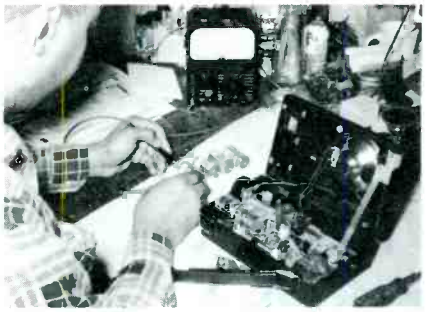

Fig. 3. Testing batteries is first step.

cooling, the radio played again.)

What is required for transistor service? Well, a few special tools, to begin with: Hand tools must be small; solder pencils are better than big guns or irons; a magnifying lamp is useful for examining printed boards for cracks; hemostats (Fig. 1) are useful for a heat-sink when soldering transistors, diodes, and quarter-watt resistors; bulb-type solder removers and desoldering tips are valuable for removing defective components from circuit boards; and even headphone jacks require special wrenches.

Some of the test instruments used for tube servicing can be used with transistors, but others are built especially for transistors. Examples: Transistor tester, bench power supply, the special analyzer, and a low-range, low-current VOM or VTVM. Then, too, the parts stock for transistor radios is bound to be different —quarter-watt resistors, low-voltage electrolytics, tiny speakers and headphone jacks, transistors, diodes, and thermistors.

Servicing Methods

It goes without saying that you must know something about transistor circuits before you can specialize. Fig. 2 shows a partial schematic of a typical AM-FM transistor portable. The symbols are a bit unusual if you haven't seen them before (remember, many of these sets will be imports). Notice the resistor symbol—a box with the value in ohms printed inside. The ground symbol is different, too—a single bar across the end of a perpendicular line (the ordinary ground symbol with the two bottom lines removed). The strip across the top of the schematic gives the location of every coil (marked S), resistor (R), and capacitor (C) in the circuit. Test points are circles with M-numbers inside them.

Now let's examine a logical servicing sequence which can be used on nearly all sets. The most common difficulty is batteries — they're in backwards, they're weak, or the holder contacts are corroded. The receiver may be completely dead, the local oscillator might be all that's dead, the set can sometimes play on FM but not on AM, and sometimes you will hear motorboating. Your first test should be to either substitute fresh batteries or (as in Fig. 3) check voltage of the old — they should be anywhere from rated voltage to no more than 20% below.

The next step is to hook up a bench power supply and an analyzer to the receiver, as in Fig. 4. Some radios use a tapped power supply, with the tap going to the speaker, and your power supply should have such an arrangement available. Monitor the set's current with the power-supply meter, or with the current range of a VOM. The amount of current varies widely, depending on the model of receiver, but you can assume when the switch is on, the set should draw current. If the current is high (more than 20 or 30 ma), this suggests a short; no current indicates an open circuit. Turn up the volume control and tune the dial; if the current shown by the meter increases, the set is probably working up through the output stage, and the trouble could be a faulty earphone jack, open voice coil, broken speaker lead, or bad speaker.

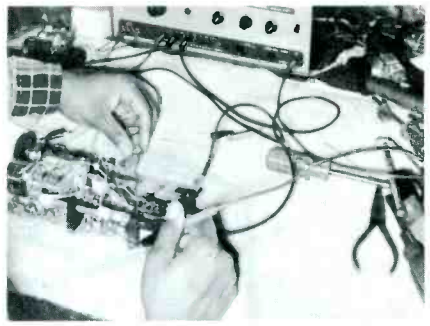

Fig. 4. Connecting set to bench supply.

At this point, if the trouble lies farther back in the set, it's best to resort to either signal injection or signal tracing, or a combination of the two. You must isolate the defective stage.

You can inject a 400-cps signal at the volume control to test the audio stages, which are always common to both AM and FM. Some sets have common transistors in the IF strip, while others have separate IF modules for AM and for FM; you will have to inject either 10.7 mc or 455 kc to check these stages.

It's also possible to use a signal tracer with a high-gain audio amplifier and a detector probe. While this technique works fine in audio, detector, and IF stages, it is practically useless at the converter and RF stages because the RF signal is very low-level. This is one point, however, where a high-gain scope is helpful — with a low-capacitance probe you can *view* the RF; use a modulated signal from a generator and adjust the scope horizontal fre-

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VOLTAGE CHECKS FOR DIFFICULTIES FOUND IN TRANSISTOR CIRCUITS

DEFECT	N-P-N			P-N-P		
	COLLECTOR	EMMITTER	BASE	COLLECTOR	EMMITTER	BASE
Open base IF transformer	High	Low	Low	Low	High	*
Open collector coil	Low	Low	OK	High	High	OK
Open emitter resistor	High	High**	OK	Low	Low**	OK
Open base (internal)	High	Low	OK	Low	High	OK
Emitter-collector leak	Low	High	OK	High	Low	OK

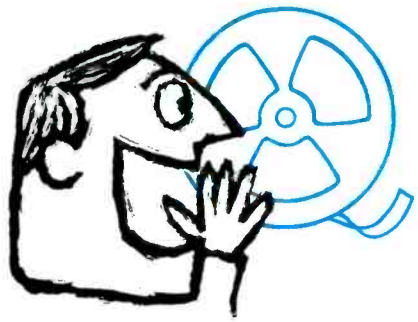
Notes:

* Reading depends on resistance of meter.

**Small change only. Emitter assumes voltage on base.

Use 20,000-ohm-per-volt meter.

All indications will be opposite to those listed if a positive ground is used.



The Sly Old Vox

TAPE RECORDERS

He can't hide his trouble from you if you know what you're looking for.

by Robert M. Glover

VOX is Latin for "voice," a term used for years by amateurs to describe voice-controlled transmitters. The operator speaks into the mike, and the rig is automatically switched to TRANSMIT by his voice. When he stops speaking, the transmitter is cut off and the receiver is actuated.

More recently, the same operational concept is being applied to tape recorders. When the voice starts, so does the tape machine. A recorder so equipped is especially handy for someone who wishes to record comments, but needs both hands for something else. One example is a surgeon during an operation. Physically handicapped persons also find VOX machines helpful for carrying on business, preparing school assignments, or corresponding by mail. Executives utilize the VOX method to record ideas as they occur and to handle paper work at the same time.

An impressive number of VOX tape recorders are sold to private investigation agencies. Many are purchased also by personnel departments for recording interviews with job applicants. Ways to use VOX tape recorders are numerous and more are being found daily. You can easily conclude, then, that VOX tape recorders are fast becoming a profitable service item.

Is the VOX really sly? Let's track him down and find out! For the most part, the VOX recorder is the some as any other; the big difference is in the addition of the VOX section. Since solid-state construction is used predominantly in VOX recorders, we will concern ourselves with transistor circuits.

Simple Amplified VOX

A typical VOX section (Fig. 1) consist of a two-stage amplifier and a relay-control (or trigger) stage. In the schematic, we've traced through the switches for you, drawing them in RECORD position. Most recorder schematics are drawn with the switches in PLAYBACK instead of RECORD position. When you get a machine on the bench, get out your pencil and redraw the switches like this to avoid becoming confused.

In Fig. 1, when the operator speaks, audio is taken from the secondary winding of the recorder's output transformer and fed to the primary winding of T1. Variable resistor R1 across the secondary winding of T1 forms part of the biasing circuit for transistor X1. R1 acts as a sensitivity control, because it works with R2 and R3 to set base bias for X1. This reverse bias must be overcome by negative peaks of the audio signal to forward-bias the transistor into conduction. The value of C1 is such that it bypasses the bias-oscillator signal from the recorder amplifier so that only audio is available at the base of X1 across R3. The value of bypass capacitor C2 is sufficient to insure that the output of this emittter-follower stage is well filtered and contains little audio.

When X1 is conducting, negative voltage across R4 increases and is applied directly to the base of X2, a common-collector DC amplifier (the same as an emitter-follower).

The output of X2, also negative-going, provides forward bias for relay-trigger transistor X3. Conduction in X3 causes relay K1 to energize, closing a set of contacts and starting the tape drive motor. When the voice stops, audio no

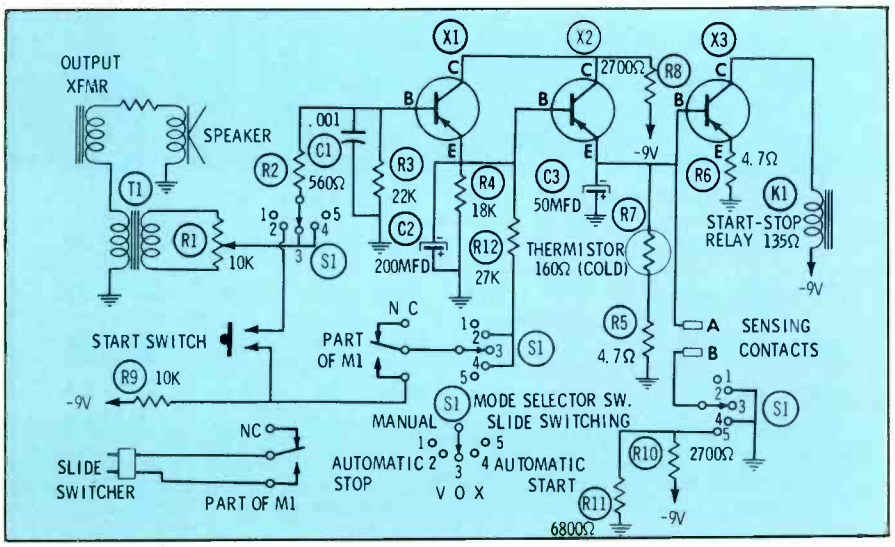


Fig. 1. Both saturation and filtering actions change audio to DC to operate relay.

longer reaches T1 and the entire chain returns to the normal state. K1 de-energizes and the drive motor stops.

Interesting use is made of a thermistor in the output (emitter) circuit of DC amplifier X2. This thermistor prevents the bias voltage for trigger transistor X3 from becoming great enough at any time to damage the junction. This could happen during any large increase in emitter current flow through X2. For example, if the mode selector switch is set for AUTOMATIC STOP (position 2), X2 emitter current does increase when the START switch is closed, and for an instant both X1 and X2 are driven to high conduction. Usual forward biasing of transistor X2 is furthered during this instant by the voltage supplied through R9 and R12 when the relay contacts close. The thermistor's resistance lowers during this high current condition and prevents forward bias on X3 from becoming high enough to damage the transistor. When the start switch opens, sufficient forward bias remains on X2 and R9 and R12 to keep K1 energized. Moving S1 to MANUAL position removes the biasing voltage on X2 and allows K1 to de-energize and remove power from the drive motor.

One form of automatic stop can be provided by a strip of metallic sensing tape on the dull side of regular recording tape. When the mode switch is in position 2 or 4, the metal strip grounds the base of X3 whenever it comes to rest across sensing contacts A and B. This places the base of X3 at the same voltage level as its emitter and K1 will de-energize as X3 no longer conducts. Thus, one way to operate this machine is by starting the drive motor with the START switch and stopping it with the sensing tape.

Another mode of operation (position 4) uses audio to start the drive motor. In this mode, the machine continues to operate until S1 is moved to MANUAL position or a piece of sensing tape contacts with A and B. (You can see that a little piece of sensing tape in the wrong place could cause abnormal operation!)

Sensing tape is used in yet another mode (position 5) to trigger K1 for operating a projector's slide-changing mechanism. In this position, S1 deactivates the audio portion of the VOX circuit and connects voltage divider R10 and R11 to sensing contact B. When a piece of sensing tape passes over A and B, trigger transistor X3 is biased into conduction and K1 is energized. This closes the appropriate contacts and the projector mechanism is actuated.

Rectified-Type VOX

A look at the circuit in Fig. 2 could be somewhat deceiving because it looks simple enough to be found in a portable. This VOX circuit is used, however, in one of the more sophisticated transistor machines; in fact, the only time this large model is likely to leave its owner's home is when repair is needed! VOX can be included in machines of various prices, as there is no need for elaborate circuits. The main function of VOX is to act as a start-stop device, no matter how complex the recorder.

Basically, the VOX unit in Fig. 2 consists of a two-stage amplifier, a rectifier, a filter and delay network, and a relay-trigger stage. The first stage is a common-emitter amplifier that receives audio from the output of either amplifier channel, depending upon the position of a selector

• *Please turn to page 99*

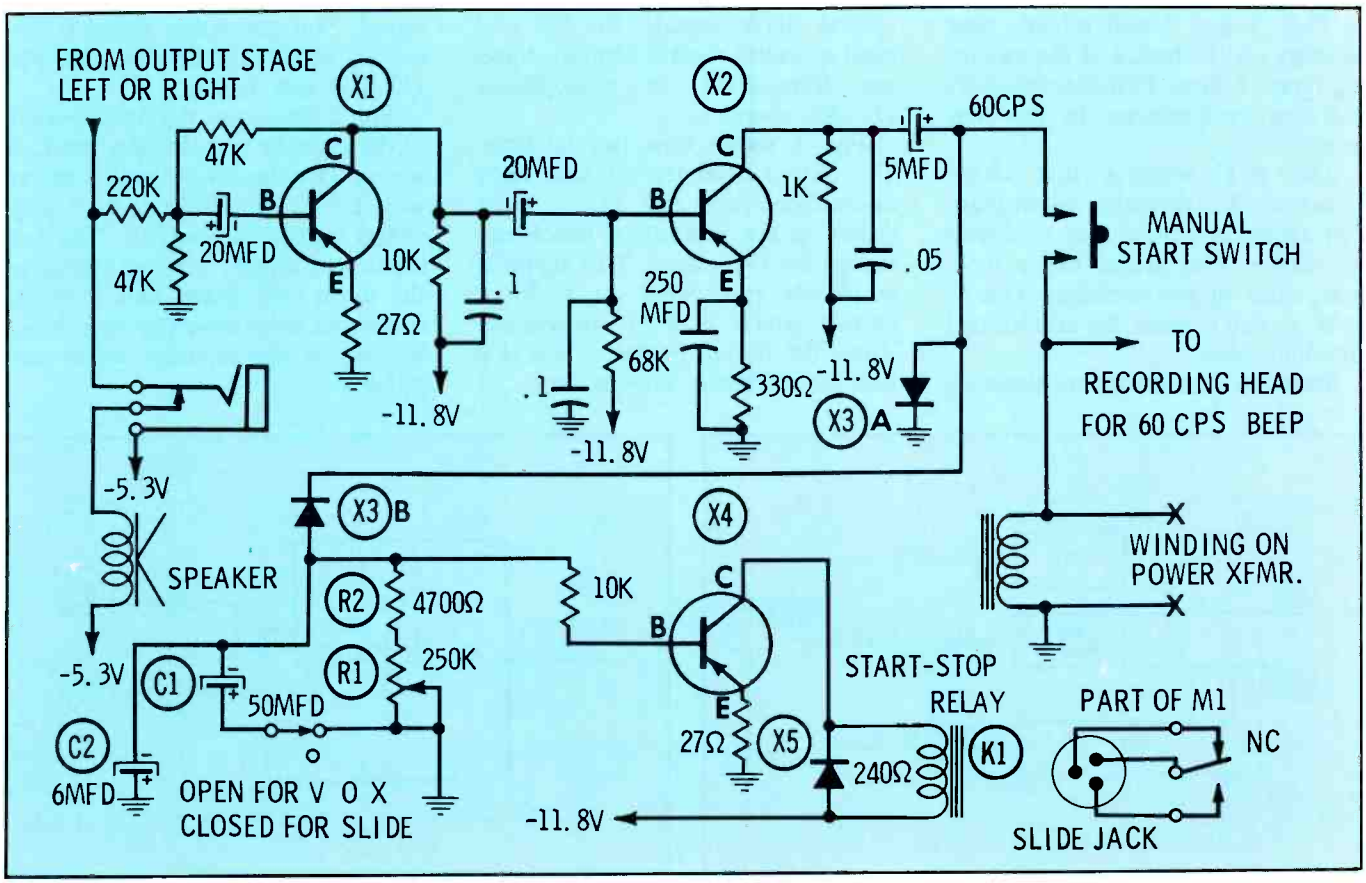


Fig. 2. In this unit, two-stage audio amplifier feeds rectifiers, and their DC output actuates the trigger transistor.

A double-barreled dose of up-to-date servicing information.

LATEST CIRCUITS for FM STEREO

by E. F. Rice and William Kreuger

In this article we will review the highlights of the newest circuits found in FM stereo. Multiplex theory and alignment have been well covered in past issues, so a glance at Figs. 1 and 2 will refresh your memory on the basics of the switching-type of Time-Division detectors that are predominant in the new models.

The FCC requires that stereo broadcasts be receivable on ordinary FM receivers—those not equipped for stereo. This means music from both sides of the orchestra (the L + R signals) must be transmitted simultaneously.

Stereo is created by transmitting a special signal capable of being processed by multiplex equipment only, in which the left and right channels are separated. When the receiver is not equipped to use the special stereo signals, the left and right channels remain combined and are transmitted as monophonic (L+R) sound.

Fig. 1 shows how this is done. The output from the left and right microphone are fed to a 38-kc switch in the transmitter which develops the L-R signal. This signal is amplitude modulated on a 38-kc carrier which is then suppressed. Thus, the output of the switch is a pair of sidebands ranging from 23 kc to 38 kc and 38 kc to 53 kc.

The monophonic signal (L+R) and a 19-kc pilot signal are combined with the L-R sidebands to produce the composite FM stereo signal. This composite signal is frequency modulated on the main FM (88-108 mc) carrier.

Fig. 2 illustrates the 38-kc switch in the receiver that decodes the L-R signal. This decoded signal is mixed with L+R and results in two individual signals (L and R). The two separate outputs, corresponding to the upper and lower halves of the composite wave-envelope, are shown leading to the separate audio amplifiers.

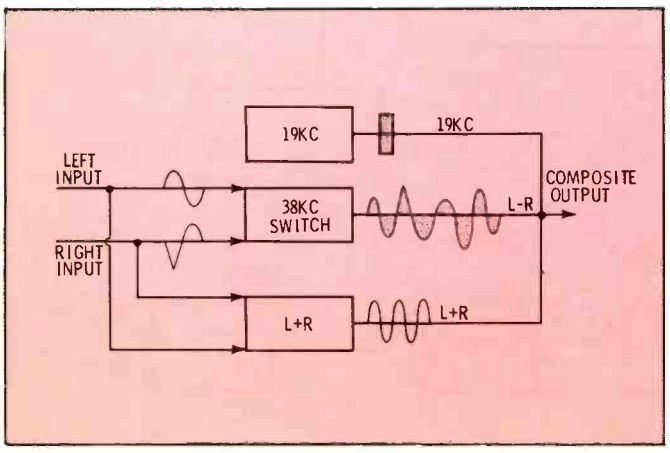


Fig. 1. Waveforms show how FM stereo signal is generated.

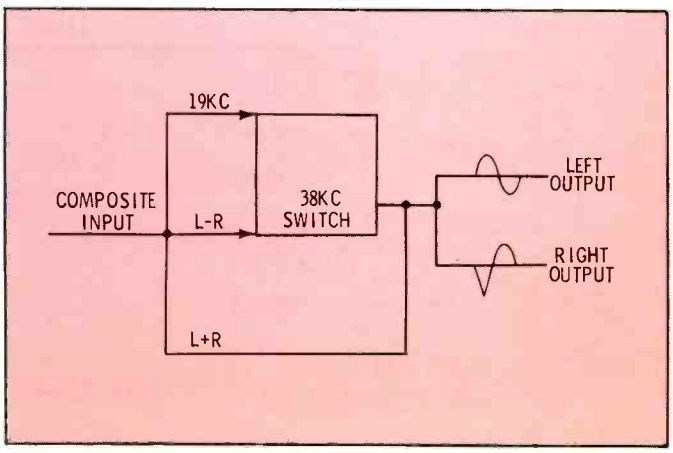


Fig. 2. Extracting both the left- and right-channel information.

The switch in Fig. 2 is actually the 38-kc oscillator that serves to reinsert the 38-kc carrier that was suppressed at the transmitter. A special sync pulse, in the form of a 19-kc sine wave pilot signal is always transmitted during stereo broadcasts to keep this switch synchronized with the one at the transmitter.

In recent models, new designs are appearing in the circuits handling the 19-kc pilot signal and developing the 38-kc carrier. Let's have a look at some of these circuits.

Double-Amplifiers

Many new models use a pair of diodes connected as a full-wave rectifier for converting the 19-kc pilot signal into positive 38-kc pulses. These pulses are fed to an amplifier whose output is a 38-kc sine wave. This sine wave is produced by a tank circuit in the amplifier. Since a free-running oscillator isn't used, the 38-kc sine wave doesn't appear at the detector diodes unless a stereo signal, containing a 19-kc pilot, is being received. This is a good point to remember when checking the oscillator output from a circuit of this type.

A typical circuit of this kind is shown in Fig. 3. Both sides of transformer L11 are tuned to extract the 19-kc pilot from the composite output of the first amplifier. When the top of the secondary is positive and the bottom is negative, diode M9 conducts, drawing electrons upward through R55, thus producing a positive pulse that is coupled through C53 to the grid of V8B. On the positive half-cycle,

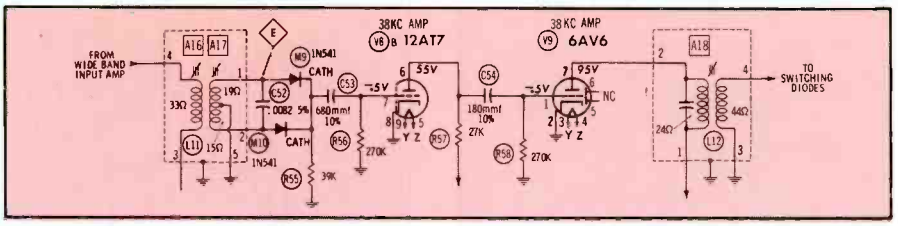


Fig. 3. Some receivers use two doubler diodes to redevelop the 38-kc signal

M10 conducts through the same path, producing another positive pulse at the grid of V8B. Therefore, this grid receives two positive pulses for each cycle of 19-kc pilot signal.

Transformer L12 is tuned to 38 kc and the sine wave produced across its secondary is used to switch the synchronous detector diodes on and off.

In contrast to this method of obtaining the 38-kc carrier are the circuits that use an oscillator, such as those in Fig. 4.

X1 is a self-sustaining 38-kc oscillator, with C4 providing collector-to-emitter feedback. This type of oscillator circuit generates a 38-kc signal even when a monophonic station is tuned in. Thus, the 38-kc signal converts supersonic noise into audible noise. This results in background hiss being heard when using a multiplex tuner on a monophonic transmissions. The circuit in Fig. 4 uses a special automatic converter switch that turns off the 38-kc oscillator when the incoming signal is monophonic. Let's see how this is done. The tuned output of the second 19-kc amplifier is coupled to the base of X2 by C1. When a stereo signal is received, positive alternations of the 19-kc pilot cause X2 to conduct. This conduction lights the stereo-indicator lamp and causes X5 to rectify the 19-kc signal and charge C3. The result is a positive voltage on the base of X3, causing it to conduct. Since the oscillator draws its base current through the collector-to-emitter resistance of X3, the oscillator runs when X3 conducts; when it doesn't conduct, the oscillator is disabled. The switch in the emitter of X3 provides for manual control of the oscillator.

The oscillator is synchronized by the 19-kc pilot coupled through C5, and is adjusted by phase control R7. Switch S1 is included in this circuit to allow the oscillator to run freely for easier adjustment during alignment.

Squelch or Muting Circuits

There are two kinds of squelch circuits in use. One functions only when the receiver's multiplex section is operating; thus, the multiplex receiver is kept silent between stations or when tuning across monophonic signals. The other type circuit operates continuously but silences the multiplex receiver only between stations.

