ELECTRONIC TECHNICIAN / DEALER

WORLD'S LARGEST ELECTRONIC TRADE CIRCULATION

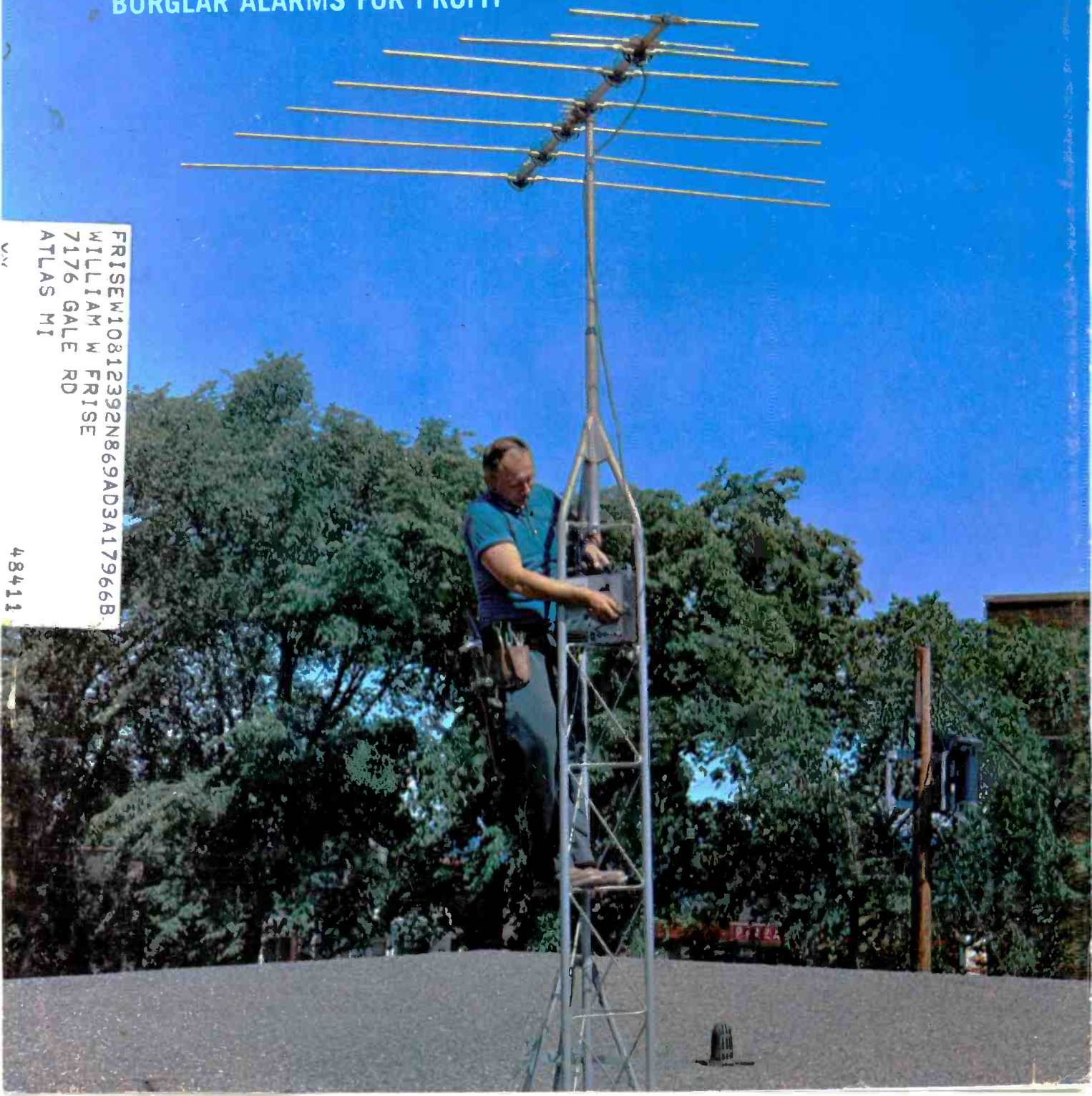
SERVICING COLOR "TIGERS"

SOLID-STATE GARAGE DOOR OPENERS

BURGLAR ALARMS FOR PROFIT

AN OJIEWAY PUBLICATION

SEPTEMBER 1968



breakthrough

B&K Model 1450 first and only service-designed oscilloscope with "intermittent analyzer" and "electronic memory"

That elusive intermittent . . . how many hours have you spent trying to locate the source of the problem—how much time was wasted testing each circuit when you could have been doing more productive work? Now, B&K know-how and engineering genius have come through for you.