The first type is illustrated by the circuit shown in Fig. 5. When the set is receiving stereo, switch S1 is open, causing both sections of the

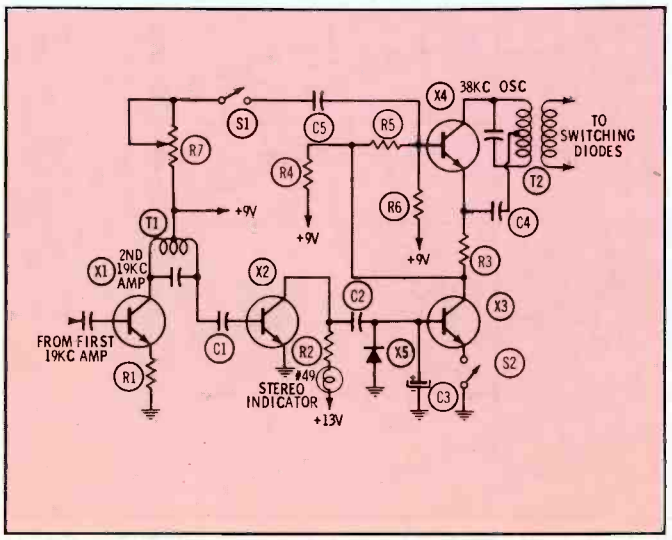


Fig. 4. 38-kc killer circuit prevents mono background hiss.

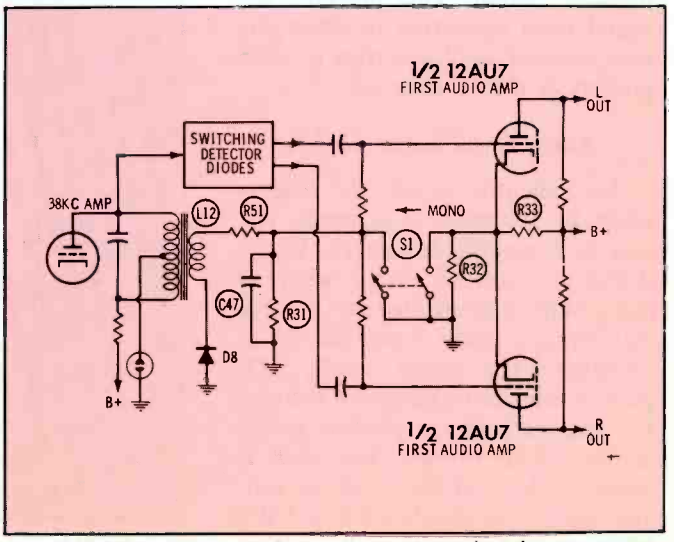


Fig. 5. Circuit allows only stereo output signals to appear.

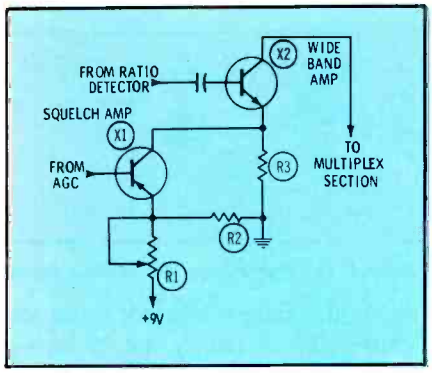


Fig. 6. Between-station muting circuit.

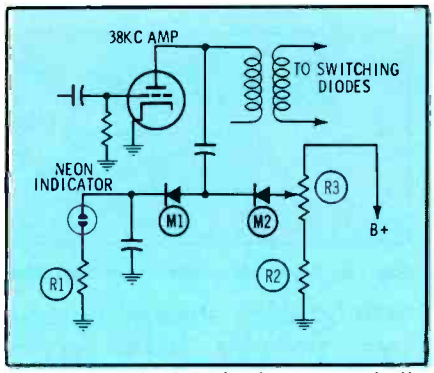


Fig. 7. Rectified 38-kc fires neon bulb.

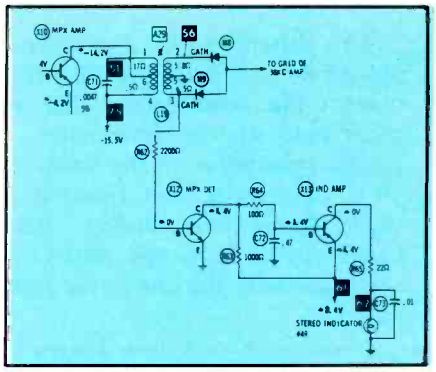


Fig. 8. L19 signal controls indicator.

12AU7 to be cut off by the high positive cathode voltage produced by voltage divider R12-R33. When a stereo station is tuned in, the 38-kc amplifer operates and a portion of its output is rectified by D8. The result is a positive charge on C47 which is applied to the grids of the 12AU7 causing them to conduct. During monophonic reception, the switch disables the squelch by connecting the cathodes directly to ground and shorting C47.

The squelch arrangement in Fig. 6 is typical of the second type of muting circuit. AGC voltage is fed to the base of squelch amplifier X1. The IF transistors are PNP's so the AGC is positive when the receiver is tuned to a station and is negative between stations. This positive voltage causes X1 to conduct between stations when no carrier is present. Because the collector current for X1 is drawn through R3, the emitter of X2 becomes positive when X1 conducts. Notice, however, X2 is an NPN unit, and positive voltage on the emitter of an NPN cuts it off. X2 is the first amplifier following the ratio detector and when it is cut off the signal path is broken at the detector output. This prevents any signal from appearing in the multiplex receiver until a carrier is again present in the IF channel.

Stereo Indicator Lights

An indicator to tell the listener when he is tuned to a stereo station is a popular accessory. Fig. 7 shows a common circuit where a neon bulb is controlled by a rectified voltage taken from the 38-kc amplifier. The upper diode, M1, permits current to be drawn through R1 and the bulb on positive halves of the 38-kc carrier. The bulb is biased with a variable positive voltage taken from bleeders R2 and R3. M2 prevent the positive alternations of the signal from reaching the bleeder resistors.

The indicator circuit shown in Fig. 8 is a bit more detailed. The indicator voltage is taken from the doubler circuit. The 19-kc signal from the secondary of L19 is used to forward-bias NPN transistor X12 on positive halves of the 19-kc pilot signal. The resulting collector current of X12 supplies base current for X13, which is a PNP. The collector current of X13 is drawn through the #49 bulb causing it to glow when a stereo broadcast is tuned in. The collector of X12 and the emitter of X13 both require a positive voltage; a special winding on the power transformer is used to provide this voltage.

Demodulator Circuits

Nearly every recent stereo receiver uses the switching type (so-called "time division") synchronous detector. With this method the composite stereo signal, which looks like Fig. 2 and contains the sidebands of the 38-kc suppressed carrier, is combined with the 38-kc oscillator signal at the input to the switching diodes. No attempt is made to separate the components of the composite signal and send them to separate amplifiers. Regardless of whether the circuit uses two diodes, four, or even six in a modified bridge, the operation always relies on the fact that L-R information is carried on one half of the 38-kc wave envelope and −(L-R) information is carried on the other half.

An entirely different approach to synchronous detection (The Biplex Detector) is used by at least one manufacturer. This system uses only one special transistor and gives the advantage of equal volume on both stereo and monophonic stations.

Fig. 9 depicts this unusual circuit in simplified form. The composite signal fed to the base contains mono-

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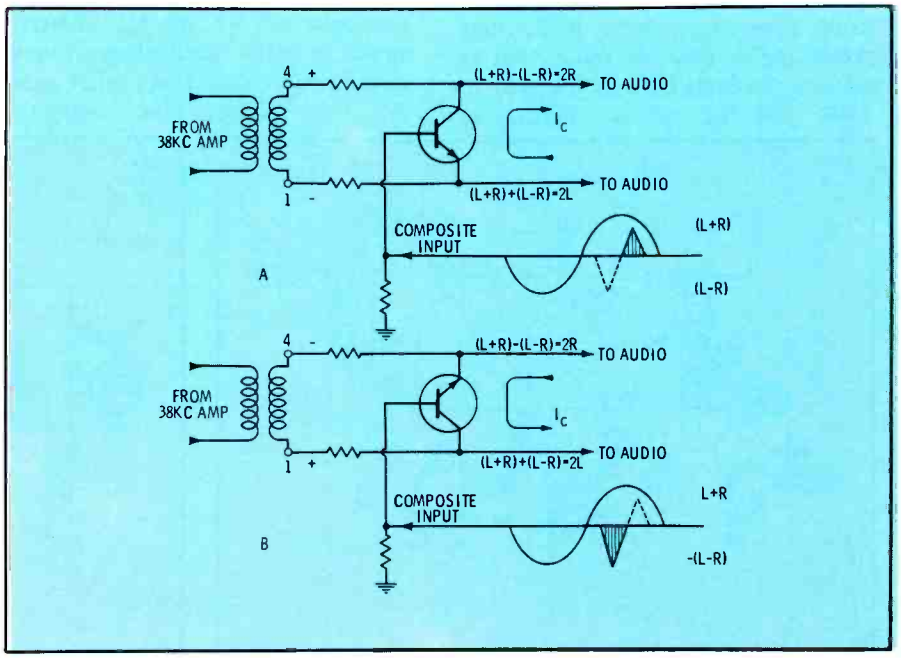

Fig. 9. This simplified schematic shows detailed operation of Biplex detector.

SALES TIPS

for NEW and USED TV

Dollars are to be had if you prepare. Here's how.

by Wayne Lemons

How do you sell new or used TV sets? Or do you?

No one has more opportunity to sell TV sets than TV technicians themselves, and possibly no group loses more sales every day. Why? I dare say that the first and greatest reason is simply lack of confidence in your own ability to sell. How often have you said to yourself or to someone else, "I'm no salesman!" The sad fact is that the fellow who says this probably isn't, but — and here the odds are 100 to 1 — he *can* be if he really *wants* to be.

I've watched good TV technicians, who can chatter entertainingly and sensibly on a service call, become literally word-bound when faced with a sales prospect. I've seen them deeply embarrassed by their shy, bumbling, anemic, and inept sales presentations. What's the underlying cause? In most cases, it is a lack of information about the product you're selling or, maybe more to the point, a lack of the right kind of information.

Sales Points—What the Customer Wants

The technician, perhaps because he is trained to sniff out trouble, is more aware of what the set looks like underneath, what tubes it uses, how easy it is to work on or make technical adjustments to, than he is of what the customer wants to see.

The average customer, on the other hand, couldn't care less whether the set has quadrature sound detection or a stacked IF system. He is looking for a good picture and adequate sound. His wife may want a cabinet that goes well with the rest of her furnishings and a set that doesn't require an engineer for its operation. Both want a set that will be reasonably trouble-free.

You can set your customer's mind at ease on this last point by having a sensible guarantee. Nothing is a stronger sales clincher than a good warranty; unless you're a fly-by-night, you're going to stand behind any set you sell anyway, so capitalize on your guarantee — use it to overcome this one reluctance of your potential TV buyer.

You will note that up to now there has been no mention of price. Strange as this may seem to some technicians, price is usually no object. This doesn't mean the customer is not interested in obtaining the best price possible for what he is getting; he is. But it is the salesman's job to get the selling done before the price tag is mentioned. Furthermore, in these days of installment buying, price-per-month may be a more important selling point than total price anyway, so don't be stampeded into talking price only. Customers quickly become suspicious of low prices and easily get the idea that something must be wrong with the set.

It is often the policy of larger merchandisers to "sell up" — that is, advertise a price leader to get the customer into the store, then— after this spider-and-fly buildup— pressure the sale of a higher-priced set.

I've found that "selling down" is a much more effective and honest approach for the technician. Here's what I mean. Show the prospect a better set than you believe he will buy and at more money than you think he may wish to pay. If you do a good job, don't be surprised when he buys the set. When you use this approach, don't be too quick to sell down. Also, never take for granted by the way a customer is dressed just how good a set he might purchase. A farmer in overalls may be able to buy and sell your store ten times over; so start with the best — you can always come down if you have to.

With a sincere sales approach, you can establish a price level that will start the customer thinking more of product quality than of price. You can instill quickly the reason why every set doesn't sell for $69.95. Once you have established this "quality" idea, you are well on your way to making the sale you want to make. The sell-down technique takes practice but it can be mastered.

The Showroom

Selling sets, whether new or used, cannot generally be done most effectively in a disorderly atmosphere. Perhaps it has been done, but the

Fig. 1. Haphazard care of sets is likely to discourage those prospective buyers.

Fig. 2. Neat appearances of the salesroom makes a difference in set sales.

Fig. 3. Rug and flowers will add greatly to attractiveness of any showfloor.

salesman's personality and orderliness of mind was the compensating factor.

If you have your used or new sets piled in helter-skelter fashion (Fig. 1), one on top of the other with little protection in between, this clearly implies to the customer what small regard you have for the sets you're selling. If you want a prospective buyer to believe your pitch about the sets, don't treat those sets with contempt. Arrange them in orderly fashion (Figs. 2 and 3), pamper them, dust them, display a bouquet of flowers on them, and make sure they're not cluttered up with old dust rags or a three-week-old newspaper (Fig. 4). Treat the sets with respect, and the customer will in turn respect your opinion of them.

Create Self-Assurance

Another important factor in selling a set, and one that will build your self-confidence, is to be sure in your own mind that the set is a good one — at least as good as you claim it to be! And be sure you know how to turn it on and adjust it. The best salesman can have little

• *Please turn to page 65*

Fig. 4. Sloppy housekeeping creates an atmosphere in which selling is difficult.

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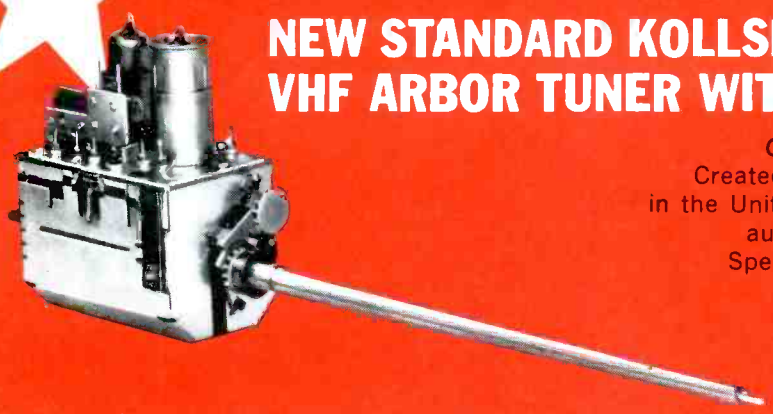

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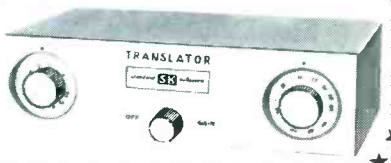
- Saves Time Servicing all Channel TV Sets
- Easier to Sell
- All Channel TV sets



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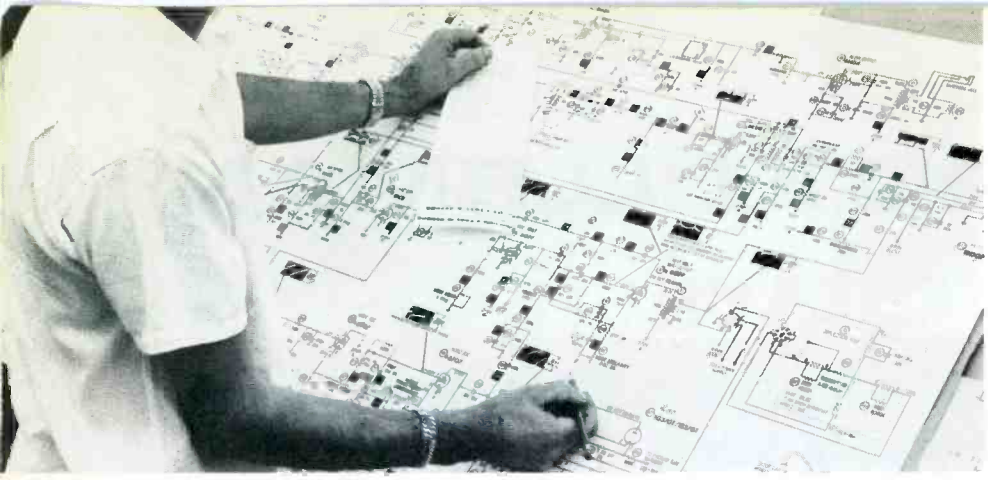
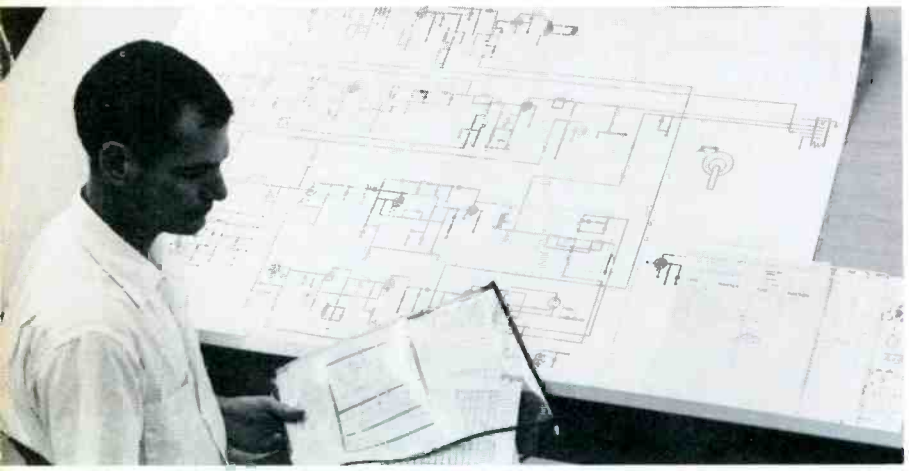
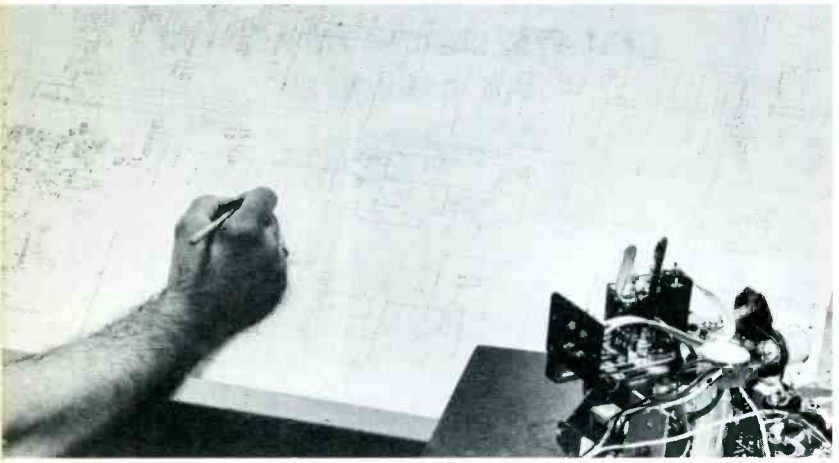


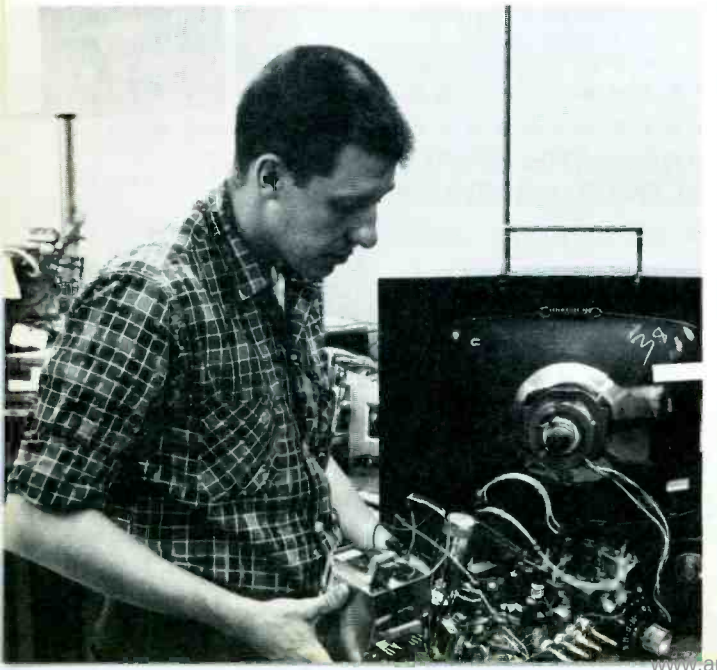
7. Finally the schematic is complete. Now the job is the final checkout. This includes verifying once more all component callouts, all voltages, points of identification (such as alignment and test points) at their proper position, CircuiTrace numbers at correct locations if the chassis uses printed boards, and all other data that was collected in the Analysis Department.



5. During the time the sketch was being prepared with Art-type, the TV chassis has been processed in the Analysis Department. One purpose of this analysis is to verify the accuracy of all components values indicated on the sketch; further, the analysis includes voltage measurements, resistance checks of coils and transformers, etc. Here the collected analysis material is being reviewed and arranged so it can be applied in proper order.



3. When the draftsman has thoroughly checked the TV chassis, and made appropriate notes, the sketching of the PHOTOFACT Standard Notation Schematic® begins. Circuit changes that constitute an alternate circuit are drawn. Components and wiring found in the actual chassis form the main diagram sketch; any circuit that was different on the manufacturer's schematic is drawn separately and shown as an alternate circuit.



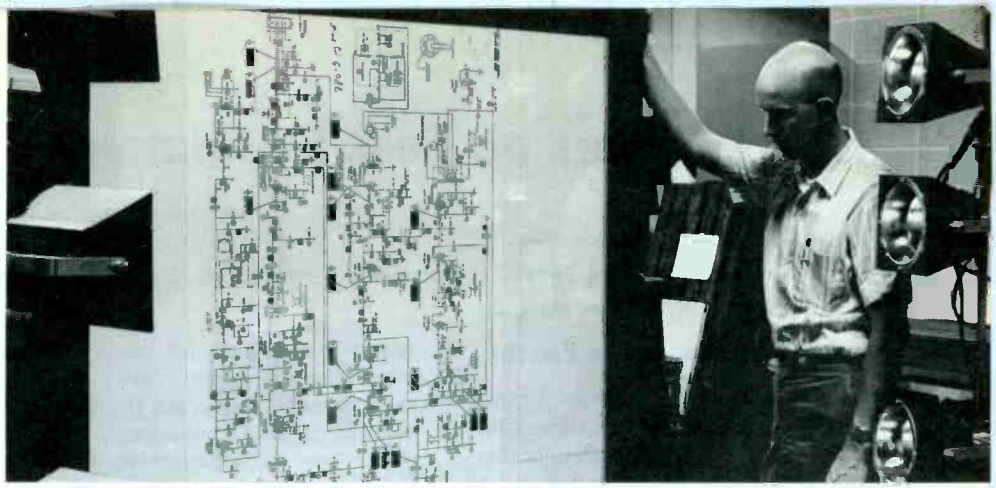
Watch

SCHEM

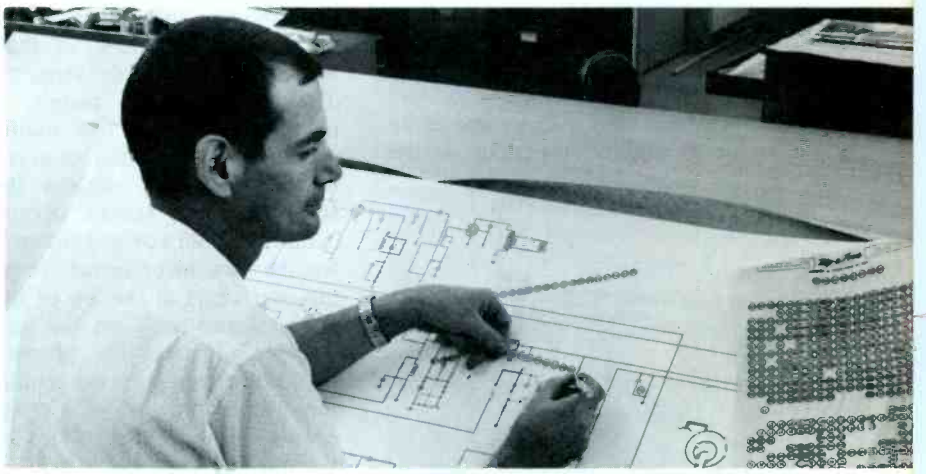
Gr

Many different steps and procedures enter into a completed is removed from the cabinet. These photos follow the PHOTOFACT

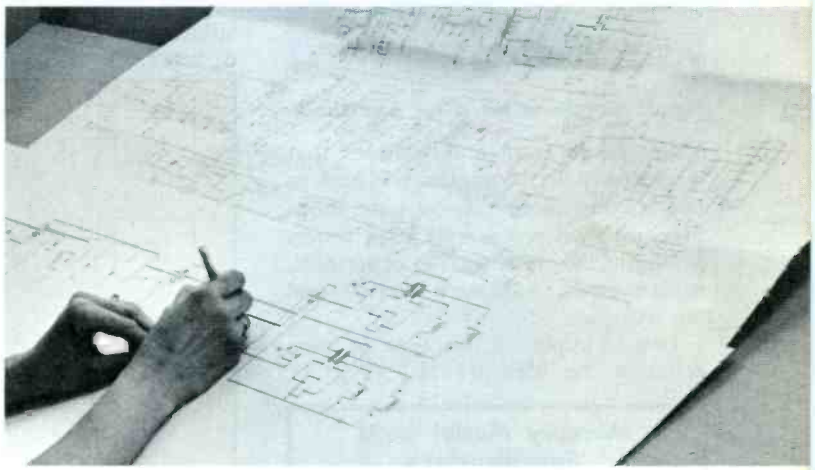
1. The first step is to disassemble the chassis and remove all shields. This permits the schematic draftsman to verify which components are inside shields, consequently, they can be so indicated in the preliminary sketch.



8. This final photo is of the first step in preparing the completed schematic for final printing. A photo is taken to reduce the schematic to the size you see in your PHOTOFACT Folder. From the reduced photostat, negatives are made and then zinc press-plates. On the press, the schematic is combined with the other data related to the set. The finished product is a folded and trimmed PHOTOFACT Folder.



6. All component parts are assigned identification numbers (known as callouts), such as (R1), (C1), (L1), (T1), etc. The original sketch is used as a reference guide in the process of placing this information on the schematic, again in Art-type. A watchful, experienced eye is alert here for any possible errors and any that are found are corrected in this step.



4. The hand-drawn sketch is then sent to the Schematic-Layout Department. With the master sketch as a guide, the diagram is rendered in Art-type on a grid board (lightweight cardboard with ¼" grids similar to graph paper). The Art-type is preprinted on sheets of clear acetate paper with wax on the back; it adheres easily to the grid board. The Art-type consists of lines, cross-overs, resistors, capacitors, coils, transformer, switches of all types, and other configurations that make up a standard PHOTOFACT schematic.

How

ATICS

ow

PHOTOFACT schematic. The process begins as soon as the chassis schematic from birth, through its growth to the completed product.

2. The chassis is then passed along to the draftsman. He checks the manufacturer's schematic of the unit against the actual TV chassis; every circuit is traced in its entirety. Any differences are noted on the manufacturer's schematic.

Notes on Test Equipment

analysis of test instruments . . . operation . . . applications

by Arnold E. Cly

Self-Service Tube Tester

For many years, a number of radio-TV service shops have given free tube-check service, but it is often bothersome and costly for a technician to stop in the middle of a repair job to check 10 tubes someone has just brought in. Also, the common do-it-yourselfer is usually on the defensive when he walks into a shop, and quite often he is slightly suspicious of the results taken from a tube tester that is probably too complex for him to operate. For these reasons, some shops have installed *self-service* tube testers similar to the types used in drugstores, supermarkets, hardware stores, and the like.

Fig. 1. Simple to setup for fast check.

One example of this type of tube tester is the Mercury 202 (Fig. 1), which is designed for simple operation. With this tester, more than 1200 tube types — including the latest nuvistors, novars, compactrons, and 10-pin types — along with vibrators, fuses, and light bulbs can be tested.

Simplicity and safety of operation are the major features of this instrument. There are only three switches: The ON-OFF toggle switch, the filament-voltage SELECTOR multiposition switch, and the TUBE QUALITY pushbutton. The user obtains the tube-socket number, METER SETTING indication, and SELECTOR SWITCH position for the tube to be tested from a large flip-over chart at the top of the tester. A numbered scale on the large 7" x 7" face indicates the proper setting for the METER SETTING control with the pushbutton in the normal (up) position. Calibrating voltage is fed to the meter, and the METER SETTING control determines the meter shunt resistance. As the block diagram in Fig. 6 shows, the SHORT and GAS tests are also made with the pushbutton in the up position. The possibility of tube or tube-tester damage resulting from a shorted or misplaced tube is greatly decreased with this arrangement.

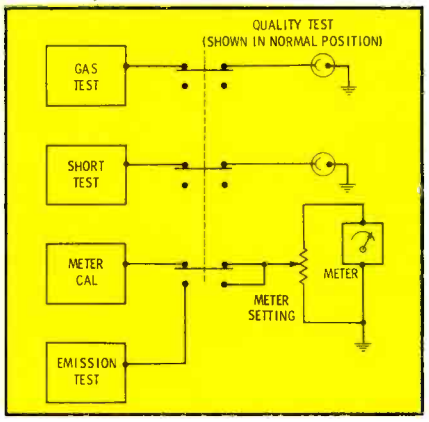


Fig. 2. Pushbutton in the up position.

Two silvered contacts for fuse tests and a bayonet socket for pilot-light tests are wired into the short-test circuit for continuity checks. Also, 6- and 12-volt three- or four-pin vibrators can be checked. Type 44 lamps are connected to each vibrator contact; a burned contact can be detected by unequal lighting of the bulbs, while a completely inoperative vibrator will not light either lamp. Above the fuse and pilot-light tester are 7- and 9-pin straighteners.

The tube tester is solidly built; the etched aluminum panel is neat and attractive. All 63 sockets have phosphor-bronze beryllium contacts to insure positive contact and long socket life. Although this tube tester will not give as much information about the status of a tube as a mutual-conductance instrument, it will show the most common defects. A Model 202 has been used in our lab for some time and has proven reliable in determining whether tubes were good, weak, or bad. Because of its simple fail-safe operation, this tester should give trouble-free operation and prove to be profitable for self-service tube sales.

Mercury Model 202E Specifications

Tube-Socket Complement:
9-pin novar, 12-pin compactron, 9- and 10-pin miniature, 8-pin loctal, 8-pin octal, and 5-pin nuvistor.

Tests Performed:
Interelement leakage, shorts, gas, emission. Checks vibrators, fuses, light bulbs.

Interelectrode Leakage Test:
Neon bulb.

Grid-Current (Gas) Test:
Neon bulb.

Power Requirements:
105-125 volts, 60 cps, 18 watts

(HWD) Size:
61" x 20" x 19½"

Weight:
20 lb

Price:
$129.95

FaradOhm Bridge/Analyzer

In the last few years, better-quality home-entertainment equipment has gone into more households. Usually these instruments have sophisticated circuits that are not found in the lower-priced units, and they may contain several components of close tolerance rating. When trouble appears in these

EICO Model 965 Specifications

Capacitance Range:
5 pf to 5000 mfd in 4 steps.

Power Factor:
0-80% at line frequency, on two highest capacitance ranges only.

Resistance Ranges:
0 to 500 megohms in 4 steps; resistances up to 100,000 megohms can be measured with the metered variable DC supply.

Resistance-Capacitance-Inductance Comparator Range:
Capacitance — standard divided by .025-50; Resistance, Inductance — standard multiplied by .025-50.

Bridge Supply Voltage:
.45 volt AC at line frequency, except 10 volts AC on lowest capacitance and highest resistance ranges.

Variable DC Supply Voltage Range:
0-500 volts DC in 6 steps.

DC VTVM Range:
0-500 volts in 6 steps; input impedance 10 megohms.

DC VTAM Range:
0-15 ma in 11 steps.

Accuracy:
±5% throughout, except on power factor below 30%.

Power Requirements:
32 to 45 watts, 117 volts AC.

Size (HWD):
8½" x 12½" x 9".

Weight:
15 lb

Price:
$129.95 (wired only).

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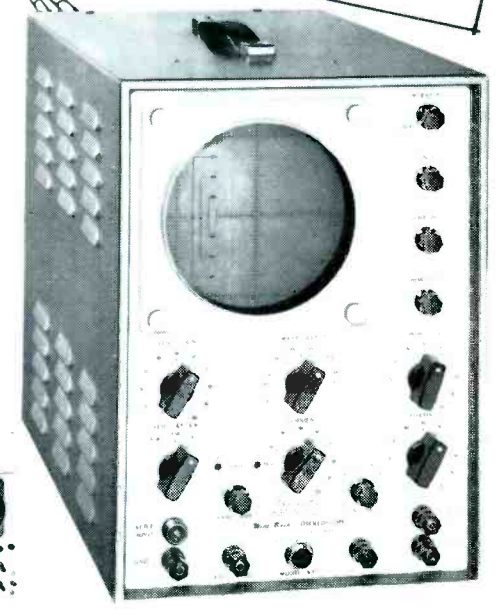

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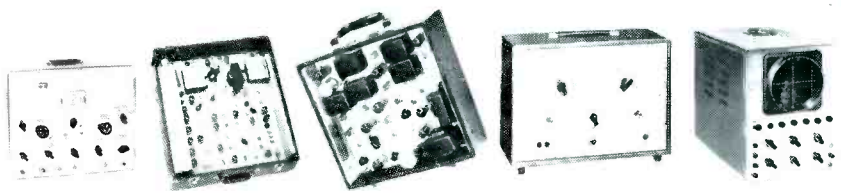

MODEL 615 MODEL 656XC MODEL 660 MODEL 661 MODEL 675A

THE HICKOK ELECTRICAL INSTRUMENT CO.

10566 Dupont Avenue • Cleveland, Ohio 44108

Represented in Canada by Stark Electronics, Ajax, Ontario
Internationally by Hughes International, Culver City, California

Circle 19 on literature card

Fig. 3. This unit has a low range of .15 ua when in the DC VTAM Position.

circuits, an instrument capable of making precision measurements is required. The EICO Model 965 Farad-ohm Bridge/Analyzer (Fig. 3) is capable of doing this job. It provides facilities for making precision measurements of resistance and capacitance; checking diode reverse and transistor quiescent current; testing insulation; and comparing resistances, capacitances, or inductances with external standards.

A DC VTVM with 6 ranges and a DC VTAM (vacuum-tube ammeter) with 11 ranges are employed in this instrument and may be used for external purposes. The voltage drop across the DC VTAM terminals is only 75 mv, and the lowest current range is an almost incomprehensible .15 ma (150 nanoamps). The meter is electronically protected in all ranges and cannot be overloaded more than 200%.

The Model 965 can be used to check the lowest-voltage capacitors found in transistorized equipment without danger of damage to the component. This is due to the low bridge-supply voltage of .45 volts AC at line frequency. When the bridge is to be used for measurements that require a different frequency and/or voltage than the instrument provides, an external supply can be used. A 1/32-amp fast-action fuse is used to protect the BRIDGE BALANCE potentiometer if excessive current is present when an external generator is applied.

Another feature of the bridge circuit is the AGC action to control the bridge detector-amplifier tube when an out-of-balance condition exists. The AGC tends to keep the meter reading on scale; however, when the null point is reached, the AGC action diminishes to afford a sharp null reading.

A 0-500 volt DC supply variable in six steps is used in measuring capacitor leakage and resistance and diode reverse or transistor quiescent current. A capacitor to be tested for leakage is placed between the proper terminal posts, and the variable-voltage supply is adjusted until the meter indicates the rated voltage of the component. The proper switch is then positioned to place the DC VTAM in the circuit, and the current drawn by the component is read from the meter. By using Ohm's law ($R = \frac{E}{I}$), the leakage resistance is determined. If desired, resistors may be measured in this manner instead of with the bridge; however, the applied voltage is chosen so the current drawn will be a convenient divisor, such as 1 ua. Then the true value is known from a simple application of Ohm's law. A plug-in shield is supplied with the instrument; when in place it encloses the component being tested to eliminate the effects of a stray field when a very low capacitance or a very high resistance is being measured.

Another feature of the Model 965 is the COMPARATOR position of the BRIDGE RANGE switch. This is especially useful when making an inductance comparison. Since the bridge supply voltage is low—.45 volts AC—magnetic-cored inductances rarely will be saturated.

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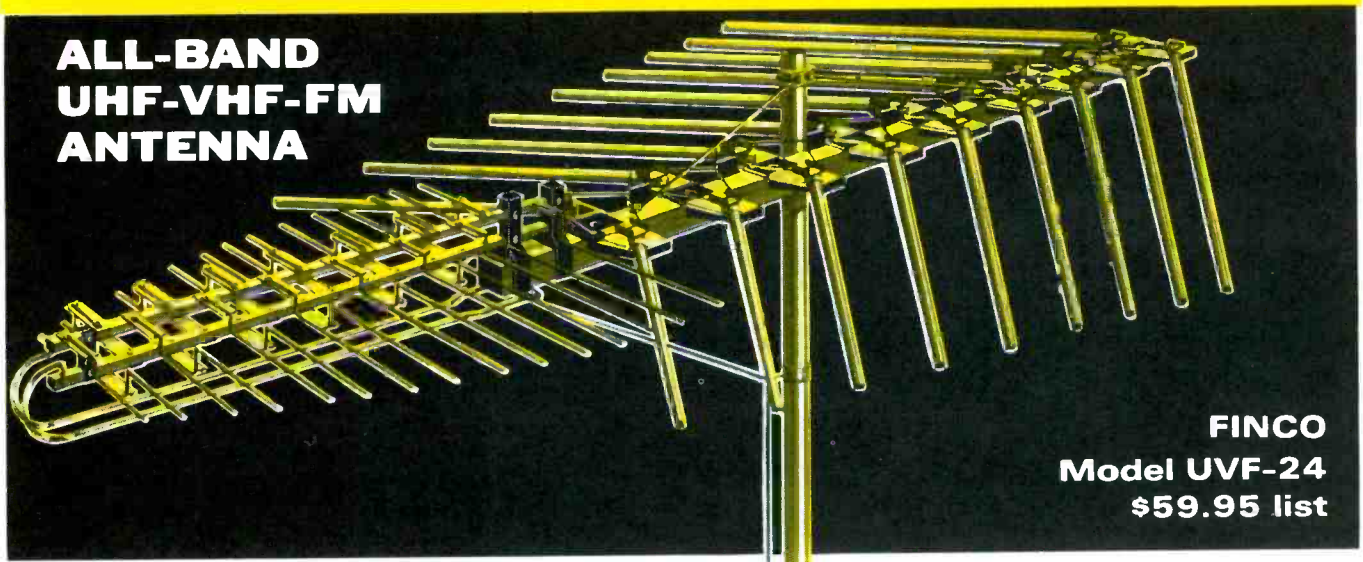
ALL-BAND UHF-VHF-FM ANTENNA



FINCO Model UVF-24 $59.95 list

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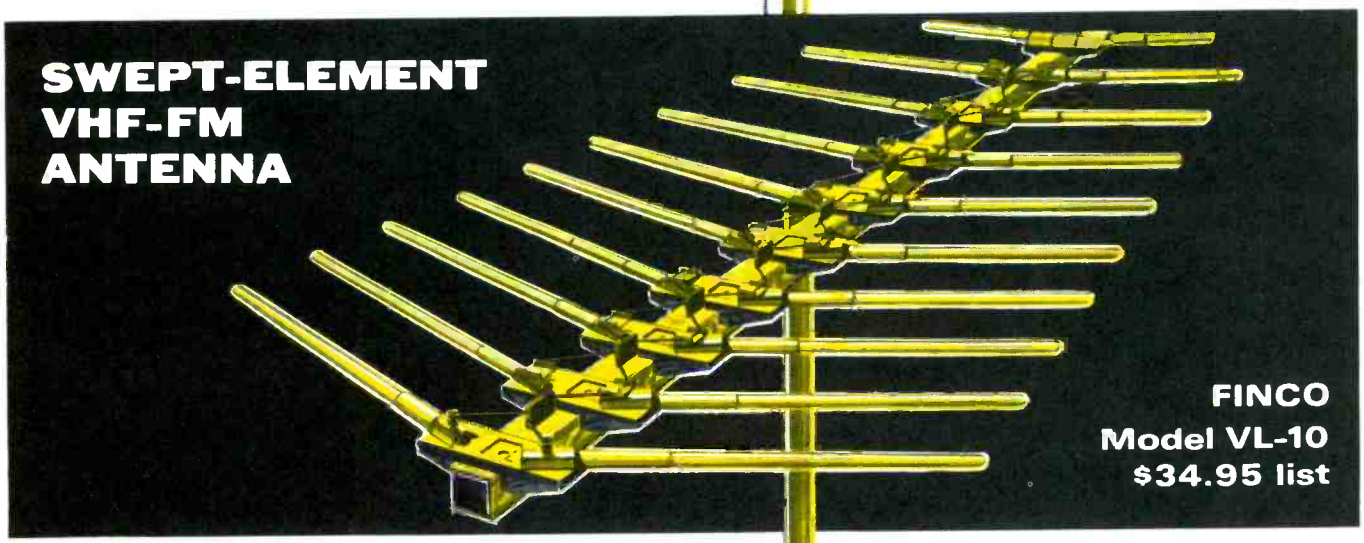
FINCO Model UVF-16—$30.50 list
FINCO Model UVF-10—$18.50 list

SWEPT-ELEMENT VHF-FM ANTENNA



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Circle 21 on literature card

Several components were tested with the Faradohm Bridge/Analyzer in our lab with excellent results. One protective feature that stood out was the illumination of the meter dial when excessive current was drawn. Insulation leakage or breakdown of a capacitor under test would cause this condition. Two incandescent lamps (in series) are in the circuit and mounted behind the meter panel. As the current increases to a high amount, the lamps glow.

A small lamp is mounted above the TEST terminal posts. When the instrument is set up so that a voltage is across these terminals, the lamp "blinks" continually as long as the voltage is present. This warns the operator that voltage is present and greatly reduces a potential shock hazard. There is also a DISCHARGE position on the FUNCTION switch to remove the charge from a capacitor when its test is completed.

A polarized jack is provided on the front panel. It is used in supplying an external polarized DC voltage to the instrument when a component being tested requires this type of voltage. Also on the front panel is a zero push-button. By depressing this button and adjusting the ZERO ADJUST control, the operator can reset the meter to zero during any part of any test.

The operating manual supplied with the Model 965 is self-explanatory. Careful reading of the manual will familiarize the user with the unit, and after a few tests are accomplished he will become aware of the versatility and usefulness of the instrument.

Circle 141 on literature card
on literature card

Versatile Oscilloscope

The Model WO-91B RCA oscilloscope (Fig. 4) is similar in many ways to the

Fig. 4. Scope has provision for coupling RF signal direct to Vertical Plates.

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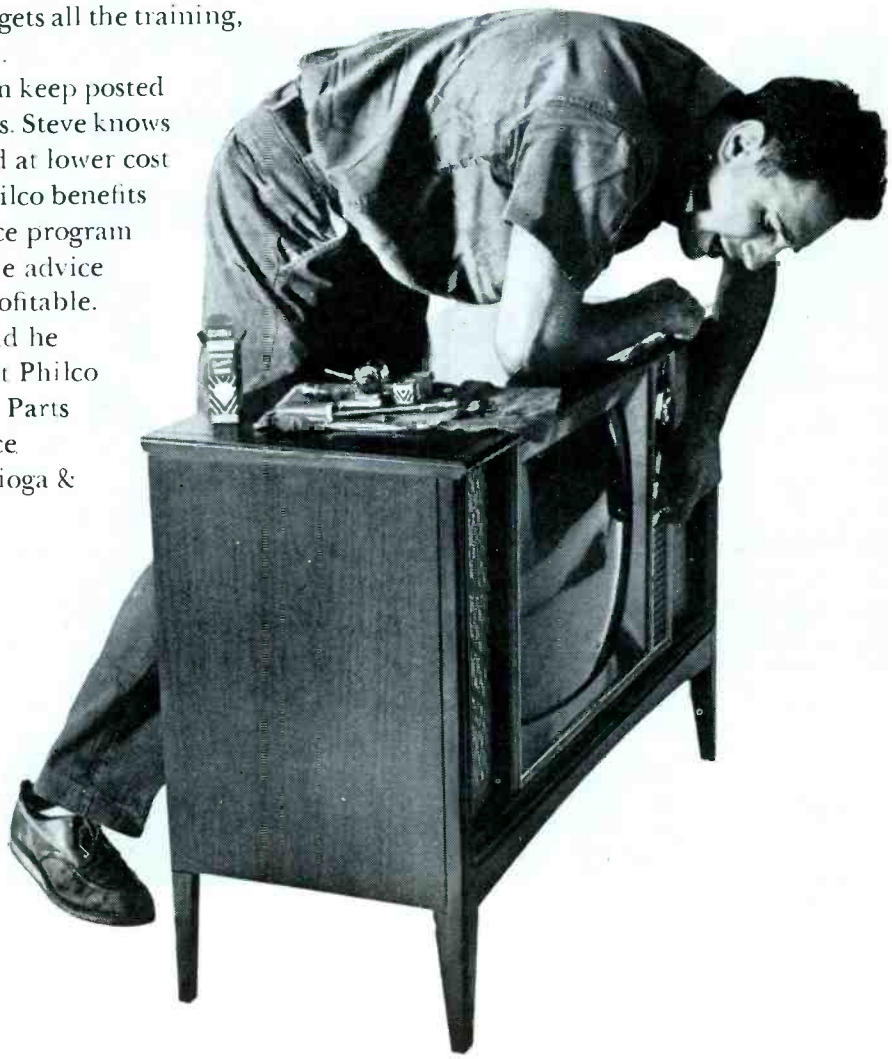
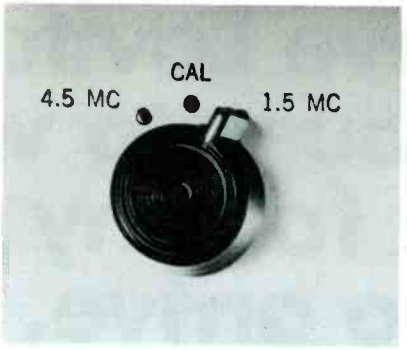


Circle 23 on literature card

earlier versions—WO-91 and WO-91A. It has many features that are essential in the service shop and for industrial uses. In case you're not familiar with the earlier WO-91's, here's a rundown on this newest model.

The instrument has a three-position (4.5 MC, CAL, and 1.5 MC) bandwidth selector switch (Fig. 5A). With the switch in the 4.5-mc (wideband) position, the bandpass of the vertical-amplifier stage has a frequency response within ±1 db from 3 cps to 4.5 mc. With the switch set to 1.5 mc (high sensitivity), the frequency response is within ±6 db from 3 cps to 1.5 mc. With the switch resting in CAL position, the input circuits and at-



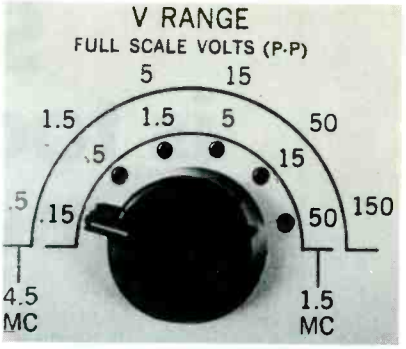


Fig. 5. Selector marks aid in calibrating instrument bandwidth and amplitude.