Result . . . the intermittent analyzer in the Model 1450 Diagnostic Oscilloscope. It will tell you *if* and *where* an intermittent occurs—even without your being there! The electronic memory will keep the intermittent indicator "on" until you return. Think of the time and money it saves.

The easiest to use 'scope ever built, its unique screen gives error-free direct readings of peak-to-peak voltages—it syncs automatically at any signal level—easily displays color reference signal. Convenient for use as a vectorscope too, all inputs and controls are on the front panel.

Deluxe in every respect, the 1450 is another B&K innovation that will make your time more profitable in solid state and color TV service. Years-ahead planning for present and future use . . . the best-value all-around 'scope you can buy. With probe. Net, **$279.95**

INTERMITTENT MONITOR. Designed to supplement the indicators on the 1450, this plug-in monitor can be placed anywhere in your shop. It flashes and buzzes when an intermittent occurs . . . and projects a professional image to your customer. Net, **$24.95**

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B&K

Where Electronic Innovation Is A Way Of Life

. . . for more details circle 101 on postcard

ELECTRONIC TECHNICIAN / DEALER

TEKFAX

COMPLETE MANUFACTURER S' CIRCUIT DIAGRAMS
AND TECHNICAL INFORMATION FOR 6 NEW SETS

GROUP 193

	SCHEMATIC NO.		SCHEMATIC NO.
EMERSON — Color TV Model 35P01/35P02	1177	RCA VICTOR — TV Chassis KCS173 Series	1180
MAGNAVOX — TV Chassis T915 Series	1181	TRUETONE — Color TV Model 2DC4815	1178
MOTOROLA — TV Chassis TS592 Series	1179	ZENITH — TV Chassis 13Y12	1176

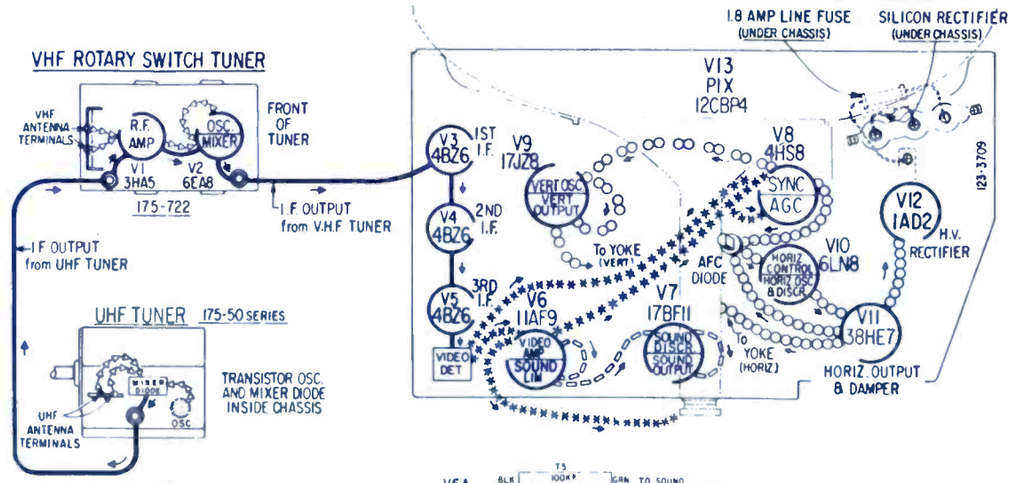
TUBE POSITIONING GUIDE

Signal Path Diagram and Parts Layout Of The 13Y12 Chassis.