RCA Model WO-91B

Specifications

Vertical Channel:
Response—±1 db from 3 cps to 4.5 mc (wideband) with maximum sensitivity of .05 rms volt per inch; –6 db from 3 cps to 1.5 mc (high sensitivity) with maximum sensitivity of .018 rms volt per inch. Rise time .1 usec in 4.5-mc position; .5 usec in 1.5-mc position. Vertical input load 1 megohm shunted by 40 pf (1 megohm shunted by 75 pf with direct probe; 10 megohm shunted by 11 pf with low-capacitance probe). Maximum input voltage, 600 volts p-p (in presence of not more than 400 volts DC).

Horizontal Channel:
Response—6 db from 3 cps to 500 kc. Sensitivity .18 rms volt per inch. Input load 2.2 megohms shunted by 30 pf. Phase control range 0° to 160°.

Z-Axis Input:
Response—3 cps to 500 kc. 12 volts rms required for trace blanking.

Internal Sweep:
Range—10 cps to 100 kc in four steps, continuously variable; two preset positions, 30 cps (TV vertical) and 7875 cps (TV horizontal).

Features:
Calibrated graticule with divisions for peak-to-peak voltage measurements. Input terminals for coupling RF directly to vertical plates of CRT (approximately 40 volts p-p per inch deflection). Combination direct/low-capacitance probe. Strong synchronization of 30-cps and 7875-cps waveforms.

Power Requirement:
105-125 volts, 50-60 cps, 75 watts

Size (HWD):
13½" x 9" x 16¾"
13¾" x 9" x 16½"

Weight:
30 lb

Price:
$249.50

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VARIABLE-TAP Room Outlets, Model VT-300

These attractive, low-priced wall outlets give you a choice of three isolation values simply by the turn of a screw. Model VT-300 is matched to 300-ohm twinlead. Also available as Model VT-75, with coaxial outlet to receiver. Ivory-colored cover plate mounts flush to wall; decorative without painting, but accepts paint readily. VARIABLE-TAPS are the newest member of the Jerrold line aimed at making your small systems installations easy and profitable.

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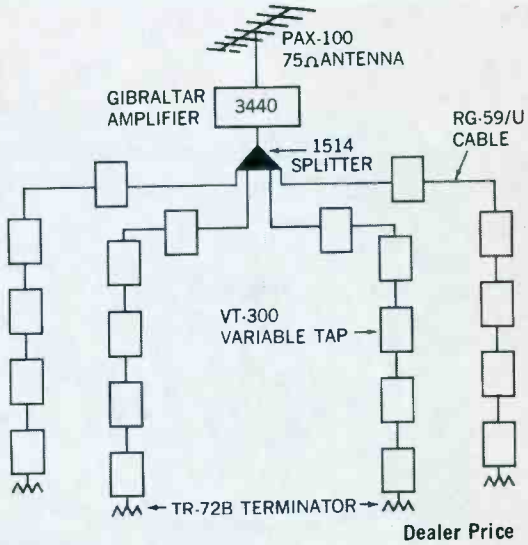

	Dealer Price
Model PAX-100 75-ohm antenna	$ 25.77
Model 3440 Gibraltar amplifier	53.70
Model 1514 4-way splitter	9.14
20 Model VT-300 Variable-Tap outlets @ $2.15	43.00
Miscellaneous (mast, mount, hardware, fittings, etc.)	20.00
Cable (500 ft. of RG-59/U)	20.00
Total Materials	$171.61
Labor (16 hours @ $5 per hour)	80.00
	$251.61
Suggested installed price to customer	350.00
YOUR PROFIT	**$98.39**

Above is shown a typical system layout, along with a bill of materials and your average profit on installation of a 20-tap system in a motel, school, or dealer showroom in your area. Start now to earn BIG profits on small systems like this—send the coupon for complete information.

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tenuators are disconnected from the vertical amplifier, and a calibrating voltage is applied to the grid of the first vertical amplifier.

Peak-to-peak voltages may be measured by using the calibrated graticule (Fig. 6) along with the frequency-compensated vertical-input attenuator and the variable internal calibrating voltage source. The vertical-input attenuator selector (Fig. 5B) is a six-position switch with two ranges, one for each bandwidth setting.

To measure the peak-to-peak value of a waveform: (1) Set the bandwidth switch to the CAL position; a 60-cps waveform will appear on the screen. (2) Adjust the V CAL control until the trace is contained exactly between the lines identified by the CAL arrows on both sides of the graticule. (3) Set the bandwidth switch to whichever position is appropriate for the waveform you're measuring. (4) Adjust the V RANGE switch to display a pattern of convenient height—within the graticule. (5) Set the V CENTERING control so that the bottom of the waveform rests on the baseline of the graticule (marked 0). (6) Read the peak-to-peak voltage on the calibrated graticule, using the 1.5-mc or 4.5-mc scale, depending on the position of the bandwidth switch.

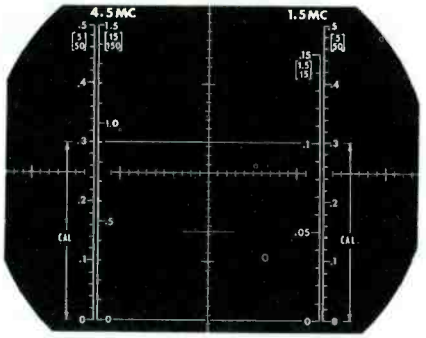

Fig. 6. P-P volts are directly on graticule.

Convenient in the WO-91B is the automatic sweep synchronization for 60-cps and 15,750-cps waveforms. In the TV V position, the scope sync is fed through an integrator network to the sync amplifier; for TV H position, a differentiator network handles the scope sync. This special handling of the sync makes the scope presentation exceptionally stable for composite television waveforms. The SWEEP range switch also provides sweep frequencies from 10 cps to 100 kc in four steps; inside the limits of each step, frequency is variable with the SWEEP VERNIER control.

The SYNC/H SEL switch (Fig. 7) has four steps for choosing sync: EXT—permits an external synchronizing voltage, applied to the SYNC terminal on the front panel, to control the sweep oscillator; LINE SYNC—couples 60-cps energy from the power transformer to lock the sweep oscillator at the power-line frequency; INT– and INT+—chooses whether the positive-going or negative-going excursion of the input waveform will synchronize the sweep oscillator.

The SYNC/H SEL switch also has two steps for selecting a horizontal input other than the scope's own sweep. One position is labeled LINE; in this position, a 60-cps signal from the power supply is coupled to the horizontal amplifier, which provides a sinusoidal horizontal sweep at the power-line frequency. A PHASE control varies the phase of this sweep voltage. When the SYNC/H SEL switch is set to the INPUT position, an external signal voltage—such as the deflection signal of an RF sweep generator—may be applied to the scope through the H input terminal.

The Z AXIS terminal on the front panel provides for intensity modulation of the

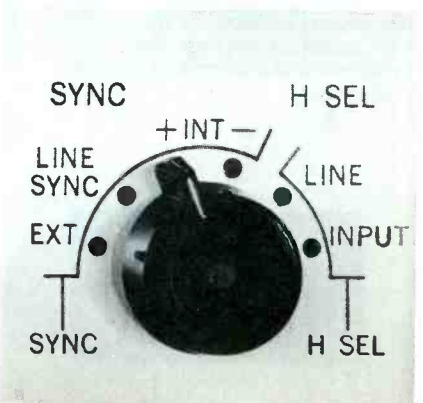

Fig. 7. Single selector chooses among horizontal inputs and the types of sync.

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SK-3012	pnp type, Audio Output Stages of Auto Radios
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SK-3014	Drift Field type for Output and Driver Stages of Hi-Fi equipment
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SK-3016	Silicon Rectifier for color, B/W TV, Radios, Phonographs
SK-3017	Silicon Rectifier for color, B/W TV, Radios, Phonographs

Circle 27 on literature card

scope trace on the scope face with an external signal; an amplitude of 12 volts is required to blank the trace. The panel terminal is connected through a .01-mfd capacitor to pin 2 (first grid) of the cathode-ray tube.

A feature that was not incorporated in previous WO-91 models is provision for coupling an RF signal directly to the vertical deflection plates by way of two terminals at the back of the unit. Coupling is through two .01-mfd capacitors.

This feature is useful for interpreting modulation quality of any transmitted AM signal. Trapezoidal and wave-envelope patterns, shown in Fig. 8, are the basic waveforms that are developed to show modulation characteristics.

To produce a trapezoidal waveform on the scope, the RF signal—taken from a pickup loop in the transmitter output tank—is coupled, through a shielded cable to avoid distortion, to the terminals at the back of the scope. The switch directly above these terminals is moved to DIRECT. The audio signal that is modulating the transmitter is connected to the H IN scope terminal, again with shielded cable, and the SYNC/H SEL switch is set to its INPUT position. Fig. 8—left—shows the various patterns displayed on the scope screen and what each means in terms of modulation percentage.

To obtain a wave-envelope pattern the RF signal is coupled to the deflection plates in the same manner as for a trapezoidal waveform. The SYNC/H SEL switch is set for INT and the SWEEP switch and SWEEP VERNIER control are adjusted at approximately the audio modulation frequency. The resulting patterns are at the right in Fig. 8. The wave-envelope system is useful mostly for tests with sine-wave modulation, but the trapezoidal system can be used with any kind of complex modulation—even voice.

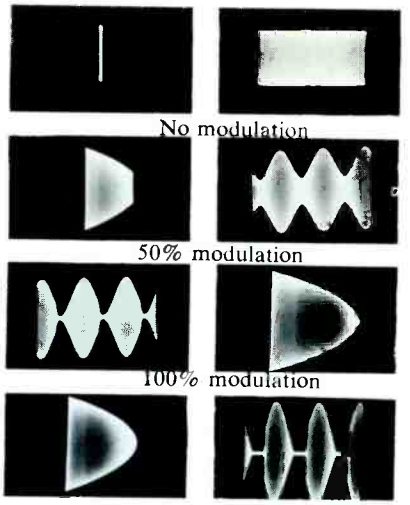


Fig. 8. Trapezoidal and wave-envelope patterns for analyzing modulation.

The WG-300B direct/low-capacitance probe that is supplied with the WB-91B incorporates a high-impedance circuit, connected across a slide switch that allows the user to easily choose either a direct or low-capacitance probe function. This eliminates groping for separate cables when changing from a direct probe to a low-capacitance type.

While working with the scope in our lab, we noticed that whenever the probe touched to DC-carrying circuit the trace would bounce—at times it would leave the screen completely, and require several seconds to return. This condition was most noticeable when the probe was used in its low-capacitance position. This phenomenon is caused by the charging of the large-value input capacitor within the probe. The time required for this capacitor to charge is further affected by the series resistance of the vertical-input attenuators. The time can be reduced considerably by momentarily turning the v RANGE switch to its highest position; the capacitor charges more quickly and the trace returns more rapidly.

The WG-302A probe for tracing RF or IF signals, is an accessory that may be purchased for the WO-91B. It snaps over the tip of the WG-300B probe. Signal tracing with this probe is quite convenient in troubleshooting VHF tuners and video-IF stages.

The comprehensive manual supplied with the WO-91B contains complete instructions on setup procedures for its many applications. There is even a section-devoted to the maintenance of the unit, which describes—among ohter things—astigmatism adjustment; alignment of vertical attenuators; and sweep-oscillator adjustments.

For further information, circle 142 on on literature card

Sales Tips

(Continued from page 50)

sales success with a set that won't come on without a jiggle here or there, or on which the salesman fumbles to find which knob turns it on or adjusts the picture.

Be sure all wires (such as the antenna) are connected *before* you turn the set on. Don't turn on a set and wait several minutes only to find the power cord hasn't been plugged in! Even if this doesn't upset the customer, it nearly always causes the salesman to blurt out some covering conversation that implies the particular set probably can't be trusted to work every time. Moral: Be sure about what you are selling. Don't just turn it on and hope; check out each set before the prospect arrives.

Be enthusiastic. If you can't believe in the set you are selling, you're not likely to sell it. Every set, new or used, has some good points, something that gives it an advantage over other sets. Get those good points fixed in your mind. Does the set have a good picture? A large speaker and good sound? A tone control? A nice cabinet? A remote control? Preset fine tuning? Keyed AGC? Filter-glass front? Simple control setup? Controls clearly marked? Hidden controls? Is it newly overhauled? Easy to service?

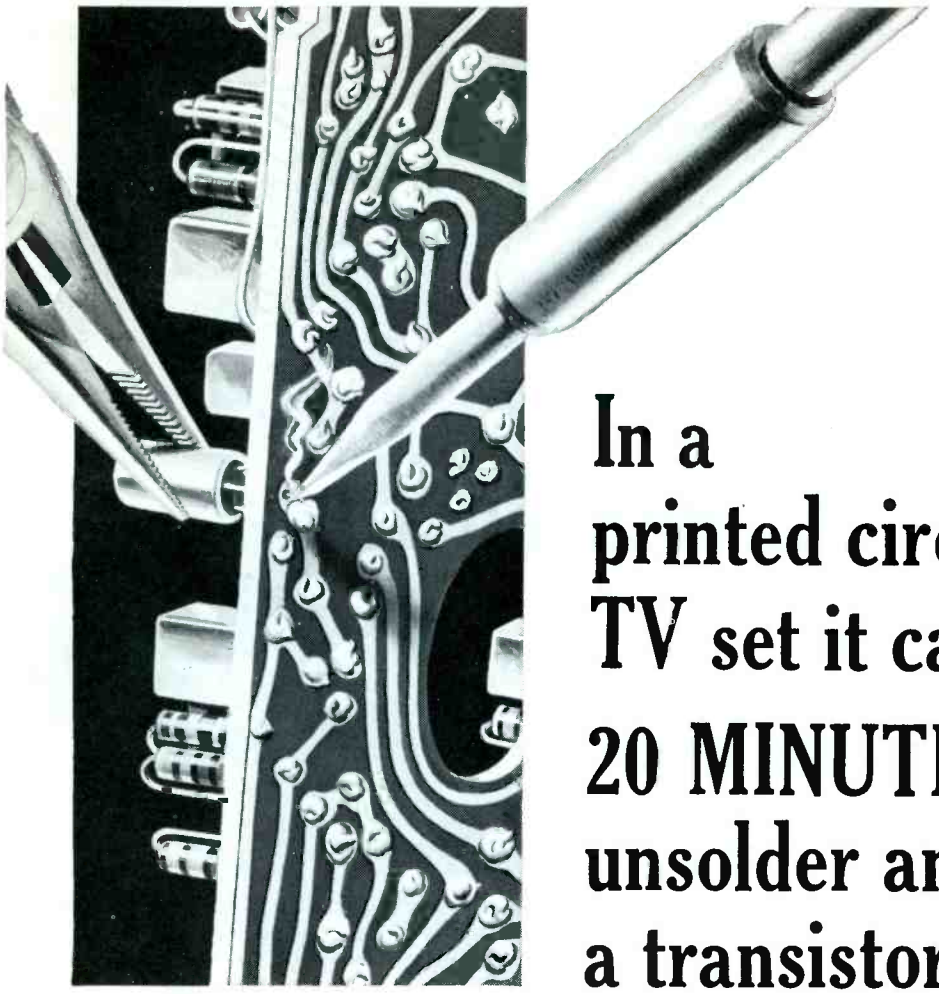
Some salesmen jot down the sales features and tape them to the back of the set or list them in a book they carry. Others tie a card to the front of the set with all the sales features listed; then they take the sales card and, with pen or pencil, point out each feature to the prospect and elaborate wherever it is helpful. This kind of presentation can't help but impress the customer and it also helps the salesman who is hard-put to remember sales points on all the various sets in the store. The few minutes it takes to make out such a card are nothing, considering the increased sales you can make using this technique.

Closing the Sale

Finally, you should know how to close a sale. Ask the buyer: What kind of terms do you prefer? How much down payment do you wish to make? How many months to pay? Fill out the forms your firm requires of the customer for establishing credit. About the trade-in: tell how much you can allow on it.

If you can't get answers to those questions, you may as well have saved your breath on the rest of your sales pitch. Make sure you know how to wind up a sale and get the prospect's name on the dotted line. In most instances, small shops find it best to have a professional financing source. These finance companies will furnish rate cards and other necessary forms for you to use with installment customers.

In summary, if you want to be a salesman, know your product, expect your customer to buy, point out the sales features, and be ready to close the deal when you ask the customer to buy. And, as a final word: Don't let a lost sale give you an inferiority complex. Analyze your sales pitch to see if there were any flaws. If there weren't, forget it, and smile . . . there's another prospect coming in the door! ▲



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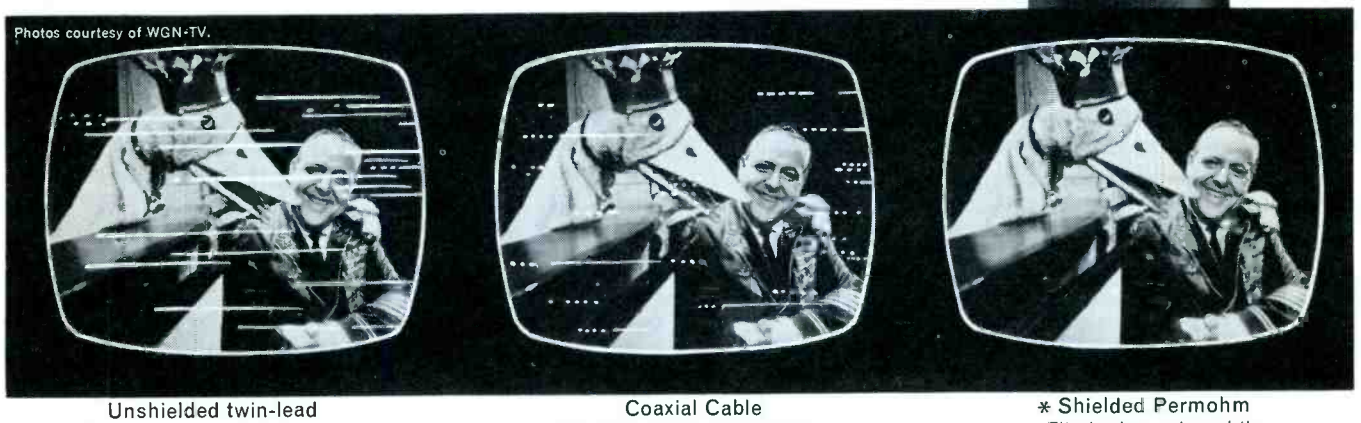

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*Belden U.S. Patent 2,782,251
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8-9-5

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Circle 33 on literature card

Unlocking Secrets of TV Alignment

by Carl Babcoke

Alignment equipment is often the most neglected and dusty of shop instruments. All too many technicians buy expensive sweep and marker generators and try enthusiastically to align a few sets; and then disillusionment sets in. Some sets worked better before his realignment and others didn't respond "the way the book said." Before he has time to develop any skill at alignment, that maze of cables and the awkwardness of the equipment—added to normal difficulties—have caused him to shove all those shiny new panels to the rear of the bench, there to gather dust in disuse.

Has this been your experience? Don't let it get you down! Drag that expensive gear back out of those dark corners and let it help you make money more quickly. Some of the following tips will help you either with the equipment or with the actual alignment. In either case, you'll find your investment isn't a loss, after all.

Equipment Accessibility

Test equipment must be ready for use without much preparation if it is really to save time (money). All of the major units should be kept in one place, with AC power and signal cables connected, ready for instant use.

One solution to this problem of equipment availability is shown in Fig. 1. Dimensions of this alignment rack are not necessary, since you may have other models of different sizes. If you build such a rack, measure your own equipment carefully and allow room for internal shelves, bracing, and AC wiring. You can build the rack in a permanent position, then put TV sets on rollabout tables and bring them close for alignment. Or, you can make the rack portable with large wheels, and move it into position at whatever bench it is needed.

Some of the convenience features of this particular rack are:

1. Sloping panel for visibility.
2. Generators and accessories arranged for shortest interconnecting leads.
3. VTVM can be removed for use elsewhere; AC plug is inside the well.
4. All other equipment plugged into outlet strips inside rack. Sweep and scope line plugs should be phased to produce alignment curve with high-frequency end to the right.
5. One AC cable and master switch controls all units.
6. Small light plugged into outlet at top provides soft illumination and shows when rack is "on."
7. Hooks on the side keep cables out of way when not in use.
8. Large drawer-type handles for easy moving.
9. Small shelf (beneath) holds soldering iron, attenuating pads, extra leads, and miscellaneous parts.
10. Extra AC plugs on front for receiver power, soldering iron, other equipment, or portable lights.
11. Storage space below; door adds to appearance.
12. Large rubber-tired (wagon) wheels for mobility.

Alignment Tips

The next step, after the "haywire look" is removed from your equipment, is to develop alignment techniques to permit accurate and speedy adjustment. Each model of TV receiver is a different problem, but some of the techniques are universal. Check the schematic for RF traps, determine which stages are stagger-tuned or overcoupled, and then pay close attention to the tips we'll give you in the following paragraphs.

Equipment requirements:

Sweep generator for IF and RF frequencies; (should develop sweep 10 mc wide over channel wanted).

Marker generator at IF and RF, (with internal crystal for calibration).

Oscilloscope with good low-frequency response—no tilt on 20-cps square wave.

Bias supplies should have two or more variable voltages, with good regulation.

Marker-adder is convenient but not necessary.

Assortment of pads, loads, coupling capacitors, and test leads (Fig. 2).

An overall sweep curve from antenna to detector is quick to obtain and may be all that is necessary if the alignment is normal or needs only slight touchup. This overall response curve will often reveal the source of some prettv obscure troubles. To set up this curve, hook up the chassis and alignment equipment as it is shown in Fig. 3.

If more is necessary than a slight adjustment of one

Fig. 1. Alignment equipment rack simplifies connections, and saves time.

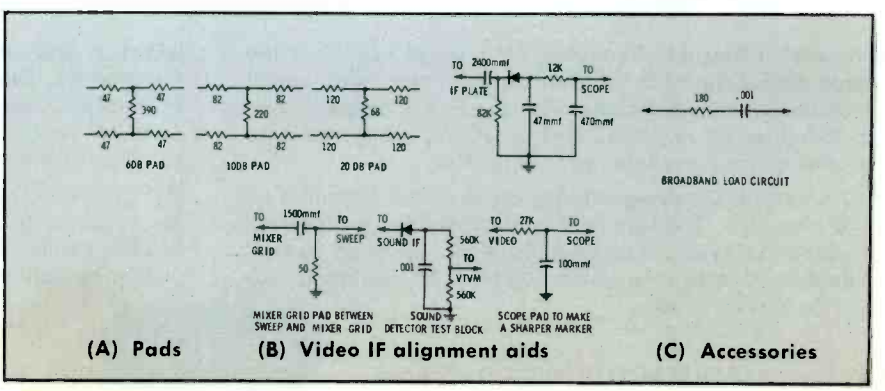

Fig. 2. Alignment is much easier with pads and detector circuit test blocks.

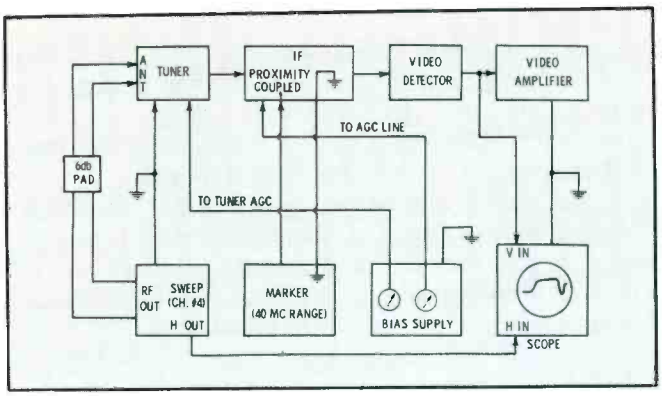

Fig. 3. The overall curve is rapidly measured with this setup.

or two slugs, a complete alignment should be undertaken. These general tips should help you align any set.

Initial Setup

Check your equipment for proper operation. The sweep-generator output cables should have resistor pads at the *end* of the cables. This is important. If in doubt, just add an 82-ohm carbon resistor between the two wires at the end.

Use the fixed AGC bias specified by the manufacturer, if it is known. Otherwise, just measure the AGC on the strongest channel and set the IF bias for this voltage. The tuner can be set at –2 volts in most cases.

Use the pads and loads that are specified by the set manufacturer for connecting the equipment to the set, if you know what they are. If not, ignore them for now.

Preliminary

Look at the overall curve, *but do not adjust anything until you have:* (1) Moved the tubes in their sockets and noted any variation in the scope trace; (2) checked tube shields for the same effect; (3) moved the chassis and printed boards and noted any variations. A normal chassis will show only temporary and very minor changes in amplitude or shape of the sweep curve. If you see more than this, clean tube sockets, resolder grounds, or take whatever steps will eliminate the instability. *Only* when the curve is stable should you actually align the set.

Aligning

Turn the sweep-generator output as high as possible without flattening the scope pattern; then reduce the output until the pattern on the scope is about half that height. Do this step without any marker at all.

Next, use as much marker as possible without distorting the sweep pattern. Distortion will vary according to the marker position on the curve, so this should be checked often and reduced if necessary. Normally, the marker should be inserted in such a way that the height or shape of the curve is not changed; this is easier if the sweep and marker are not attached to the same point. One excellent attachment method is with the marker-cable ground on the receiver chassis and the "hot" lead to the shield of the first IF tube. Some experimenting will find the best method for each receiver.

Where the shape of the curve is not important and a strong marker is needed, such as while adjusting traps, you may inject the marker at an unbypassed cathode in the IF strip or at an IF grid through an isolation resistor.

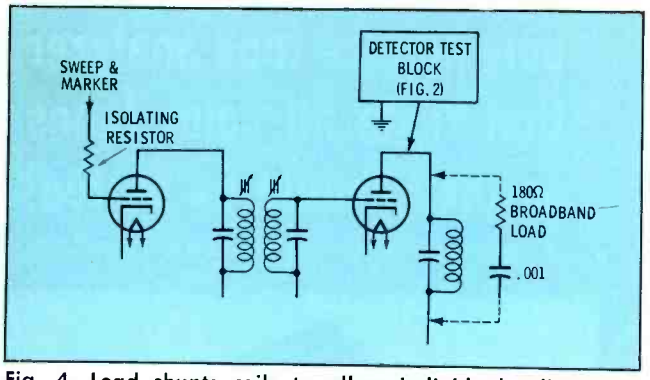

Fig. 4. Load shunts coils to allow individual adjustment.

The single-tuned (stagger-tuned) coils should be preset for their approximate frequency, even though they may be changed later in the alignment procedure. One easy method of presetting is to set the marker for each desired frequency and adjust the slug for maximum height of the marker, while viewing the overall sweep. For this step, disregard any change in the shape of the curve, but tune the marker as far above the base line as possible. A finger placed under the marker pip on the scope face can help find this maximum point.

Overcoupled stages should be aligned one at a time, as shown in Fig. 4. A broadbanding load circuit (Fig. 2B) is connected across all overcoupled coils except the one to be adjusted, to load them down so they won't affect the adjustment. A detector test block (Fig. 2B, also) is used for connecting the scope, since the set's own video detector can't be used. These steps are taken for each IF transformer, until all have been aligned. In many sets, both the tuner IF transformer and the first IF transformer are overcoupled. In others, only the last IF transformer is overcoupled.

Traps, also, can be set by the same technique—aligning only the stage containing the trap. This avoids false results because of overloads or problems with multiple traps. Simply disable those not being adjusted.

Only after traps and overcoupled stages have been done should the stagger-tuned stages be tackled. Do them while watching overall sweep pattern. *Do not reset* the overcoupled stages or the traps when you do this final alignment.

A radically different curve on each channel indicates need for alignment of the antenna, RF, and mixer stages in the tuner. Black-and-white sets are usually considered normal if the curve does not tilt more than 20% from one channel to another.

Conclusion

This, obviously, isn't a step-by-step alignment procedure for any particular set. The manufacturer's instructions or the PHOTOFACT Folder will give you comprehensive and specific data on each model. This group of hints and tips, however, should give you enough general insight into alignment to allow you to dust off those sweep instruments and start using them to upgrade the quality of service you offer. ▲

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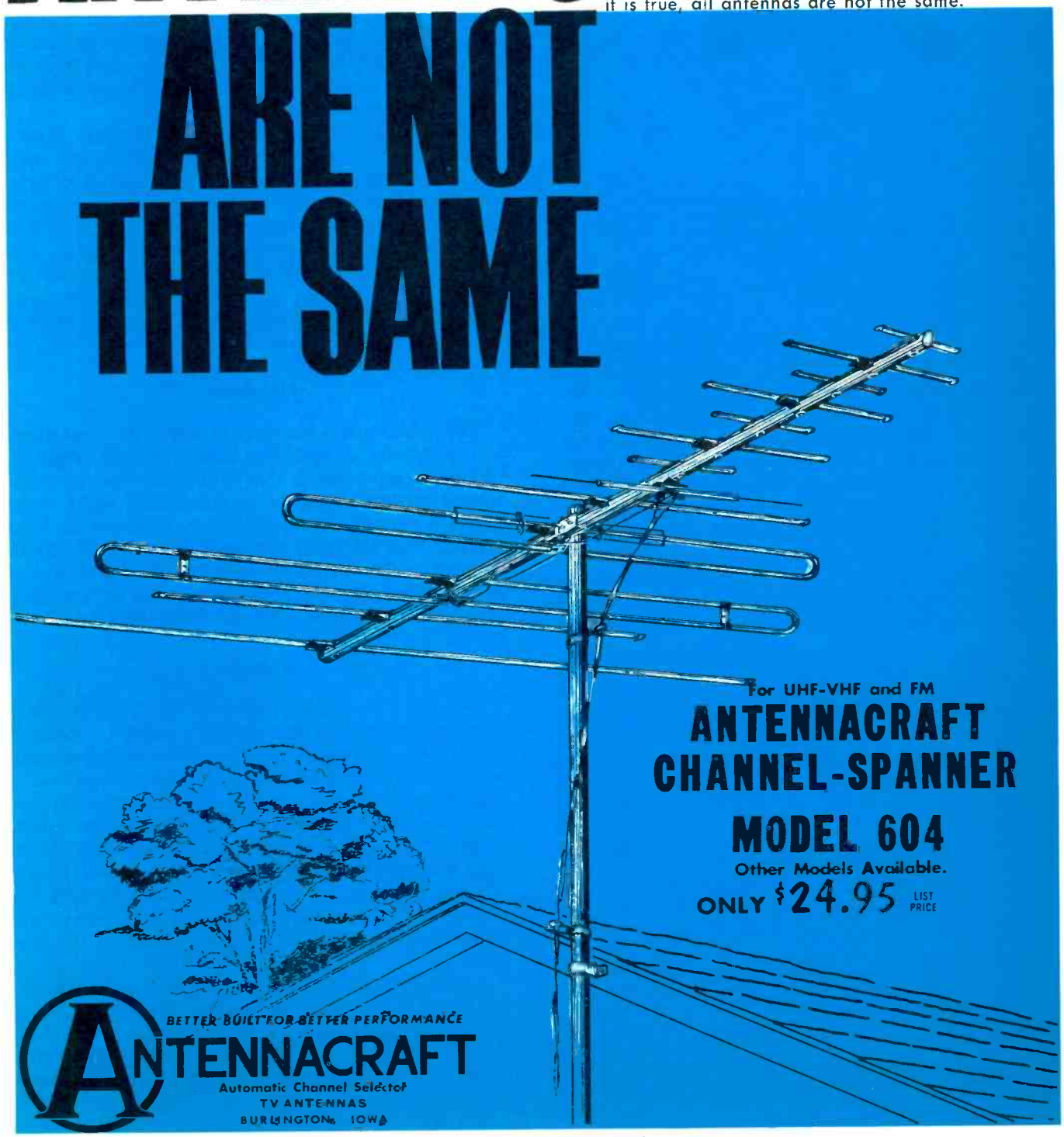

Circle 36 on literature card

This modern group deserves your aquaintance.

by Rufus P. Turner

Words coined to name electronic devices often use certain suffixes (or sometimes, root-endings) which eventually come to designate whole families of devices—thus . . . *tron* and . . . *ode* for tubes and tube-like devices (magnetron, thyratron, cyclotron, diode, triode, pentode), . . . *ac* for computers (Eniac, Geniac, Seac) and . . . *syn* for synchronous devices (autosyn, selsyn, microsyn). And there are many more.

The most glamorous of these word endings at present is . . . *istor*. This is simply a derivative of the word *resistor* and designates a device that behaves in some way like a resistor. Best known for its most famous member, the transistor, the . . . istor family contains many semiconductor devices; but the family also boasts cousins which are not semiconductors, even though they behave somewhat like a transistor.

The ending . . . *istor* was first used in the late 1940's to name a newly developed heat-sensitive resistor, the *thermistor*. That was the start of the present . . . istor clan. Next came the transistor (a *transfer resistor* or resistor having transconductance), and since then the family has grown so fast and so large that several new members may appear before the ink has dried on this page. How many . . . istors do you know? Meet here 18 important members of this numerous family.

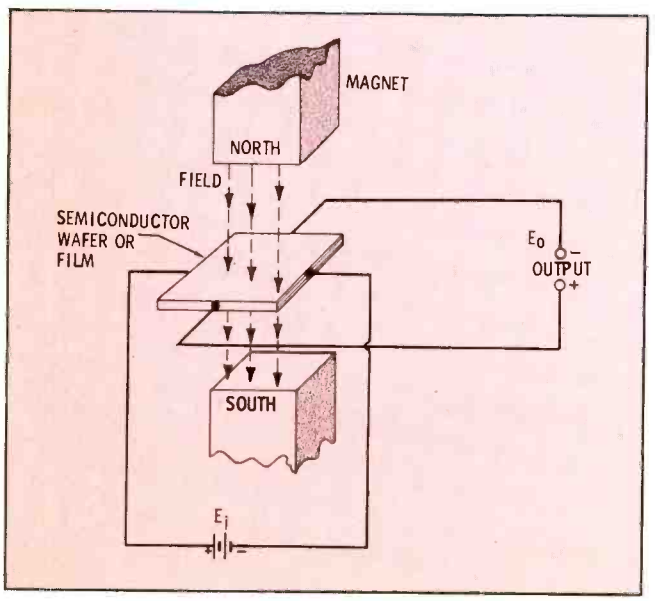

Fig. 1. Structure of the hall-effect transistor (hallistor).

Ferristor™

This device is not a semiconductor but it's a miniature, high-frequency magnetic-amplifier-type component. Its name derives from the term *ferromagnetic,* which describes the nature of this device, and from the fact that it is transistor-like in many of its applications (thus, *ferristor* = "iron transistor").

The core of the ferristor usually is made from a high-permeability metal such as *Permalloy,* and on it are wound control and load coils as in any other magnetic amplifier. The load winding is tuned to resonance at the power supply frequency (generally 100 kc) by means of a series capacitor. The ferristor displays negative AC resistance and consequently is easily adaptable to simple flip-flop operation. This relatively simple component finds application in counters and computers for relatively slow speeds.

Fieldistor

The *fieldistor* is a transistor in which the input (control) electrode is capacitive, to provide high input impedance comparable to that of a tube. Control of the current carriers within the semiconductor wafer of the device is therefore accomplished by action of the electrostatic field set up by the input signal. What was attempted in the laboratory model of the fieldistor now is accomplished on a commercial basis in the field-effect transistor (June 1964 PF REPORTER).

Hallistor

Fig. 1 is a simplified diagram of the *hallistor* (Hall-effect generator). In this device, electrical contact is made to the four edges of a thin wafer of indium antimonide or indium arsenide. A DC bias voltage, EI, is applied between two opposite edges, A and B; and output terminals are connected to the other two edges, C and D. If a magnetic field then is caused to penetrate the wafer in the direction shown, a DC voltage (Eo) will appear at the output terminals, with the polarity shown, and will be proportional to the strength of the magnetic field. This action is termed the *Hall effect.*

The *hallistor* output voltage may be used in measuring magnetic field strength (as in a fluxmeter in which the *hallistor* is mounted in the end of the test probe). It also may be used for electronic control operations involving a magnetic field, since it requires no switch contacts.

The *hallistor* finds use in analog computers in which

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the magnetic field may be used to represent one variable, the DC bias a second variable, and the output voltage their product. This latter application suggests another use of the hallistor—in a wattmeter in which the magnetic field is proportional to a current component, bias voltage to the voltage component, and output voltage thus represents the power in watts.

Lumistor

The *lumistor* (see Fig. 2) is a sandwich consisting of an electroluminescent (light-emitting) layer and a photoconductive layer facing each other. The arrangement is similar to mounting a flat lamp on a flat photocell.

In operation of the lumistor, the DC voltage E1 biases the electroluminescent layer to the point that its phosphor coating emits light. The input signal, introduced through transformer T1, modulates the current from E1, causing the electroluminescent layer to emit cycles of light proportional to the frequency and intensity of the signal. These luminous cycles cause the resistance of the photosenstive layer to change in the same way, and thus modulate the current flowing from battery E2 through the lumistor and load resistor R1. If E2 is much larger than the signal voltage, the AC signal voltage across R1 will be proportionately greater than the input signal voltage. Thus, the lumistor can amplify.

Magnetoresistor

This device is somewhat similar to the hallistor, except that the *magnetoresistor* has only two terminals. The magnetoresistor is a resistor made of indium antimonide or indium arsenide, the resistance of which may be varied by means of an external magnetic field (the field traverse the magnetoresistor as it does the hallistor in Fig. 1).

A magnetoresistor may be connected in series with a bias voltage (AC or DC) and a meter, amplifier, or conventional load resistor. The current flowing through the magnetoresistor is proportional to the strength (and frequency, if the field is alternating or fluctuating) of the magnetic field. This action has been made the basis of flux meters, tubeless and transistorless amplifiers, and specialized analog computers.

Magnistor™

Like the ferristor, the *magnistor* is not a semiconductor device, but behaves as some semiconductor devices (such as switching transistors) do. It consists essentially of a flat plate of suitable ferrite or ceramic which has several apertures through which coils are wound for input and output signals. The response of the plate to pulsations shows a pronounced hysteresis loop (like that of a magnetic amplifier), and this provides two-state response which may be used in switching and memory application in computers.

Memistor

Here is an electrolytic device. Essentially, it is a refined, subminiature electroplating cell. Current passing through the cell removes metal from the anode and then

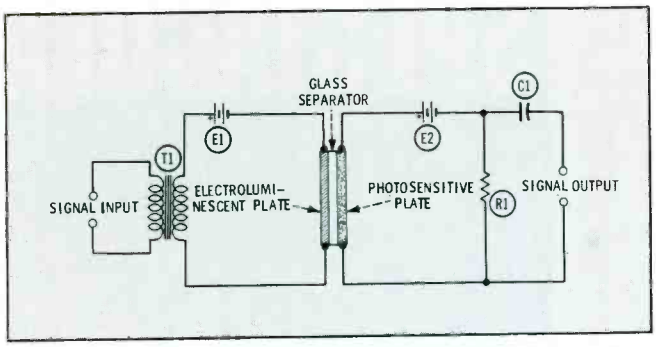

Fig. 2. The lumistor utilizes light to produce amplification.

plates it on the cathode. Elapsed time then may be determined by testing the cell to determine the extent of the metal deposition on the cathode. In its action, the memistor is a time-variable resistor (*memistor* = "resistor with memory").

Negistor

Semiconductor devices such as the tunnel diode have made available to the designer and experimenter simple two-terminal negative resistors. These are resistors whose volt-ampere response curve shows a negative slope over some part of its range (at which an increase in current produces a decrease in voltage drop). The negistor is such a component, which provides higher power-handling capability than conventional tunnel diodes.

Although the negistor is a two-terminal device, its internal structure is complex: It often consists of two suitably processed transistors (one NPN, one PNP) direct-coupled to each other and provided with heavy positive feedback. Direct current is passed in at one lead of the negistor, flows through the transistors in "series-aiding," and out through the other lead. A part of the volt-ampere characteristic exhibits the desired negative slope.

The negistor makes possible simple, two-terminal oscillators, amplifiers, Q-multipliers, and loss compensators.

Photoresistor

A photoconductive cell, of whatever type, is a light-sensitive resistor. Adjustable-intensity light may be used to vary its resistance and thus control either AC or DC. Such cells are available in the following types: cadmium sulfide, copper oxide, germanium, lead sulfide, selenium, and silicon. They are obtainable in a wide range of operating voltage, power capability, and light sensitivity.

Raysistor®

This device is a combination of lamp and photocell in a light-tight housing. It may be used for control, switching, and amplification in the same manner as the lumistor (Fig. 2), which it resembles in operating principle. *Raysistors* are available in a wide range of operating values and in types that use either a neon lamp or filament-type lamp.

Sensistor™

A simple, two-terminal component, the *sensistor* is

WINEGARD'S FALL COLOR SPECTACULAR

Know how many color TV sets will be sold before the end of the year? Close to 2 million! There's no telling how many more will be sold during 1966. But the figure will be way up in the millions —and we'd like every single one of those sets to be hooked-up to a new Winegard made-for-color antenna. Impossible? Maybe. But we're sure going to try. And here's how we plan to do it. We're going to tell more people than ever before (and more often than ever before) that they do need a special antenna for color TV reception. Then we're going to tell them how very special Winegard made-for-color antennas are . . .

- They effectively reduce snow, ghosts and distortion in all reception areas—metropolitan, suburban and deep fringe!
- They make color TV brighter, sharper and more brilliantly alive!
- They make all-channel black & white reception better than ever!
- And they make expensive new color sets (black & white sets, too) worth every penny!

We're going to tell them on television, in magazines and via in-store merchandising aids. And the nice thing about advertising is, if you have an outstanding product, a truthful story and sensible prices—and if you tell people often enough, they'll buy. We call it our Fall Color Spectacular. Winegard dealers will call it the best thing that ever happened to antenna and accessory sales. Better call your Winegard distributor or write for complete information about Winegard's Fall Color Spectacular. It's here now!

Spectacular WINEGARD Made-For-Color TV Commercials . . . thousands of them!

Winegard has actually scheduled more than 2,000 minute and 30-second commercials to run before the end of the year. They'll be seen from coast to coast and in color as well as black & white. And here's the best part. They're more than commercials. They're station testimonials! That's right. Station engineers throughout the country have tested Winegard made-for-color antennas and found them to be everything we say they are and more. Wait 'til color TV prospects (and owners) hear these commercials. And they'll start hearing them in October!

Spectacular WINEGARD Made-For-Color Ads in ✳ LIFE ✳ PARADE ✳ SUNSET

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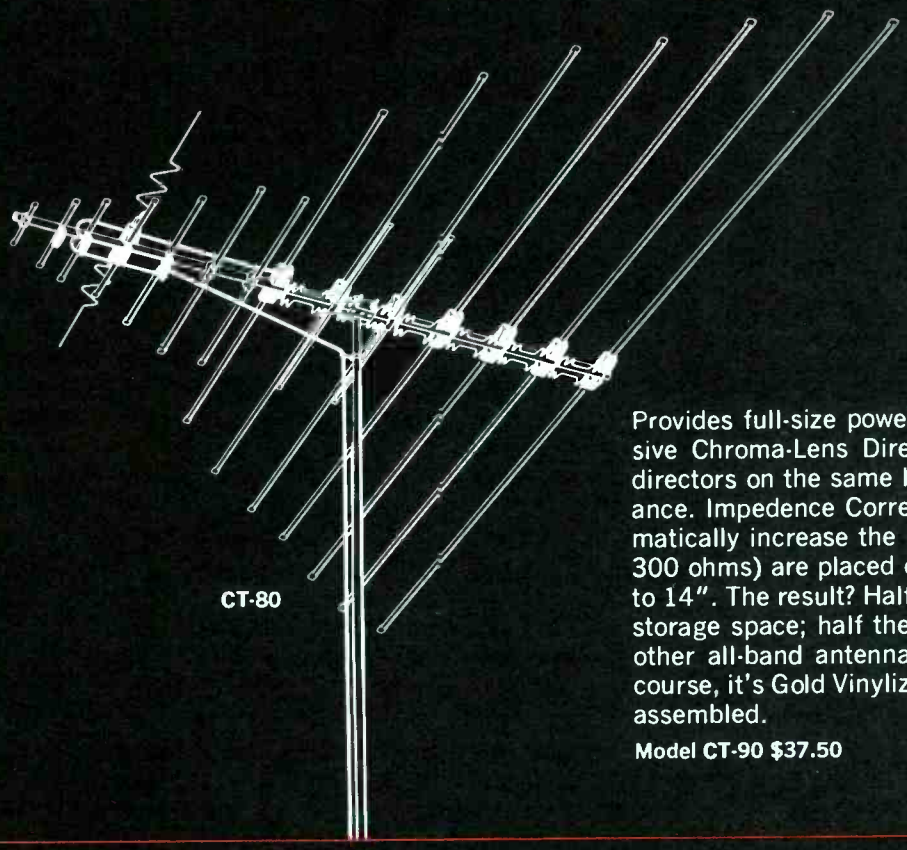
MADE-FOR-COLOR ANTENNAS



CT-80

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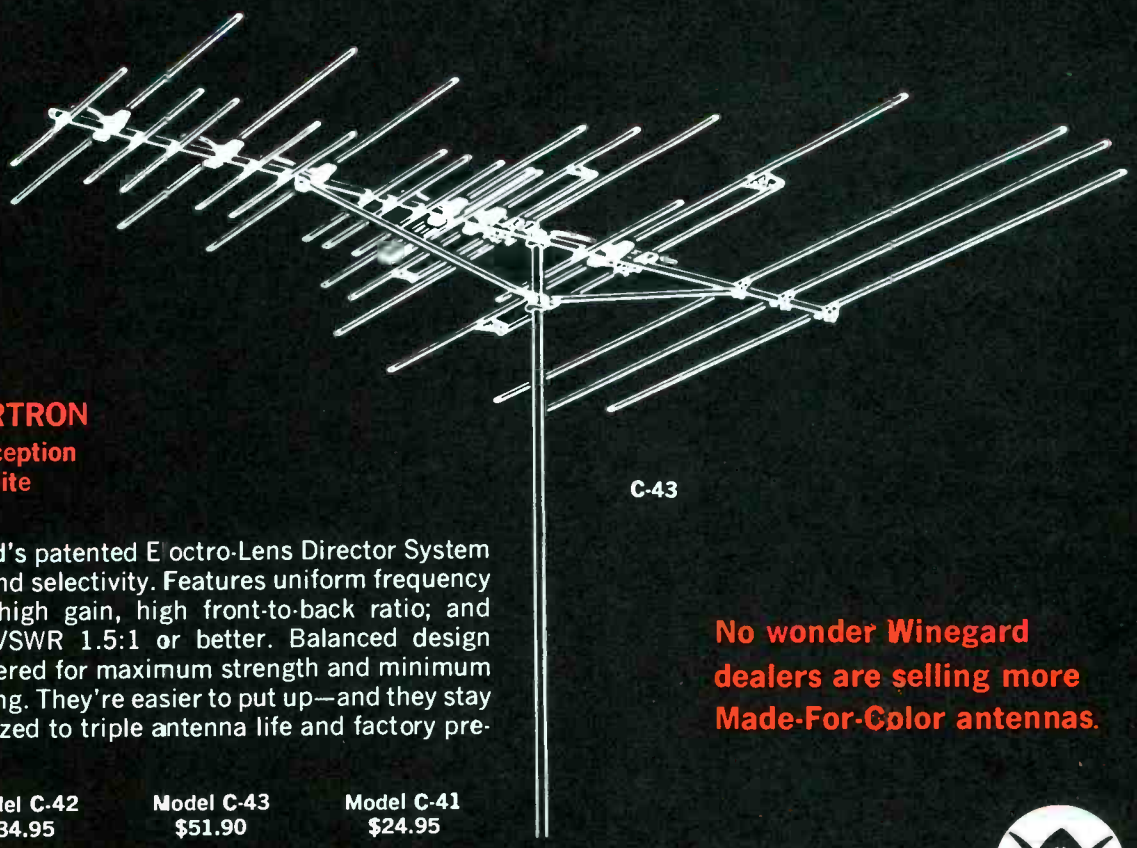
Model CT-90 $37.50 **Model CT-80 $27.50** **Model CT-40 $17.50**



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WINEGARD COLORTRON

. . . for the best VHF reception in color and black & white

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No wonder Winegard dealers are selling more Made-For-Color antennas.