SOUND CIRCUIT
COMPOSITE VIDEO
R F SIGNAL
VERTICAL CIRCUIT
HORIZONTAL CIRCUIT
INTERMEDIATE FREQUENCY

1176
ZENITH
TV Chassis 13Y12

SEPTEMBER • 1968



NOTES:

ALL VOLTAGES MEASURED FROM CHASSIS TO POINTS INDICATED.
ALL VOLTAGES ARE D.C. UNLESS OTHERWISE SPECIFIED.
ALL D.C. VOLTAGES TO BE MEASURED WITH A VACUUM TUBE VOLTMETER HAVING 11 MEGOHM INPUT RESISTANCE.
ALL VOLTAGE MEASUREMENTS TO BE MADE WITH NO SIGNAL PRESENT. NORMAL SETTING OF CONTROLS AND CHANNEL SELECTOR SET TO CHANNEL 2 UNLESS OTHERWISE SPECIFIED.
ALL CAPACITOR VALUES IN MICROFARADS UNLESS OTHERWISE SPECIFIED
ALL CAPACITOR CAPACITY TOLERANCE SEE LEGEND
ALL RESISTORS ARE ±10% TOLERANCE, CARBON, 1/2 WATT UNLESS OTHERWISE SPECIFIED.
RESISTANCE MEASUREMENTS SHOWN WITH COIL DISCONNECTED FROM CIRCUIT.
COIL RESISTANCES NOT GIVEN ARE UNDER ONE OHM.

▶ INDICATES 20% TOLERANCE MAY BE USED

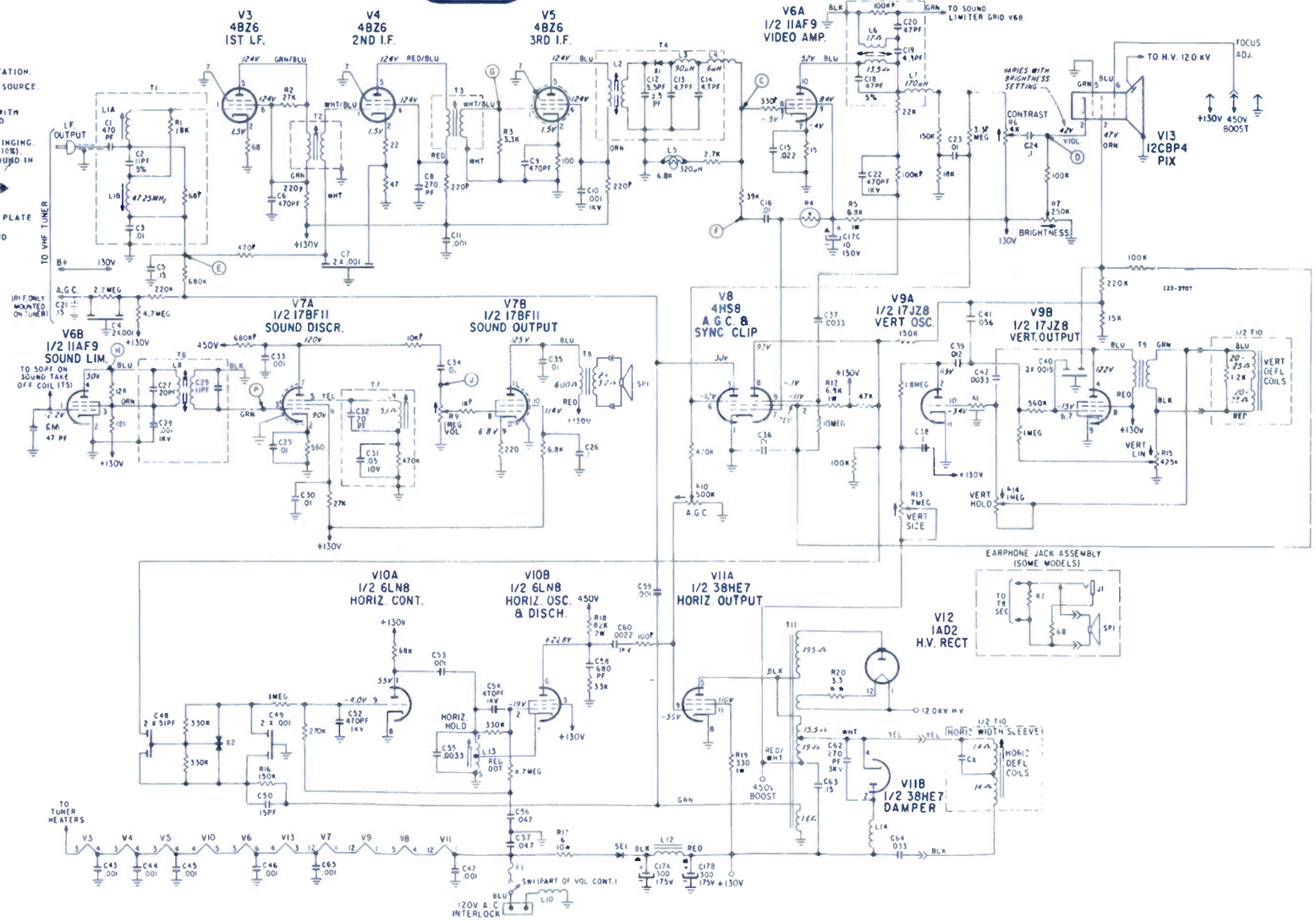
ARROWS ON POTENTIOMETERS INDICATE CLOCKWISE ROTATION.
CHASSIS ⏚ ○— INDICATES VOLTAGE SOURCE.