ANTENNA SYSTEMS 3000 KIRKWOOD, BURLINGTON, IOWA

Circle 40 on literature card

a temperature-sensitive resistor made from specially processed silicon. It has a positive temperature coefficient of resistance and may be used in temperature measurement and control, time delay, compensation of transistor bias circuits, and measurement of wind velocity.

Silistor

Another name for the sensistor.

Stabistor

This is a specially processed silicon diode (or assembly of diodes in series) which is used to stabilize the current in transistor circuits and similar systems. In this application, the stabistor is made to conduct forward current. This compensating device also corrects for ambient temperature variations.

Thermistor

As the name indicates, this is a temperature-sensitive resistor. Thermistors are available in rod, disc, wafer, washer, and bead shapes and in an extensive range of current, voltage, power, nominal resistance, and temperature ratings. They are also available with either positive or negative temperature coefficient of resistance.

Thermistors are used in a great many ways—temperature measurement and control, circuit stabilization, time delay instrumentation, and low-frequency switching are only a few.

Thyristor

This is a special, switching-type transistor whose operation is similar to that of a thyratron tube. With the thyristor connected as a common-emitter transistor with DC collector-to-emitter voltage, the collector current is extremely low (ideally, zero). This is the OFF state. At a critical value of collector voltage, a positive base-input trigger signal will switch the collector current to a stable high value (this is the ON state), and this high current will continue to flow, even though the trigger pulse is removed, until either a negative base-input trigger signal is applied or the collector current is momentarily interrupted.

The thyristor enables the user to achieve switching action with a single-transistor circuit.

Transistor

This component now needs no identification. Transistors presently are available with maximum-collector-voltage ratings from 12 to better than 100, frequency ratings from audio to UHF, and power dissipation from 1 mw to several tens of watts. Transistors may soon be separated into two basic categories: conventional and field-effect (see Fieldistor).

Trigistor®

The *trigistor* is a low-powered switching device consisting of a silicor bar in which four layers are pro-

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We're at it again . . . making the 260® a better buy than ever. This latest improvement is built-in *meter* protection . . . standard on *regular** 260 volt-ohm milliammeters—Series 5 and 5M.

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260-5 with new meter protection..... $49.95

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DC MICROAMPERES: 0-50 (250 MV Drop)

DC MILLIAMPERES: 0-1; 0-10; 0-100; 0-500

DC AMPERES: 0-10 (250 MV Drop)

RESISTANCE RANGES: RX1 0-2000 ohms (12 ohms center) RX100 0-200K ohms (1200 ohms center) RX10K 0-20 megohms (120K ohms center)

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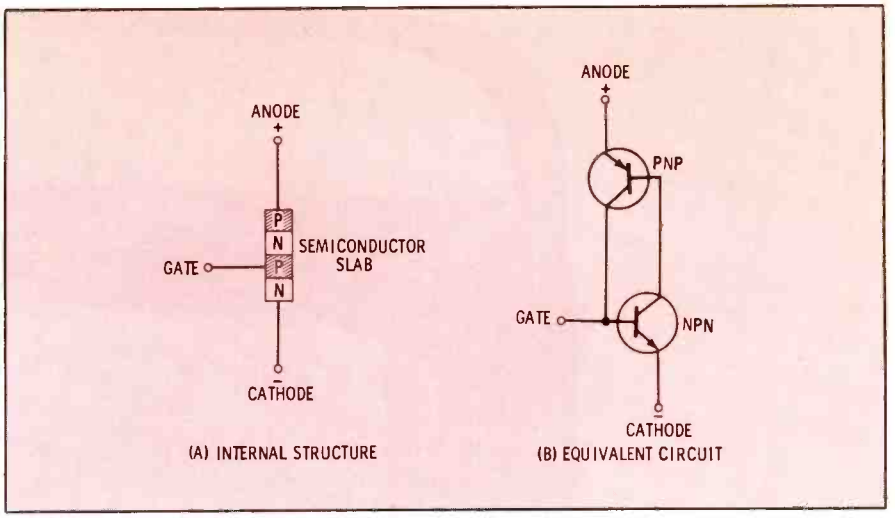

Fig. 3. Solid-state trigistor operates in virtually the same way as a thyratron.

cessed to give a PNPN structure (see Fig. 3A). Leads are attached to the top P-layer, bottom N-layer, and the lowermost P-layer. This structure gives the effect of two transistors, one PNP and one NPN, direct-coupled to each other automatically and providing positive feedback between themselves (Fig. 3B).

At a certain critical value of applied DC voltage, the device passes very little current (ideally, zero current). This is its OFF state. If then a positive trigger voltage is applied to the gate electrode (cathode negative), the current will switch to a high value (the ON state) and will continue to flow, even though the pulse is applied or the anode voltage is momentarily removed. This action, like that of the thyristor, resembles thyratron behavior.

Varistor

Whereas the resistance of many semiconductor devices varies with applied voltage, the varistor is designed specifically to exploit this "nonohmic" peculiarity. The silicon carbide resistor is an example. The current through a varistor increases nonlinearly with applied voltage thus, in some units when the voltage is doubled the current increases eight times.

This action may be used in many ways. Some applications of varistors include harmonic generation, voltage level detection, curve changing, selective control of circuits, volume compression, surge protection, and voltage regulation. Varistors are obtainable in a very wide range of current, voltage, and power ratings; and, like thermistors, are available in many shapes and sizes.

Conclusion

New members of the family . . . istors are being born in research labs regularly. This introduction should help you to recognize them in almost any form, in any surroundings. You'll be seeing a lot of them in months and years ahead. ▲

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Circle 46 on literature card

Tinyvision

(Continued from page 29)

uum-tube horizontal-output circuits. Note that the yoke is connected in series with the supply voltage and the output transistor; also note that the flyback primary shunts the yoke.

In the circuit of Fig. 2B (General Electric TA Chassis) the yoke is shunt-fed—connected through C5 across X1—to prevent DC shift from affecting the centering. During retrace time C5 is charged from ground through the yoke by the power-supply and the flyback pulse. During trace time C5 discharges through the deflection yoke and X1, producing the sweep. T2 is tapped to feed a pulse back through R1 to sharpen the edges of the retrace pulse. Although the load (T2) is connected in series with X1's emitter, signal is applied between the emitter and base, and X1 is connected as a common-emitter class-C amplifier. The solid-state high voltage rectifier uses C1 and C2 to bypass RF hash.

Operation of the output circuit of the Motorola TS-432 (Fig. 2C) is basically the same as the circuit in Fig. 2B. The two transistors are not connected in push-pull, but in series to reduce the breakdown voltage requirements. If one transistor shorts they should both be changed without bothering to check further! T2 has an adjustable core which permits control of the width and high voltage.

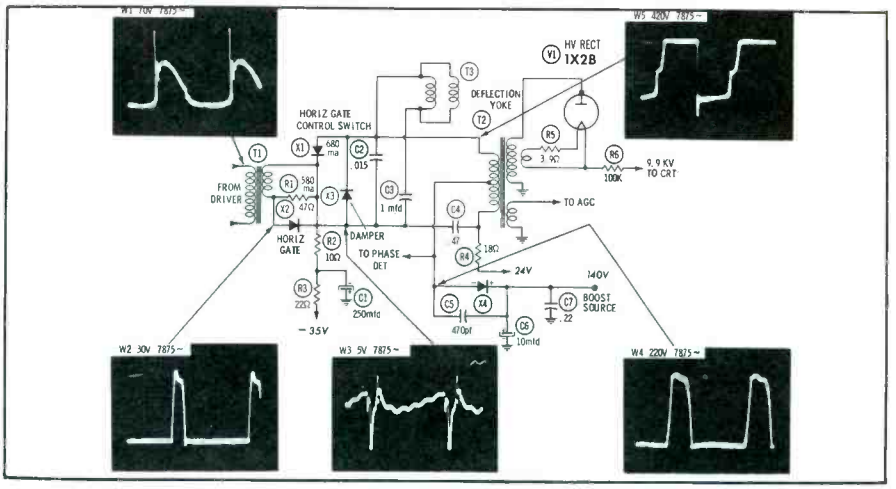

Fig. 3. GCS replaces vacuum tube or transistor in horizontal-output stage.

The *gate-controlled switch* replaces the output transistor, in Fig. 3. Unlike in the SCR, anode current can be shut off by a negative pulse on the gate. Operation is then comparable to a class-C amplifier.

All of these circuits use transformer coupling into the horizontal output stage and this eliminates a favorite test used by many technicians when approaching high voltage or horizontal sweep problems in tube-type receivers: measurement of the DC "drive voltage" at the horizontal output grid. In the transistor sets this test will no longer be reliable. A scope at the input to the horizontal output stage is the best way to tell if the transistor oscillator is driving the output stage properly; but remember, a good waveform here does not prove that the emitter-base circuit of the output stage is working correctly.

Another point to remember in connection with oscillator operation is: operating the receiver with an intermittent horizontal oscillator, or one that is off-frequency, is likely to result in damage to the output transistor. This means that when testing or adjusting the horizontal oscillator an isolating probe (one which does not detune the circuit) must be used with the scope or voltmeter. Be careful not to short between terminals accidentally. When troubleshooting in the horizontal section, a 130-volt, 10-watt zener diode should be temporarily connected across the horizontal output transistor with the cathode of the zener on the positive element of the transistor (on the emitter in the case of a PNP unit). Also, avoid checking the high voltage by sparking the anode to ground, as this also will damage the output transistor.

Leakage in Transistors

The failure of associated compon-

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Circle 47 on literature card

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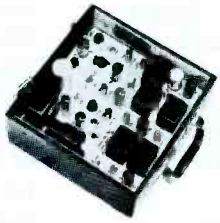

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White Dot
Color Display
Television Generator

Model 661
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NTSC Standard
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Model 677
Wide Band Service
Technician's
Oscilloscope

Model 662
Installer's Color
TV Generator

Model 656XC
Color Space Bar,
White Dot
TV Generator

Model 6000A
Service Technician's
High Speed
Deluxe Portable
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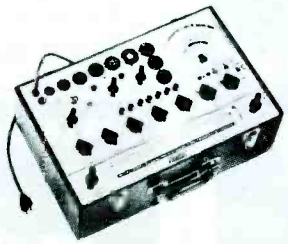

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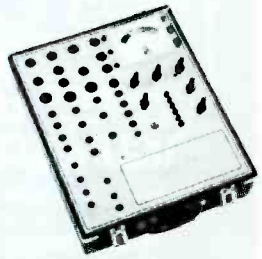

Model 799
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Circle 49 on literature card

ents is usually more common than failure of transistors. When a transistor fails, the most common symptom is leakage. Leakage is directly related to the junction temperature and so tests for leakage must be made under operating conditions. High leakage in a transistor is characterized by:

1. Excessive heating of the outer case.
2. Low collector-to-emitter voltage. (The difference between the collector and emitter potentials can be determined by subtraction or by direct measurement between the two elements).
3. Large voltage drop across the emitter resistor.

One way to check the general condition of a transistor without removing it from the chassis is to short the base to the emitter while noting the collector or emitter voltage (whichever is greater with respect to ground). The voltage should increase to practically the full power-supply potential because shorting the base to the emitter will cause a normal transistor to be cut off. In a defective transistor, however, leakage current continues to flow and the resulting voltage drop across the series resistance in the collector or emitter circuits gives a clue to the defect.

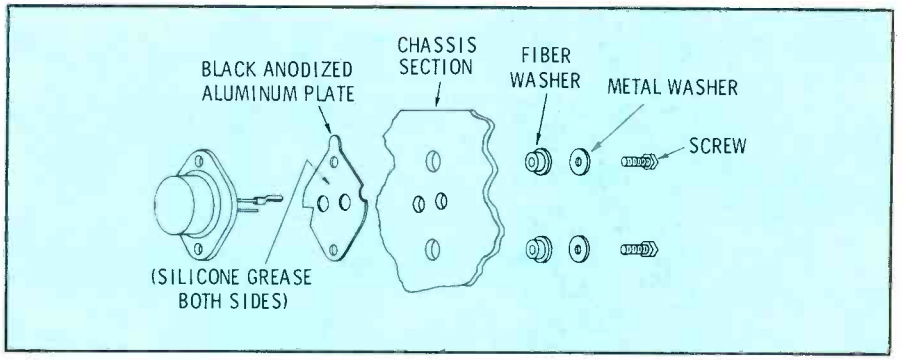


Fig. 4. Typical method of mounting replacement transistor to heat sink.

In TV servicing, you must be more careful about using "substitution-type" transistors than in radios, because the amount of leakage current varies between different units of the same type and makes a difference in circuits where waveshapes or cutoff voltages are important. In TV's, replacement transistors should be of the type specified by the manufacturer.

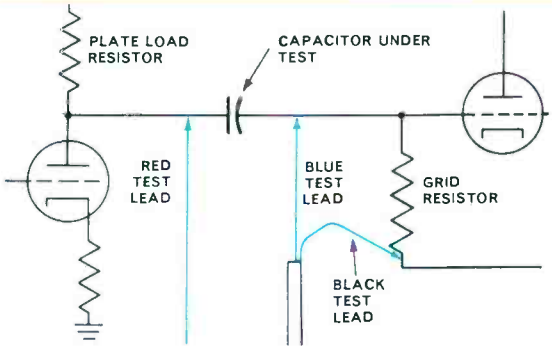
Also, be sure to replace mica or fiber washers, silicon grease, and other accessories which have been used to improve the efficiency of the heat sink. Fig. 4 illustrates a typical mounting; note that in this case the transistor is insulated from the chassis.

Summary

To summarize, here is a checklist of ideas to speed your bench work on transistorized receivers:

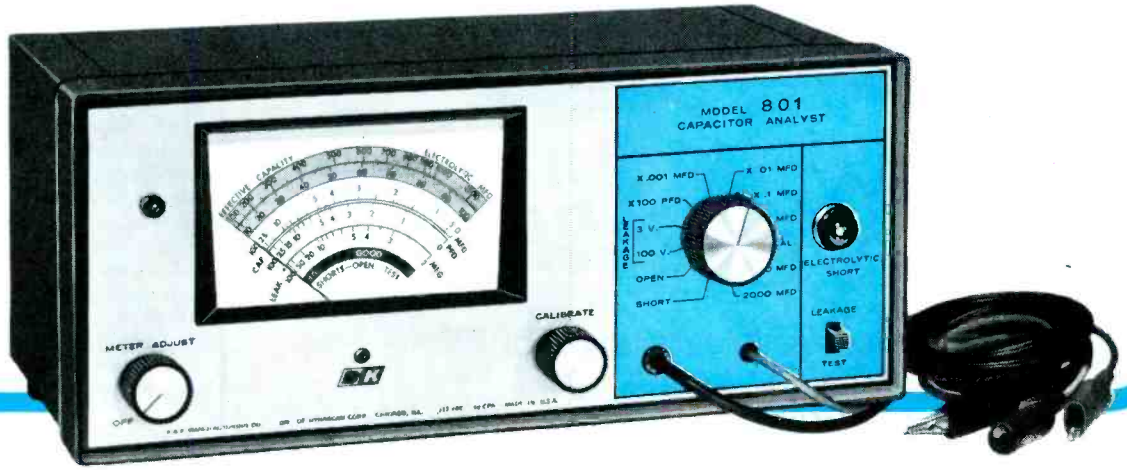
1. Always have complete service information available before starting the job.
2. Use the scope to identify the defective stage, followed by the VTVM or VOM to pinpoint the faulty part.
3. Use the ohmmeter with caution; in-circuit readings are unreliable.
4. Use only specifically recommended transistors for replacement. And reinstall all heat-sink parts and silicon grease.
5. Check high voltage at the anode with a high-voltage probe, or use a neon bulb near the flyback transformer; don't arc the anode lead.
6. Connect a 130-volt, 10-watt zener from collector to emitter of the horizontal output transistor when servicing the oscillator. Better still, when possible disconnect the output stage and use the scope to observe oscillator operation.
7. Look for defective damper diodes in any sweep circuit which is not working (vertical and horizontal; oscillator and output).
8. Check emitter voltage and case temperature first when you suspect a transistor is defective.
9. Use only a capacitor checker (especially an in-circuit checker) specifically designed for transistorized equipment.
10. Never try to use a booster on the CRT filament voltage because the supply voltage is often DC.

locate defective capacitors in-circuit



3-LEAD LEAKAGE TEST: One test lead is connected to the plate side of the capacitor and the ground lead to the grid leak return on the other side of the capacitor, and the meter is zeroed. The third test lead is then connected to the grid side of the capacitor and the meter scale shows the leakage directly in megohms.

The B & K model 801 capacitor analyst **really works** without unsoldering or altering circuitry



Both in-circuit and out-of-circuit capacitor testing can be done quickly and accurately with the new B & K Model 801 Capacitor Analyst. Foil, mica, general purpose and temperature compensating ceramic, and electrolytic capacitors can be accurately tested for leakage, capacitance, opens, and shorts.

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Circle 52 on literature card

BOOK REVIEW

Planning and Installing Master Antenna TV Systems: Lon Cantor; John F. Rider Publisher, Inc., New York, New York; 136 pages, 6" x 9", softbound; $3.95.

MATV installations are becoming more common in hotels, motels, and apartment buildings. This book describes ways a radio-TV technician or sound-system installer can enter this lucrative field.

The first two chapters describe the economics of MATV installation, list methods of obtaining contracts, and supply a typical specification sheet for an installation contract. Chapter three describes small systems and their applications in homes, TV shops and showrooms, and schools.

Requirements for the head-end system are covered in the fourth chapter. Block diagrams instead of schematics are used, and many other illustrations support the text material — graphically explaining characteristics of antennas, baluns, mixers, and preamplifiers. Methods of eliminating ghosts, co-channel, adjacent-channel, and man-made interference are also described. Distribution components (cable, tapoffs, matching transformers, terminations) and their applications are covered in the fifth chapter.

Methods of actually laying out an MATV distribution system are listed in Chapter six. A thorough explanation of the use of the **db** and **dbmv** is given to aid in calculations of the signal voltage available at any part of the distribution system. Gain, output capability, noise figure, and VSWR for head-end and distribution equipment are explained in Chapter seven Overall requirements for the head-end and entire distribution system are summarized by Chapter eight.

Methods of adding background music or CCTV to MATV systems are brought out in the ninth chapter. The tenth chapter supplies information on CATV and translator operation. Chapter 11, the final one, brings the reader methods of installation, initial system checkout, plus maintenance and troubleshooting procedures. The appendix contains a db conversion chart and nomograph, plus other charts and tables useful for MATV system designers and installers. ▲

Square Waves

(Continued from page 31)

four-terminal network. However for a square wave check, the unit is treated as a three-terminal network. Since there is a DC path through the resistors, it is best to check for defective resistors with an ohmmeter. If the resistance from input to output does not read within 20% of 48K, the unit is rejected. Again, since both terminals of the 330-pf capacitor are externally available, we can check it on a capacitor bridge.

On the other hand, a square wave test is the only feasible method of checking the value of the .0025-mfd capacitor; the test setup shown in Fig. 5 is used. It follows from previous discussion that the 15K resistor can be neglected. Accordingly, this is a test of a simple integrating circuit in which a 33K resistor feeds into a .0025-mfd capacitor. The value of this capacitor can be measured quickly by determining the rise time of the output wave-form. The time constant of the integrating circuit is: RC = 33,000 x .0025 x 10^{-6} = 82.5 usec. If the time constant of an integrating circuit is Tc. the rise time of the output waveform is equal to 2.2 Tc.

This is perhaps a novel fact, but it is easily demonstrated. Fig. 3 shows the universal time-constant curves. Curve A rises from 10% to 90% of its final value in 2.2 time constants. This is the basis of the capacitance-measurement test. The time constant of the integrating circuit in Fig. 6 was found to be 82.5 usec. The output waveform will therefore rise from 10% to 90% of its final voltage in 2.2 x 82.5 = 182 usec. Accordingly, the waveform is displayed in the form of curve A in Fig. 3. Horizontal intervals are counted from the 10% to the 90% points of maximum voltage. By determining the sweep speed (Fig. 6) and by counting the number of horizontal intervals, you can find the rise time. Here, the sweep speed was 100 usec/cm.

If the rise time is within 20% of 182 usec, the .0025-mfd capacitor is within tolerance. Thus, the value of the capacitor through the 33K resistor has been measured. This is the most practical way to make this measurement, and this test can be made at any square wave frequency.

Now, to find whether the .0025-mfd capacitor is leaky, it is best merely to make an ohmmeter check from the 33K resistor terminal to the .0025-mfd capacitor terminal. To make a leakage test at working volt-

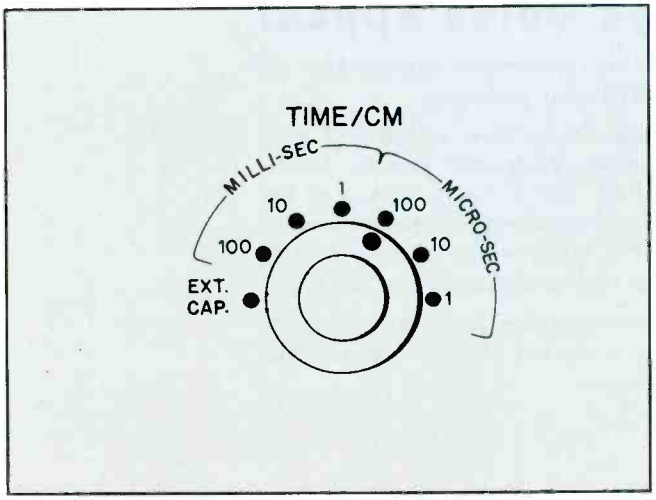

Fig. 6. Sweep of 100 usec/cm to read 182 usec rise time.

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Circle 55 on literature card

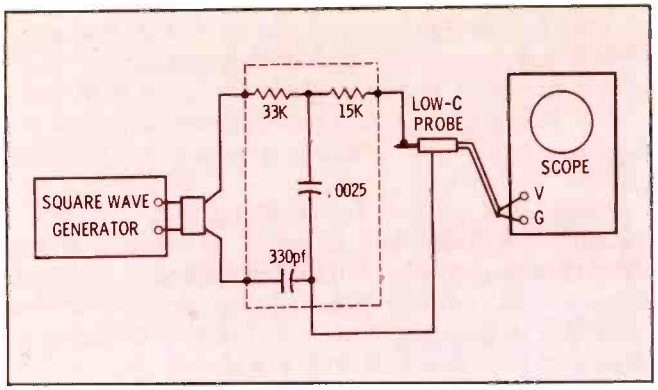


Fig. 7. 60-cps voltage across 330-pf capacitor prevents test.

age, use a regular leakage tester. The capacitor tester can indicate leakage through the capacitor (via the 33K resistor), although it cannot measure the capacitance value.

If the .0025-mfd capacitor is open, the rise time will be extremely short compared to normal conditions. In such an event, the unit would be rejected, of course, without necessity for further tests.

Four-Terminal Test?

Since the unit in Fig. 5 is actually a four-terminal network, you may wonder whether it could be tested as a four-terminal device. For example, it might be considered that the test setup shown in Fig. 7 could be utilized. It cannot. In this arrangement, the "ground" lead is connected in series with the 330-pf capacitor. The ground lead of a square wave generator is at a different 60-cps level than that of the scope; hence, there would be a substantial 60-cps drop developed across the 330-pf capacitor and a large hum voltage displayed on the scope screen.

Therefore, square wave tests of four-terminal networks such as depicted in Fig. 5 must be made as three-terminal tests. Terminal connections must be selected so that the generator case is connected directly to the scope case. The common ground lead between generator and scope must not include any series capacitance or resistance.

Conclusion

You have seen in this and past articles how typical standard RC units can be checked for defects. Also you have learned a new way to measure capacitance, even through series resistance. With these basic square-wave techniques firmly in mind, you will be in a good position to consider square-wave testing of other circu its and of even more elaborate PC units.

The next article, by one of the PF Reporter staff, will review and connect up for you the principles and practice of square-wave testing in simple networks as we've presented to date. Following that, in a final article on these principles of advanced testing, we will explain some of the sophisticated techniques used for analyzing multicomponent networks — even those with many terminals.

In the months to follow, you'll be introduced thoroughly to practical ways of using these new, advanced servicing techniques to speed and simplify unusual troubleshooting problems in present-day equipment—audio units, video amplifiers, and so on. You'll want to follow this series and learn these modern ways to analyze systems, circuits, and networks. ▲

Pads and Attenuators

(Continued from page 33)

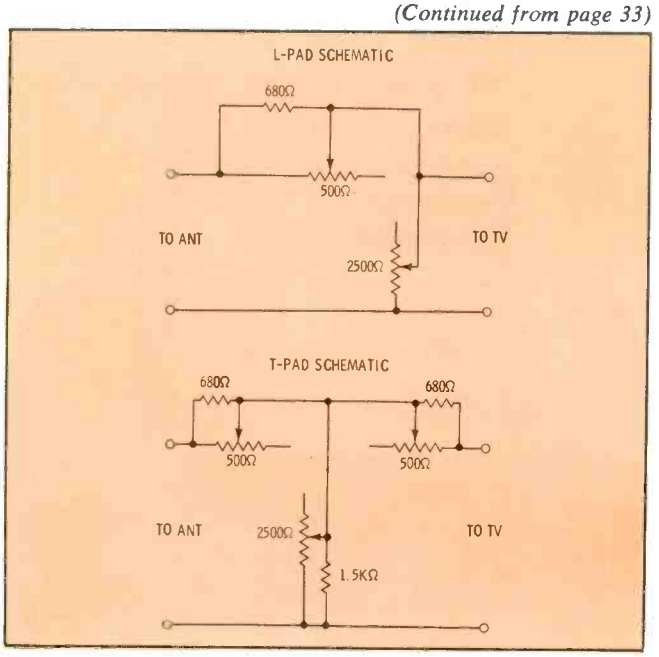


Fig. 5. L and T pads for use with TV transmission line.

attenuator can be used where boosters in strong signal areas tend to produce over-loading that causes smear, distortion, pulling, and ghosts. An easy solution to this problem is to insert the attenuator shown in Fig. 6.

Fixed-Resistor Pads

Fixed resistor pads have few uses in audio work because carbon units are too low in wattage and wire-wound units introduce undesirable inductance which affects frequency response. Their two main uses, then, are for RF signal reduction (attenuator pads) and connecting circuits of unequal impedances (matching pads).

Where pads are used for matching, they introduce a certain unavoidable loss of power. Therefore, a pad should not be used where signal loss cannot be tolerated. For example, suppose you want to match a 72-ohm transmission line to 300-ohm input of to a TV receiver. If you are in weak-signal area, you should use a matching transformer of balun coil; if, however, there is plenty of signal, the pad will do the job.

Fig. 7 illustrates the balanced "L" pad, sometimes called the "U" pad and Table 4 gives the impedance values for matching signal generator outputs or transmission line to the 300-ohm input of a TV set or FM receiver. Matching from the receiver side into the pad avoids detuning the RF gain and band-width. The use

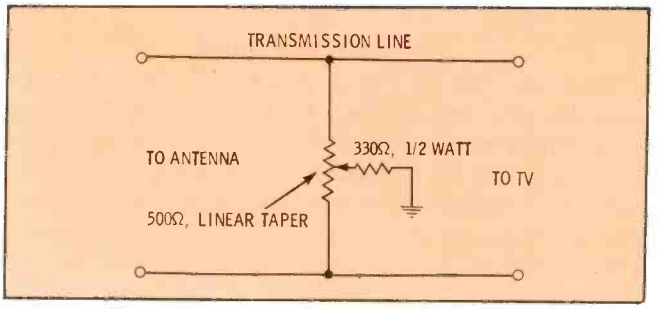
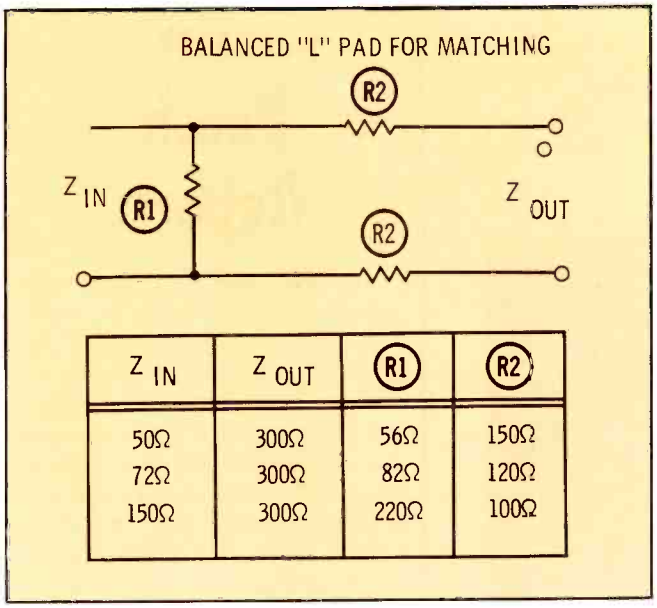


Fig. 6. Makeshift attenuator for insertion in a TV lead.



Z IN	Z OUT	R1	R2
50Ω	300Ω	56Ω	150Ω
72Ω	300Ω	82Ω	120Ω
150Ω	300Ω	220Ω	100Ω

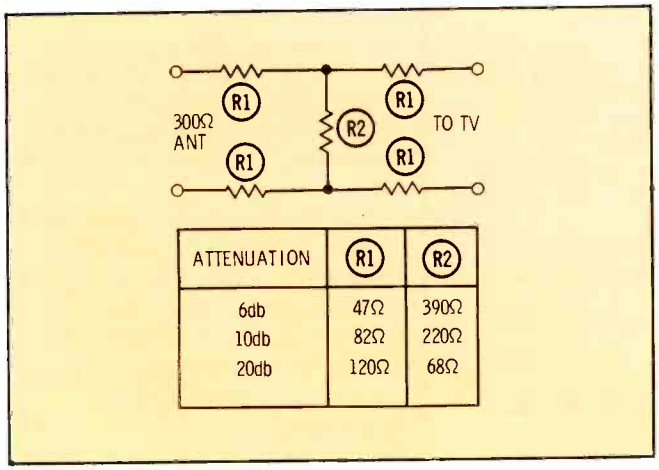
Fig. 7. L-pad matches source to load impedance of 300 ohms.

of a resistive matching pad has the advantage of allowing an impedance match that does not vary with frequency. There is, however, a 10-db insertion loss with such a matching pad. Without the pad, the mismatch would cause reflections in the line and would result in ghosts in the picture.

Where excessive antenna signal causes overloading, a fixed resistor pad can be used for any desired degree of attenuation. Fig. 8 shows the circuit configuration and Table 5 lists the resistance values for popular steps of attenuation in a 300-ohm antenna line. The amount of attenuation used is usually 6 db, 10 db, or 20 db, which corresponds to voltage-loss ratios of 1/2, 1/3, and 1/10, respectively. Pads can be cascaded to provide other values of attenuation—e.g., two 20-db pads would offer 40-db of attenuation. Carbon resistors of the smallest wattage should be used; wirewound resistors are *not* suitable because of their inductance.

Summary

The most common attenuators are of the variable "L" and "T" variety, used in audio circuits. In RF circuits, fixed "H" pads are of greatest use. With the information in the tables, you should be able to choose, design, and put together a pad or attenuator for whatever your purpose. ▲



ATTENUATION	R1	R2
6db	47Ω	390Ω
10db	82Ω	220Ω
20db	120Ω	68Ω

Fig. 8. H-pad reduces television signal to reduce overload.

PFR

Bench Report

This portable instrument will measure up to 10 watts of transmitter power output; indicate the percentage of modulation; check relative field strength; and measure standing-wave ratio. It may also be used as a test oscillator for checking crystals, or as an aid in receiver alignment. It has a headphone jack; therefore, modulation quality may be monitored directly if desired.

Antenna efficiency can be calculated by observing the percent of reflected power reading when the standing-wave ratio is measured. For wattage, multiply the decimal reading on the meter by .01; then, multiply the answer by the power output reading to determine how much power is actually being radiated. The instrument does not compensate for loss in the cables, so the reflected power reading should be taken in close proximity to the antenna.

This transistorized unit operates on a 9-volt dry cell, and battery replacement is simple: merely remove four screws from the front panel and insert a fresh battery in the holder. To increase battery life, always place the power switch in the REFLECTED position when the unit is not in use.

The Model 91-07 "Signal Optimizer" comes equipped with an extendable whip antenna, connecting cable, and instruction manual. It is available from electronic distributors carrying **Utica Communications CB** equipment. ▲

For further information circle 150 on literature card

(Continued from page 35)

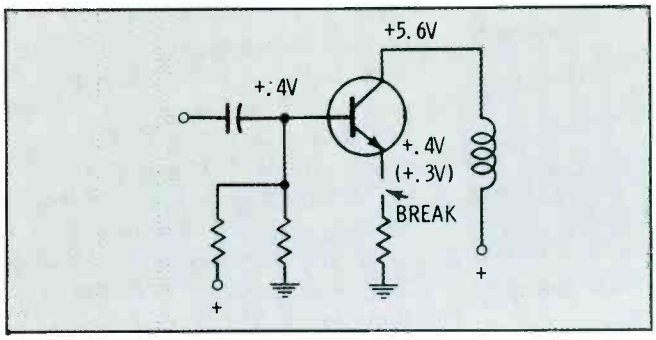


Fig. 5. Diagram shows the effects of an emitter-circuit break.

quency to display the modulation envelope of the RF signal.

When you've isolated the faulty stage, you'll want to make some qualitative checks on it. Table 1 is a checklist of voltage deviations that can often indicate quickly what's wrong in the stage. For instance, the chart says that an open emitter resistor will cause the emitter voltage of an NPN transistor to go slightly high, while the collector voltage also goes high. Fig. 5 shows why: with no emitter circuit to ground (the negative side of the power supply), the emitter assumes the voltage of the base. Since current flow through the collector circuit is almost eliminated, collector voltage increases practically to source potential.

You should also check the transistor. Substitution with a known good one is the most reliable method. A transistor tester can be as dependable as a tube tester, if you remember that neither provides a check at the operating frequency. If a transitor checks okay on a tester, then is replaced in the circuit and still doesn't work, it might have been temporarily healed by unsoldering—the remedy is to try a new one. You'll probably need a good transistor substitution guide, as it's a rare shop that has many direct replacement transistors—they're simply too numerous. Most parts distributors have replacement guides available.

A finger on the grid of a tube injects 60 cps hum, for signal tracing. But a finger on the base of a transistor seldom gets the same result, as the transistor is a low-impedance device and the base circuit isn't as susceptible to hum pickup.

You can also measure the operating voltage across the emitter circuit, which is usually common to both base and collector—a large voltage drop indicates a shorted transistor with maximum current, while little or no voltage indicates an open transistor and no current.

The ohmmeter check (of a transistor) is based on the theory that a transistor is a two-diode device, and you can check the forward-to-backward resistance of each diode. This proves only whether the transistor is open or shorted. Be careful to use a low-current VOM or VTVM, or you might burn out the transistor.

A VTVM will service all transistor sets—a VOM can be used for nearly all circuits, but the low impedance will kill the local oscillator circuit if used to measure voltages there. Modern VOMs are available with high ohm-per-volt sensitivities; some are designed especially for use in transistors circuits.

Aside from transistors, other components can cause trouble. Resistors and capacitors are usually overrated, but as receivers get old, capacitors can fail. Open or weak capacitors cause loss of decoupling (and thus motorboating) or loss of gain. Such things as switches and speakers might seem to be rugged, but sometimes a set will be found with a defective switch. Speakers can be torn, bent, or jammed, and thus cause extreme distortion; replacement is the only cure.

FM Troubleshooting

As you would suspect, since FM operates at high frequencies, the FM local oscillator is the first thing to quit if battery voltage is even slightly low. For this reason, transistor FM's should be scope-and-sweep aligned, with the IF's broadbanded and flat-topped. For one thing, this reduces distortion on modulation peaks. Also, if you peak the transformers, FM tapers off when batteries do, quitting before AM. If you broadband them, however, leaving some freeway in alignment, the set won't quit so suddenly.

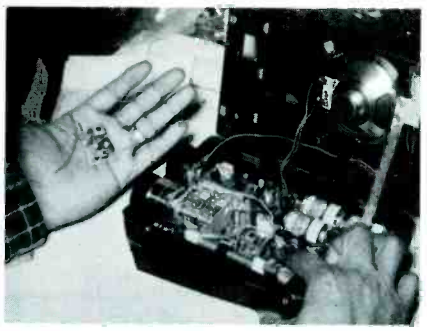


Fig. 6. Modules in modern portables.

Watch out for differences in station signals on FM. Most of these receivers use extendable whip antennas for FM—in other words, a single vertical monopole (not dipole). Standard FM stations use horizontally-polarized antennas, and to receive them with the most signal, the receiving antenna should be horizontal. However, because of the increasing number of automobile and portable FM receivers using vertical antennas, the FCC now permits FM stations to utilize a secondary antenna which is vertically polarized. Therefore, stations using both horizontal and vertical polarization will have a greater and more uniform signal strength in portable FM sets. Occasionally you may want to mention this to a customer.

A fairly recent development in portable FM is the use of modules like those shown in Fig. 6—small circuit boards containing all components for a given stage (transistor, IF can, resistors, and capacitors of an IF stage, for example). You may find it necessary to work on one of these in an FM IF strip. If you do factory or warranty service, you'll probably replace the entire module.

Things To Come

Modules and subassemblies are coming into portable FM. You might as well get used to them. And when you've come this far, it's but a short step to the next major service task you'll probably have—transistor TV. With the basics of AM-FM transistors in your store of knowledge, it will be easy to go on to transistor TV. Even simpler, you must admit, than making the transition from tube radio to tube TV. Here we go again . . . ▲

Sly Old VOX

(Continued from page 37)

switch. The voice signal is amplified in X1 and RC coupled to common-emitter amplifier X2.

After being amplified further by X2, the signal is then rectified by dual diode X3. The resultant pulsating DC is filtered by C1 and C2, creating forward bias on the base of X4, the relay-trigger transistor, and causing it to conduct. This energizes K1 and starts the tape drive motor.

When speech is stopped, C2 discharges through R1 and R2. If speech is resumed before C2 has discharged below the biasing level that keeps X4 conducting and K1 thus energized, the drive motor will continue to operate. The RC time constant is adjustable from zero to about four seconds, depending on the setting of R1, thus allowing the speaker to pause for breath without stopping the drive motor.

As you might suppose, when conversation initially begins here is also a slight delay while the capacitors charge. To avoid clipping of any of these first words, a manual-start feature is included so the operator may start the drive motor before speaking into the microphone. On one machine, a small 60-cps signal from a special secondary winding on the power transformer is applied to point A through a momentary-contact switch. This signal is rectified by X3 and suppiles forward bias to X4, enegizing M1 and setting the tape in motion.

Diode X5 is connected across M1. It acts as a limiter to keep any transient voltage pulses generated by the inductance of the relay coil from damaging X4.

Slide synchronization is available on this same machine. The small 60-cps signal is fed to the microphone input of the channel not being used to actuate the VOX section. When a slide change is required, the operator switches the VOX input temporarily to the opposite channel and momentarily closes a switch that inserts the 60 cps *beep*, then switches back and continues recording narrative. In playback, the narrative is picked up in one channel, while the other channel's output — containing the recorded beeps — is fed to the input of the VOX circuit where K1 is actuated and operates the slide changing mechanism of the projector.

Troubleshooting VOX

Now that you understand what VOX tape recorders do and how, let's explore why they sometimes don't do what they're supposed to.

Troubles lie in these areas:

A. Drive motor doesn't operate
B. Drive motor operates continuously
C. Drive motor operates intermittently
D. Auxiliary control doesn't fuction properly

Of course, you'll have all the conventional tape-recorder troubles such as loose belts, clutch adjustments, switch adjustments, etc., but VOX machines will require consideration of the additional section.

Doesn't Operate

For the first trouble, let's examine the circuit in Fig. 1. Assuming the machine works okay on MANUAL, consider what might cause the drive motor to fail to start in VOX operation. Does the relay work? Listen for it to click when you speak into the microphone. Can't hear a click? If the unit has a sealed relay, you might not hear the click, so check the slide-projector

jack for continuity when you speak. Even if the projector contacts show continuity, the relay could still be partially defective — it has several sets of contacts and the motor contacts may not be connecting properly. The fact that any contacts work, however, proves the VOX section is functioning.

Let's assume we didn't get continuity across the projector contacts. The relay can be inoperative for several reasons, so it's time to dig deeper.

With the VOX circuit exposed, check for bias voltage between the base and emitter of X3 while you speak into the microphone. Be sure the bias polarity is correct. If your meter reveals no voltage increase, try again between the emitter of X2 and ground. A voltage shift here, but not at the X3 emitter, indicates an open trigger transistor. (If you measure no voltage here, check first to be sure the MODE switch isn't in position 2 or 4.) A large increase in the resistance of R6 could cause X3 to become inoperative; emitter voltage in this instance would be negative with respect to base. If X3 is open, check for excessively high negative voltage between the emitter of X2 and ground. This indicates that the emitter resistance of X2 has increased and, besides rendering the emitter-follower stage inoperative, has possibly burned out X3.

If any of the bias resistors in the unit have increased in value, they could render the section inoperative. X1 depends on proper biasing, but it can be varied; try adjusting R1 and noting if the relay pulls in when you speak into the microphone.

Another quick overall check is to push the START button. If this triggers the relay, you'll know the trouble must lie in the audio path prior to the VOX stages: Transformer T1 might have an open winding, the printed circuit could have a crack in it, or R1 might be faulty.

The PC board should receive close scrutiny as a possible trouble spot. Portable recorders can easily develop board troubles if the machine is set down too hard. A relay mounted on a PC board may exert quite a strain whenever the board is in a vertical position. Take this fact into consideration when servicing VOX circuits and check the board carefully.

Operates Continuously

What if the drive motor runs constantly in VOX mode, but manual operation is normal? The relay may be stuck. Trigger transistor X3 could have a collector-emitter short, or some other stage could be forward-biased even without the audio input. If you open the emitter circuit of a transistor and the relay de-energizes, it's a simple matter to check voltages and locate the cause of the uncontrolled conduction. An off-value resistor is the most likely culprit.

Intermittents

Intermittent operation of a unit usually strikes dread in the heart of anyone who repairs electronic equipment for a living. It's reverse psychology, but you can learn to regard an intermittent as a challenge (you can't get out of it, anyway) and actually look forward to smoking out the trouble.

In searching for intermittent troubles of the VOX circuits, the relay is what you must assume is operating erratically. It controls the drive

motor, but several other factors directly or indirectly affect relay operation. Faulty relay contacts can cause intermittent operation of the drive motor, but a sealed relay is not too likely to produce this trouble. Never discount the possibility entirely, however.

A leaky trigger transistor, however, is a common cause for intermittent operation; in fact, X1, X2, and X3 are all suspects in cases of this kind. The thermistor might be defective. If C2 or C3 were to become open or leaky, erratic relay operation could result. The old practice of flexing circuit boards will sometimes reveal an intermittent. Also, because of their extensive use, switches shouldn't be overlooked as a possible source of intermittent trouble.

Auxiliary Controls

When auxiliary controls do not function properly, a thorough examination of normal operation will usually suggest a number of possible trouble spots. Mostly, these troubles resolve to be loose jacks, dirty contacts, or bad switches. However, if component failure is suspected, resistance checks or substitution will usually find the trouble.

When you're confronted with abnormal operation of the VOX circuit and its auxiliary controls, your most effective troubleshooting aid is understanding what the circuit is supposed to do. Armed with this, you can move step by step through each action until the abnormal circuit is spotted.

The Rectified Type

Let's look for trouble possibilities in the circuit of Fig. 2. The first two stages can be treated as conventional RC-coupled audio stages, and troubleshooting them should pose no problem. A faulty rectifier diode X3 would cause insufficient forward biasing of X4. If C1, or especially C2, were to become leaky, the relay could produce a chatter. If R1 increased in value, the time constant would be very long and could not be adjusted for correct start-stop operation of the relay. Were R1 too small, no delay at all would be evident.

An increase of the stabilizing resistance between the emitter of X4 and ground would cause the relay trigger to become inoperative. If this resistance becomes too low, relay M1 will remain energized and the drive motor will run continuously.

If the relay in this machine is one with the contacts exposed, corrosion or pitting of the contacts could be a source of intermittent trouble. Using a good burnishing tool will fix them if they're not too badly pitted (a burnishing tool is the only device you should ever use to clean relay points). If the pitting is very deep, replace the relay rather than trying to file the points down—they'd just go bad again soon.

Conclusion

This article has acquainted you with VOX tape recorders and some of the servicing problems you'll find. It would be well to keep in mind that a VOX tape recorder is, in general terms, a standard-type machine to which has been added one or more stages to control its drive motor upon receiving an audio signal. Don't hesitate to accept them for repair. When you get one on the bench, you'll find the old VOX isn't so sly. ▲

FM Stereo

(Continued from page 40)

phonic information—that is, L+R audio at frequencies from 50 to 15,000 cps. It also contains a stereo difference signal in the form of supersonic audio sidebands ranging from 23 to 53 kc. When a 38-kc carrier is added to these sidebands, the result is L-R and −(L-R) signals.

In the biplex detector, a special NPN transistor is used which has bilateral characteristics. This means that it can conduct in both directions. In other words, the emitter can become the collector, and the collector can become the emitter, when the transistor is properly biased and driven with an AC signal.

For a thorough explanation, let's begin with the time shown in Fig. 9A, when terminal 4 of the transformer secondary is positive and terminal 1 is negative. The NPN transistor conducts as shown. If the composite signal is fed to the base, the high-frequency sidebands that comprise the difference signal are combined with the 38-kc subcarrier and the resulting L-R components appear at the collector and emitter. The collector signal undergoes a phase reversal but the emitter signal remains in the original phase. This gives −(L-R) at the collector and L-R at the emitter.

However, the composite signal applied to the base also contains the L+R frequencies and these are unaffected by the presence of the 38-kc subcarrier. Therefore, the L+R signal appears at both the collector and emitter, in its original form, with no phase reversal. When the difference signals and the L+R signal are combined algebraically at the emitter and collector terminals, the result is 2R at the collector and 2L at the emitter.

For the other half of the 38-kc cycle, which is shown in part B of Fig. 9, the emitter and collector have changed places and the transistor is conducting in the opposite direction. Notice that the input signal to the base is marked −(L-R) and is drawn as a negative-going signal. This is to be expected since L-R consists of sidebands which are on the opposite (positive) half-cycle. The L+R signal *has not* changed polarity, because it is pure audio and is not related to the 38-kc carrier.

With the transistor conducting in the opposite direction, the collector is now at the bottom and the phase-inverted version of −(L-R) now appears at this terminal with the label L-R. At the top terminal, which is now the emitter, no phase inversion occurs and −(L-R) still appears there. As before, L+R is unaffected and appears at both terminals. The algebraic addition of these voltages again produces 2R at the top and 2L at the bottom.