PICTURE TUBE 2ND ANODE VOLTAGE TO BE MEASURED WITH ELECTROSTATIC KILOVOLTMETER WITH BRIGHTNESS AND CONTRAST CONTROLS FULL COUNTER-CLOCKWISE

CX= CAPACITOR VALUE SELECTED FOR MINIMUM YOKE RINGING. VARIES WITH A RANGE OF 47 PF TO 72 PF (3 K.V., ± 10%). WHEN NECESSARY, REPLACE WITH EXACT VALUE FOUND IN YOKE.

CIRCLED LETTERS INDICATE ALIGNMENT AND TEST POINTS WHERE APPLICABLE. Ⓒ→

C - DETECTOR OUTPUT
D - VIDEO OUTPUT
E - I.F. AGC
F - GROUNDED FOR I.F. ALIGNMENT
G - 3RD I.F. GRID
H - SOUND LIMITER PLATE
J - SOUND OUTPUT
P - SOUND DISC GRID



SYMBOL	DESCRIPTION	ZENITH PART NO.
C17A	300μf elect cap 175v	22-5577
C17B	300μf elect cap 175v	22-5577
C17C	10μf elect cap 150v	22-5577
C20	47pf disc cap 5% 500v	22-2467
C40	2 x .0015μf disc cap 10% 500v	22-26
C49	2 x .001μf disc cap 10% 500v	22-21
C62	270pf disc cap 10% 3kv	22-4602
C66	47pf disc cap 5% 500v	22-2467
R4	voltage dependent resistor	63-5472
R6	4K contrast control	63-6463
R7	250K bright control	63-5419
R9	1M volume control	63-6916
R10	500K AGC control	63-5470
R13	7M vert size cont	63-6463
R14	1M vert hold cont	63-6915
R15	425K vert lin cont ±30%	63-7558
R17	6Ω resistor 10% 10w	63-4450
R18	82K resistor 10% 2w	63-5750
R19	330 resistor 10% 1w	63-6049
R20	3.3Ω WW res 10% ½w	63-2769
L2	4th IF winding assy	Pt. of T4
L3	det series peaking coil	20-2013
L4	choke coil	20-2004
L5	det shunt peaking coil	20-2520
L7	video series peaking coil	20-2014
L6	sound take off coil assy	Pt of T5
L8	intercarrier coil wind assy	Pt of T6
L9	quad coil wind assy	Pt of T7
L10	line filter coil	20-1424
L12	filter choke	95-2619
L13	horiz osc coil wind assy	S-56875
L14	spook coil	20-2005
T1	1st IF trap coil assy wiring	S-80520
T2	2nd IF trans assy	S-66852
T3	3rd IF trans assy	S-66853
T4	4th IF trans assy	S-66854
T5	sound take off assy	S-80558
T6	intercarrier coil assy	S-77495
T7	quad coil assy	S-79340
T8	sound output xformer	95-2499
T9	vert output xformer	95-2618
T10	yoke	95-2457
T11	horiz sweep trans bracket assy	S-78383
X1	crystal diode	103-23
X2	dual silicon diode	103-101
A1	integrator	87-4
R1	fuse 1.8a	136-65