Conclusion

Stereo receivers have been changing and improving at a rapid rate in the last two years, and no doubt some of the ideas presented here as the latest circuits will be "latest" for only a short time. This is the challenge faced by repair technicians since the early days of the electronics industry. Your future depends on your ability to reapply basic principles to the understanding of each new step in the advancement of the industry. ▲

Solutions to Problems on Page 14

(1) The unknown is the number of capacitors in the amplifier. We represent this by the letter "×." Since there are 12 more resistors than there are capacitors, the number of resistors equals the number of capacitors plus 12, or × + 12.

The equation can be written:

$\times + (\times + 12) = 46$

And solved:

$2\times + 12 = 46 \qquad 2\times = 46 - 12 \qquad 2\times = 34$

× = 17, the number of capacitors in the amplifier. Since there are 12 more resistors, the number of resistors is 17+ 12 = 29. To check: 17 + 29 = 46 components.

(2) The technician can wire the stereo amplifier in 3 hours; so, he can do 1/3 of the job in 1 hour. His helper can wire the amplifier in 4 hours, or 1/4 of the job in 1 hour.

Now, since 1/3 + 1/4 = 4/12 + 3/12, together they can do 7/12 of the job in 1 hour.

Since they can do 7/12 of the job in 1 hour, they can do the full job in "×" hours. The equation is:

(7/12) times (×) = 1 complete job, or $\frac{7\times}{12} = 1$.

Multiplying both sides of the equation by 12 we get: $7\times = 12$.

Divide both sides of the equation by 7 to get rid of the coefficient of × we get: $\times = \frac{12}{7}$ or 1 5/7 hours, or 1:43 hours (1 hour and 43 minutes).

Ed. Note: Providing they don't get in each other's way.

(3) There was another problem hidden in the letter: If PF Reporter readers can solve these first two problems, they have to use logic. The logic they use is of the same step-by-step nature as troubleshooting should be. Why, then, don't these same intelligent technicians use such logic in their everyday work?

Answer: The good ones do. — Ed.

The Troubleshooter

answers your servicing problems

Internal Interference

The customer's original complaint on a Motorola Chasis 542A-07 (covered in PHOTOFACT Folder 382-1) was a fuzzy picture with an intermittent herringbone pattern. When using a VTVM set for DC voltage, placing the probe on the second and third IF stages causes audio motorboating, severe herringbone pattern, and video overload.

Chapter 12, "Interference Troubles," of the Howard W. Sams book *TV Servicing Guide* indicates this symptom can be caused by signals generated within the receiver. How can I correct this trouble?

V. E. JACKENS

Miami, Fla.

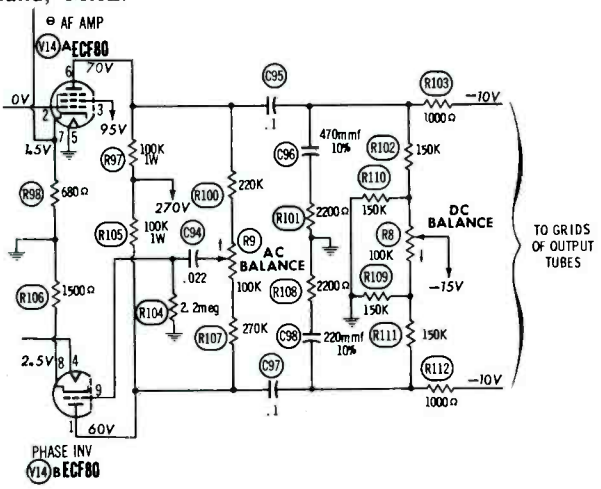
The symptoms you describe indicate that the IF stages are oscillating; which causes the poor resolution and the herringbone pattern. Check the response of the complete receiver by using a sweep generator, and align it following the procedures given in PHOTOFACT. *You may also find some trouble other than misalignment is causing the IF stages to oscillate. Such a symptom could be caused by an open plate, screen-grid, or AGC bypass capacitor. Try bridging all these capacitors with units known to be good; many times this will reveal the one that is defective.*

Output Stage Balance

How are the AC BALANCE and DC BALANCE of H. H. Scott Model 399 (covered in PHOTOFACT Folder 526-8) adjusted for proper output when the output tubes are changed?

D. F. BURDICK

Midland, Mich.



No Brightness Control

In my Philco TV Chassis 13N52 (covered in PHOTOFACT Folder 657-2), the brightness control loses control after the set has been on about eight seconds. In servicing this set for elimination of retrace lines, I substituted tubes and filters, replaced the blanking couplate, tested the vertical-output transformer, tested the yoke, and checked every connection to the retrac circuitry—including the video output circuitry. All voltages on the video output and the picture tube are correct, as are the values of all resistors.

LEON MALISZESKI

Vallejo, California

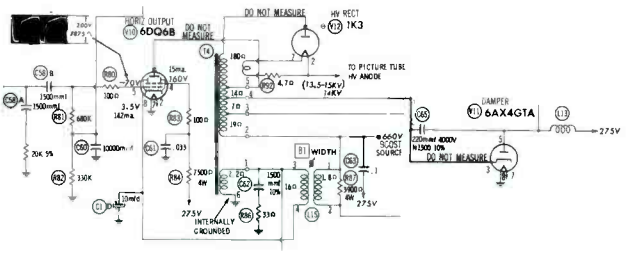
The clue to your trouble is the fact that you are unable to control the brightness of the picture tube. Check the circuitry about the brightness control. One other trouble that could cause this symptom is a short between the control grid, pin 2, and the cathode, pin 7, of the picture tube. A test of the picture tube should indicate whether or not this trouble exists.

Outputs of the paraphase amplifier (phase inverter) are balanced by the AC BALANCE control. First, disconnect the speaker from A channel; then connect a 16-ohm non-inductive 25-watt resistor across the 16-ohm tap. Connect a scope across the load resistor; then, inject a 1000-cps sine wave at the grid of V14A. Increase the oscillator output until clipping is just noticeable on the scope. With this condition present, adjust the AC BALANCE control until the clipping is symmetrical. Next, make the same adjustments for B channel.

DC BALANCE control adjustment is relatively simple. Merely connect a DC voltmeter between both plates of the power output stage and adjust the DC BALANCE control for minimum voltage reading. Repeat this adjustment for the opposite channel.

Intermittent Sweep

I am having trouble with a Zenith Chassis 16D25Q (covered in PHOTOFACT Folder 466-2). The raster is normal for



about one-half minute; then it becomes narrow and blooms, and the high voltage disappears. I changed the horizontal-output transformer because it was cooked, but that did not solve the problem. The only abnormal voltage reading is on pin 5 of V10. When the raster is normal, I get −75 volts on pin 5; then as the raster narrows, voltage drops to −25 volts.

THOMAS E. CASEDA
Nonty-Glo, Pa.

Indications are that the flyback transformer was overheating because of the reduction in grid bias. C58B could be breaking down intermittently and placing a positive potential on the grid of the horizontal-output tube. Check this capacitor by substitution. If C58 is not the cause of trouble, measure the cathode current of V10; it should be 142 ma. If the cathode current is greater than normal, check the output circuit for an excessive load. Be sure to replace the damper tube, V11. Also check the B+ boost line for additional clues.

"It's a surprise. My husband's joining a Citizen's Band."

Product Report

For further information on any of the following items, circle the associated number on the Catalog & Literature Card.

Paging Microphone
(143)

A compact, dynamic microphone permits control of as many as four separate circuits for paging, dispatch, PA, audio-visual work, and ham radio operation.

The new "Mark III DBS" microphone, manufactured by **Audiophonics Corp.,** offers up to four DPDT switches, each controlling a separate circuit. It is available in ceramic, Cerra-Dynamic™, or high- or low-Z dynamic types. The base, prepared for desk mounting, also has a ½" flange to permit direct conduit attachment.

The cast-aluminum base of the unit is for use in industrial plants, hospitals, and other PA applications. It has an adjustable gooseneck, and brush-chromed zinc microphone body.

Tuner and Control Cleaners
(144)

Three new electronic tuner and control cleaners come with extender tubes to direct the spray into cramped working areas. Aerosol-packed, the three new items are **Quietrole** "Mark II" for tuners, "Spray-Pack" for controls and switches, and "Silitron" for general cleaning use. The new Quietrole products are harmless to plastics and metals, are nonconductive, nonflammable, and noncorrosive, and have little effect on capacitance and resistance.

Tape Cleans Recording Head
(145)

A tape leader (impregnated with formula CO-05) is prespliced to the tape at both ends. It cleans oxide from recording heads on every tape run-through. The "Ferrotape" magnetic recording tape, made by **Ferrodynamics Corporation,** has reversing and stop tabs spliced in at both ends for operating the new automatic bidirectional or automatic-stop tape recorders. "Ferrotape" is available in lengths from 300′ to 2400′ in 1.5-mil and 1-mil acetate bases. It is also manufactured in lengths to 2400′ in 1.5-mil, 1-mil, and .5-mil, mylar bases.

CB Direction-Finding Antenna
(146)

The "signal-Hunter," designed for practical and emergency use on CB frequencies, permits locating hidden transmitters, tracking down CB interference, and locating stations in distress.

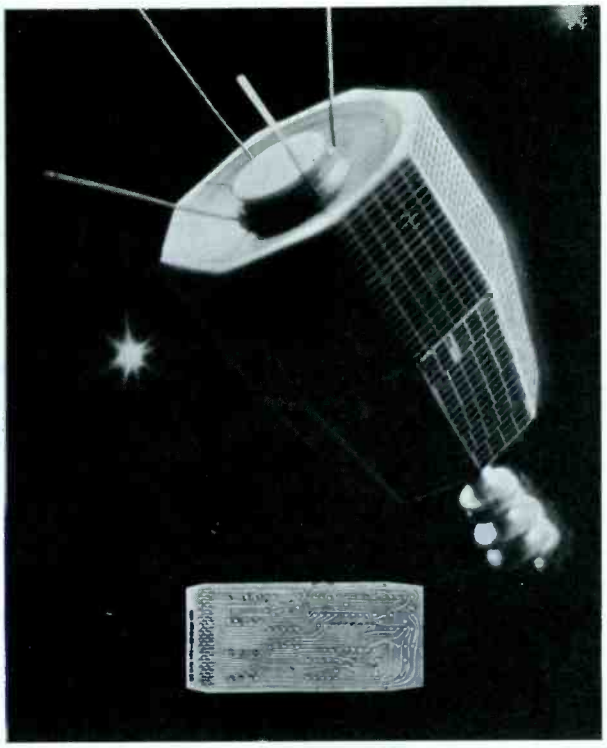
Installation is quite simple; the **Gold Line Company** unit clips on the car window, then is retained by a heavy-duty suction cup. The only electrical connection is a coaxial connector plugged into the antenna socket of the CB set. An 8′ cable permits mounting on either side of the car. Curved or flat windows are accommodated by an adjustable mounting bracket. Tuning is done with a knob at the top of the loop — no special tools or test equipment are needed.

The antenna is operated by tuning its directional pointer; as the loop swing, it homes in on the incoming signal. Indications are viewed on the receiver S-meter or heard as changes in speaker volume. If desired, the loop can be used for transmitting over short distances. The instructions provided with the antenna describe several operating and direction-finding techniques.

The price is $9.95 and includes the coaxial connector (P1-259) and cable (RG-58/U).

23-Channel Transceiver
(147)

A new CB radio, the **Pearce-Simpson** "Director," has solid-state circuitry and requires no warmup period. Its "Hetro-sync®" circuitry utilizes two frequencies instead of three (the usual method of synthesizing in a 23-channel CB unit). For stability, a zener diode is used in



SOLID RCA CIRCUIT DESIGNED FOR RELAY

RELAY uses Solid RCA Circuits.

RCA Victor Color TV uses Solid Copper Circuits.

Why?

RCA Solid Copper Circuits won't come loose. Won't short circuit. Won't go haywire. They're the Space Age advance over old-fashioned "hand wiring."

"HIS MASTER'S VOICE"

RCA The Most Trusted Name in Electronics

Tmk(s)®

the input-power circuit, and special crystals provide a transmitter frequency tolerance of ±.003%. Power drain is .4 amp on receive, 1.5 amps on transmit. Features include dual-conversion superhet receiver design, negative-peak clipping and saturation limiting to prevent overmodulation, squelch and automatic noise limiting, TVI filter, and dustproof enclosed antenna relay. The unit is 2 3/4" high 8 1/2" wide by 8 1/2" deep, weighs 5 lb., and is priced at $299.90.

Home Videotape Recorder

(149)

Home videotape recording systems will play back recordings of live action or television broadcasts. The new **Ampex** line is built around a compact videotape recorder which retails at $1095 in a one-speed tabletop model; $1295 for a two-speed model.

The machine is approximately the size of a conventional audio tape recorder, and is designed for tape interchangeability with future color recorders. The magnetic tape moves past rotating recording and playback heads at a speed of 9.6 ips. A second speed of 4.8 ips will also be offered but this speed can't be used with color.

The recorder will play back black-and-white television programs through nearly any home television receiver, color or b-w, that has had certain connection components added (estimated cost, installed, $25). No internal modification of receiver circuitry is necessary.

INDEX TO ADVERTISERS

OCTOBER, 1965

FREE Catalog and Literature Service

**Check "Index to Advertisers" for further information from these companies.*

Please allow 60 to 90 days for delivery.

ANTENNAS & ACCESSORIES

79. *ALLIANCE* — Colorful 4-page brochure describing in detail all the features of *Tenna-Rotors*.

80. *ANTENNACRAFT*—Literature featuring 3 new 75-ohm, all-channel TV antennas available in factory-built or kit form.*

81. *CLEAR BEAM*—Flyers describing "Suburbanite" all-channel Yagi, and "Slimline" and "Dynamatic" indoor antennas.

82. *FINNEY* — Catalog 20-337 covering U-Vert series UHF converters and catalog 20-338 on Model 65-1 distribution amplifier.*

83. *JERROLD*—Brochure featuring *Coloraxial* system including 75-ohm antennas, matching transformers, preamplifiers, and cable.*

84. *JFD*—Literature on complete line of log-periodic antennas for VHF, UHF, FM, and FM stereo. Brochure showing converters, amplifiers, and accessories; also complete '64-'65 dealer catalog plus dealer wall chart of antenna selection by area.*

85. *MOSLEY ELECTRONICS* — Illustrated catalog giving specifications and features on large line of antennas for Citizens band, amateur, and TV applications.

86. *STANDARD KOLLSMAN* — Catalog sheet on Model TA transistorized UHF converter and transistor converter kit.*

87. *TRIO*—Brochure on installation and materials for improving UHF translator reception.

88. *WINEGARD* — Catalogs describing Chroma-Tel all-channel antennas, and "Color Match" transformer and cable packages.*

89. *ZENITH*—Information bulletins on antennas, rotors, batteries, tubes, power converters, record changers, picture tubes, wire, and cable.*

AUDIO & HI-FI

90. *ADMIRAL* — Folders describing line of '65 equipment; includes black-and-white TV, color TV, radio, and stereo hi-fi.

91. *AMECO*—Flyer describing Model PCFM preamplifier for FM receivers.

92. *GC ELECTRONICS*—Revised wall chart, No. FR-250-W, containing cross reference for tape and phono drives and belts.*

93. *JENSEN* — 24-page catalog, No. 165-K, illustrates and describes speakers and speaker system kits.*

94. *LAFAYETTE*—New 512-page 1966 catalog No. 660 listing electronics equipment for home, hobby, and industry.

95. *NUTONE*—Two full-color booklets illustrating built-in stereo music systems and intercom-radio systems. Includes specifications, installing ideas, and prices.

96. *OAKTRON* — "The Blueprint to Better Sound," an 8-page catalog of loudspeakers and baffles giving detailed specifications and list prices.*

97. *OXFORD TRANSDUCER*—4-page catalog describing three lines of automobile rear-seat speaker kits.*

98. *QUAM-NICHOLS* — Catalog 65 listing replacement speakers for public address systems, hi-fi, auto radio, and radio-TV applications.

99. *SETCHELL-CARLSON* — Illustrated booklet supplying information on company's 1966 line and explaining *UNITIZED* construction.

COMMUNICATIONS

100. *EICO*—Data sheet on Model 753 *Tri-Band* transceiver and other ham gear, plus full-line catalog.*

101. *PEARCE-SIMPSON* — Specification brochure on IBC 301 business-band two-way radio, *Companion II, Director, Escort II, Guardian 23*, and *Sentry* Citizens-band transceivers.

102. *SPRAGUE* — Circular M-853 describes SK-1, SK-10, SK-20, and SK-30 *Suppressikits* for vehicles with alternators or DC generators.*

COMPONENTS

103. *ADC* — Booklet titled "Wave Filters, Their Design and Specifications" describing methods for specifying filters, and literature listing telephone coils, jack panels, and other communications components.

104. *BUSSMANN*—Bulletin SHF-12 introducing shielded fuseholder designed to prevent radiation and reception of RF energy via the fuseholder.*

105. *COMPONENT SPECIALTIES*—Catalog featuring intercoms, speakers, earphones, and other replacement components.

106. *E-Z-HOOK*—Catalog listing full line of test connectors.

107. *LITTELFUSE* — New circuit breaker cross reference brochure.*

108. *MERIT*—Form 850, 1965-66 general catalog and replacement guide for coils and transformers.

109. *ONEIDA*—Catalog listing line of hardware, switches, resistors, and other replacement items.

110. *SONOTONE*—Brochure titled "This Is Sonotone" illustrating production and uses of rechargeable batteries.*

111. *SWITCHCRAFT*—New product bulletin No. 153 describing Series 32000, and Series 32000TL "T-Lite" illuminated switches.*

SERVICE AIDS

112. *CASTLE*—How to get fast overhaul service on all makes and models of television tuners is described in leaflets. Shipping instructions, labels, and tags are also included.*

113. *EBY*—Literature giving details on CA-1 and CA-2 test-point adaptors for color picture tubes.

114. *ELECTRONIC CHEMICAL* — Catalog sheet describing aerosol cleaners for electrical contacts, volume controls, and tape heads.*

115. *I.E.H.*—Specification sheet for color service adapters and harnesses.

116. *LUBRA CLEAN*—Information on new tuner cleaner.

117. *PRECISION TUNER*—Literature supplying information on complete low-cost repair and alignment services for any TV tuner.*

118. *RAWN* — Detailed instruction sheets on TV knob and plastic repairs with *Plas-T-Pair*.

119. *YEATS*—The new "back-saving" appliance dolly Model 7 is featured in a four-page booklet describing feather-weight aluminum construction.

SPECIAL EQUIPMENT

120. *ATR* — Descriptive literature on selling new all-transistor *Karadio* Model 707, having retail price of $29.95. Other literature on complete line of DC-AC inverters for operating 117-volt PA systems and other electronics gear.

121. *GREYHOUND* — The complete story of the speed, convenience, and special service provided by the Greyhound Package Express routes.

122. *PERMA-POWER* — Four-page catalog, GB281, illustrating solid-state garage door operator using pulse tone modulation.*

TECHNICAL PUBLICATIONS

123. *CLEVELAND INSTITUTE OF ELECTRONICS*—Free illustrated brochure describes electronic slide rule and four lesson Instruction Course and grading service.*

124. *HOWARD W. SAMS* — Literature describing popular and informative publications on radio and TV servicing, communications, audio, hi-fi, and industrial electronics, including special new 1965 catalog of technical books on every phase of electronics.*

125. *RCA INSTITUTES* — 64-page book, "Your Career in Electronics" detailing home study courses in telecommunications, industrial electronics, TV servicing, solid-state electronics, and drafting. Preparation for FCC license, and courses in mobile communications and computer programming also available.*

TEST EQUIPMENT

126. *B & K*—New 1966 catalog featuring test equipment for color TV, auto radio, and transistor radio servicing, including tube testers designed for testing latest receiving tube types.*

127. *BLONDER-TONGUE* — Complete information on Model 4122 UHF-VHF sweep generator and other *Lab-Line* products.*

128. *HICKOK*—Specification sheets on Model 662 installer's color generator, Model 677 wideband scope, Model 470A uni-scale VTVM and Model 799 *Mustang* tube tester.*

129. *JACKSON*—New 8½" x 11" catalog listing full line of test equipment.*

130. *LECTROTECH* — Bulletins on *Meiergards, Lectrocells*, Models V-6 and V-7 color-bar generators, Model T-100 horizontal-deflection circuit meter, Model U-75 UHF translator.*

131. *MERCURY*—Complete line of test equipment contained in new 8½" x 11" catalog.*

132. *SECO*—New colorful folder describing 20 test instruments including tube testers.*

133. *SENCORE*—Latest information on TC-136 tube tester and SS137 sweep-circuit analyzer, plus catalog describing full line of products.*

134. *SIMPSON* — Complete 16-page brochure on entire line of electronic test equipment; also, catalog on line of panel meters.*

TOOLS

135. *ARROW*—Literature containing illustrations and diagrams showing uses of staple-gun tackers for electrical and electronic wiring.

136. *BERNS*—Data on unique 3-in-1 picture-tube repair tools, on *Audio Pin-Play Crimper* that enables technician to make solderless plug and ground connections, also for color and other picture tubes. Model AV-2 for RCA type phono plugs, along with C rings for shielded braided wire ground connections and LC-3 for 5/32" pin diameter.*

137. *ENTERPRISE DEVELOPMENT*—Time-saving techniques in brochure from Endeco demonstrate improved desoldering and resoldering techniques for speeding and and simplifying operations on PC boards.*

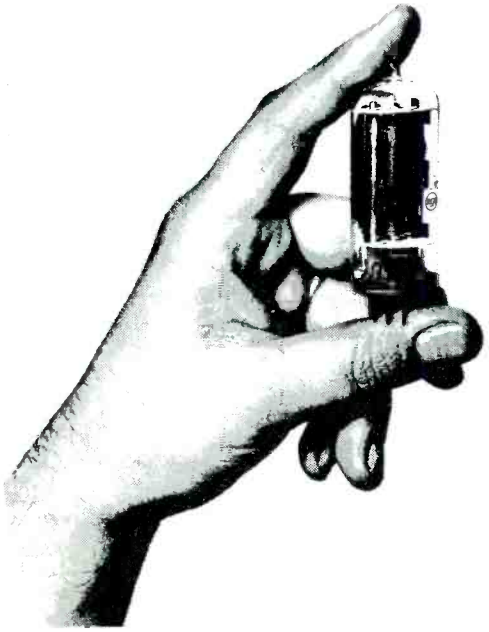
138. *VACO*—Catalog listing tools for use with solderless terminals.

TUBES & TRANSISTORS

139. *WORKMAN*—Cross-reference list for entertainment-type transistor replacements.*

Meet some of the people responsible for RCA's personal quality performance program

Norman Haythorn
Ronnie Ferguson
Charles Daher
Liz Johnson
Bernice Runnalls
Hans Weber
Rose Manigault
Nadia Spas
Theresa Pagano
Hazel Anderson
Jean Gurski
Julie Harris
Elizabeth Postbrigel
George Merrett
Claire Wade
Mildred Sherman
Alexander M. Collins
Shigeko Strelecki



People are the prime ingredient in RCA's attempt to achieve zero defects in the production of receiving tubes. Thousands of RCA people engaged in the manufacturing of receiving tubes have deeply committed themselves to the attainment of missile-type reliability in commercial receiving tube production. They say, "I pledge to strive for error-free performance in every task I undertake through my personal quality performance."

That's why replacing with RCA receiving tubes—across the board—is your best short-cut to a satisfied customer instead of a callback.

RCA ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N.J.

The Most Trusted Name in Electronics

Introducing a Complete Line of Littelfuse Quality Circuit Breakers

Actual Size
1¾" x 13/16" x ½"

Exact replacement from factory to you

Designed for the protection of television receiver circuits, the Littelfuse Manual Reset Circuit Breaker is also ideally suited as a current overload protector for model railroads and power operated toy transformers, hair dryers, small household appliances, home workshop power tools, office machines, small fractional horsepower motors and all types of electronic or electrical control wiring.

LITTELFUSE DES PLAINES, ILLINOIS

Circle 78 on literature card