1177

EMERSON
Color TV Model
35P01/35P02

ELECTRONIC TECHNICIAN / DEALER **TEKFAX**

SEPTEMBER • 1968

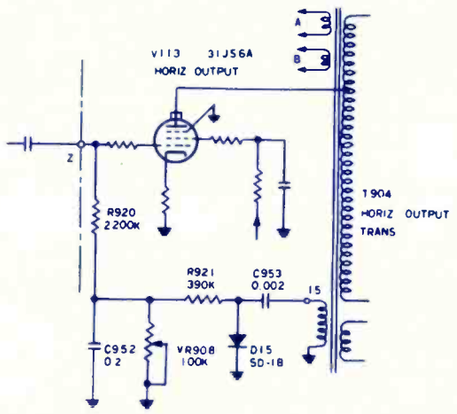
COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR 6 NEW SETS

SYMBOL	DESCRIPTION	EMERSON PART NO.
C908	elect capacitor 60+ 50+ 30μf 450v	981974
C931	elect capacitor 100+ 33+ 22μf 350v	981977
C939	elect capacitor 60+ 50+ 30μf 450v	981975
C940	elect capacitor 60+ 50+ 30μf 450v	981974
C942	elect capacitor 200+ 40μf 300v	981976
R931	WW resistor 4Ω 35w	981980
R932	WW resistor 2.2K 8w	981978
R933	WW resistor 1.2K 15w	981979
L101	47.25MHz trap coil	981982
L102	peaking coil A 12μh	981995
L103	peaking coil 15μh	981997
L104	peaking coil 470μh	981993
L105	peaking coil 100μh	981991
L106	choke coil 6.8μh	981996
L107	peaking coil 82μh	981990
L108	peaking coil 100μh	981991
L109, L110, L111	choke coil 6.8μh	981996
L112	sound take-off coil	981986
L113	quad coil	981988
L114	peaking coil 100μh	981991
L115	peaking coil 180μh	981992
L116, L117	choke coil	981998
L118	peaking coil 820μh	981994
L119	peaking coil 68μh	981989
L301	horiz osc & stabilizer coil	982014
L303	peaking coil 6.8μh 10%	982024
L304, L305	phase coil	982022

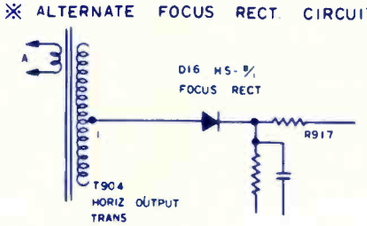
NOTE :

1. All resistance values in ohms K = 1,000 M = 1,000,000
2. Voltage reading taken with "VTVM" from point indicated to chassis ground. Voltage Readings may vary ± 10%. Tuner on unused channel. Contrast at maximum. AGC at fully clockwise, other controls at normal, line voltage 120 volts.
   ●Marked voltage readings were taken using a color bar signal, all controls at normal.
3. All waveforms measured with strong signal input. Contrast and AGC set to give normal picture. Line voltage 120 volts.
5. Numbers in circles refer to waveform numbers.
6. Unless otherwise noted in schematic, all capacitor values less than 1 are expressed in mfd, and the values more than 1 are in pF.

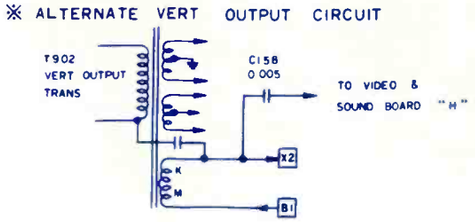
※ ALTERNATE HORIZ. OUTPUT CIRCUIT

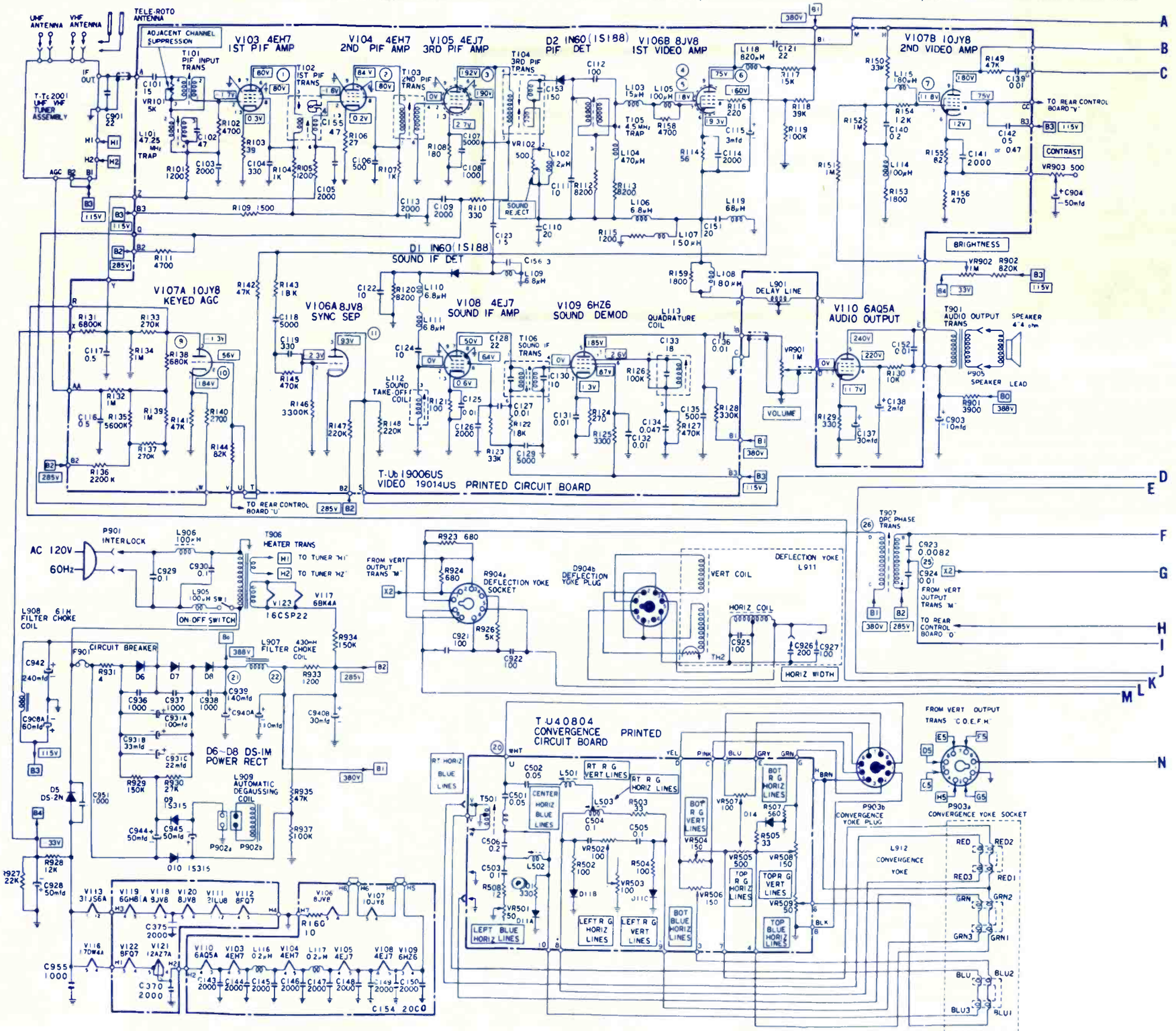


※ ALTERNATE FOCUS RECT. CIRCUIT



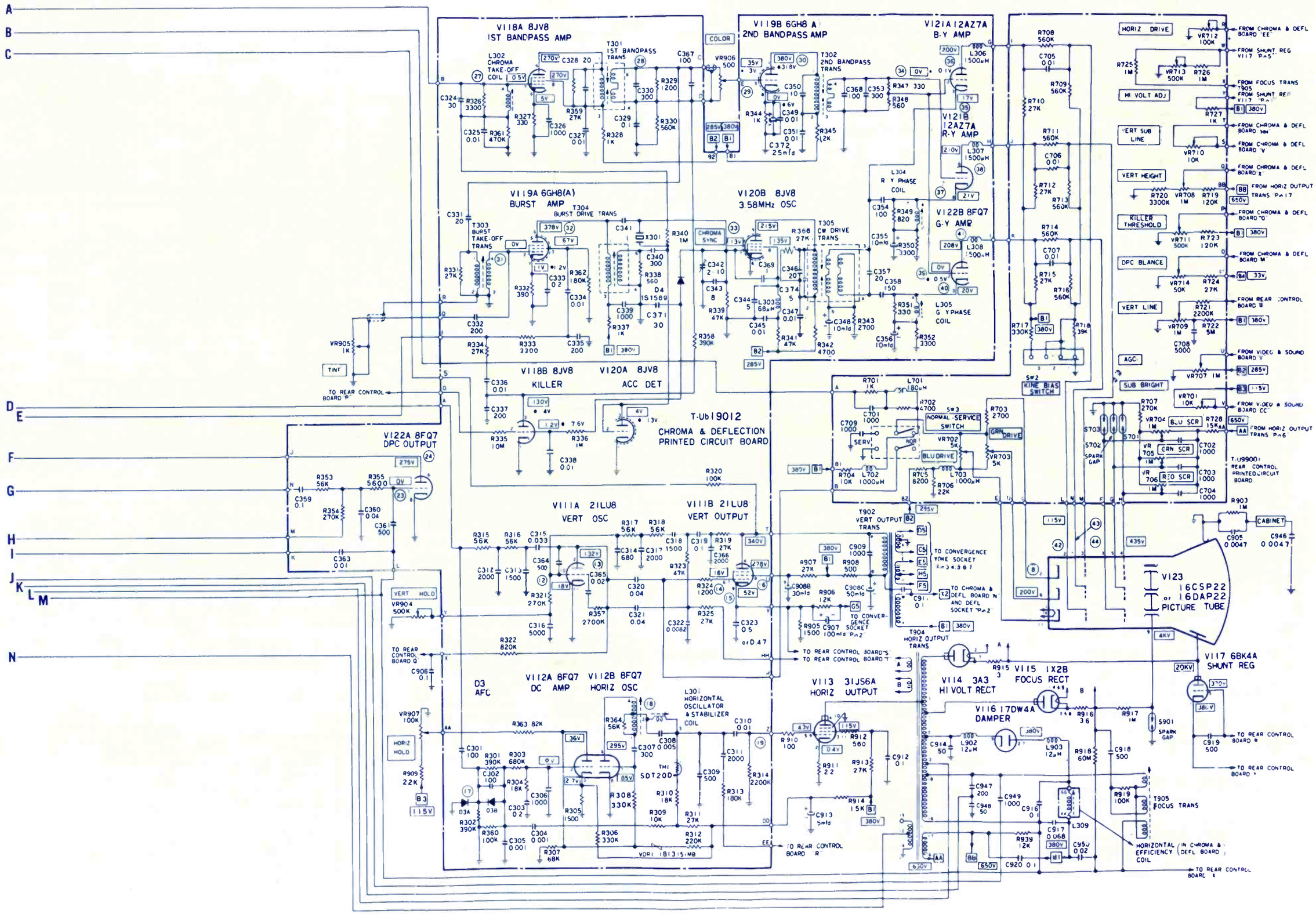
※ ALTERNATE VERT. OUTPUT CIRCUIT





L306, L307, L308 — choke coil 1500μh	982023
L309 — horiz lin coil	982015
L501 — convergence coil right R/G vert lines	982035
L502 — convergence coil center horiz blue lines	982038
L503 — convergence coil right R/G vert lines	982036
L901 — delay line coil	981931
L905, L906 — filter coil AC line	981929
L907 — filter choke coil	981920
L909 — degaussing coil	981928
L911 — deflection yoke	981891
T101 — PIF input xformer	981981
T102, T103 — 1st & 2nd PIF xformer	981983
T104 — 3rd PIF xformer	981984
T105 — 4.5MHz trap coil	981985
T106 — sound IF xformer	981987
T301 — 1st band pass xformer	982017
T302 — 2nd band pass xformer	982018
T303 — burst take-off xformer	982020
T304 — burst drive xformer	982021
T305 — drive xformer	982019
T501 — convergence xformer-rt horiz blue	982037
T901 — audio output xformer	981938
T902 — vert output xformer	981939
T904 — horiz output xformer	981924
T905 — focus xformer	981919
T906 — heater xformer	981930
T907 — phase xformer	981918
VR902 — bright control	981964
VR903 — contrast control	981963
VR904 — vert hold control	981964
VR905 — tint control	981962
VR906 — color control	981961
VR907 — horiz hold control	981965
F901 — circuit breaker	981948
X301 — crystal 3.58MHz	982034
D3 — diode AFC	982363
VHF tuner	981893
UHF tuner	982060

EMERSON
Color TV Model 35P01/35P02



1178

TRUETONE

Color TV Model
2DC4815

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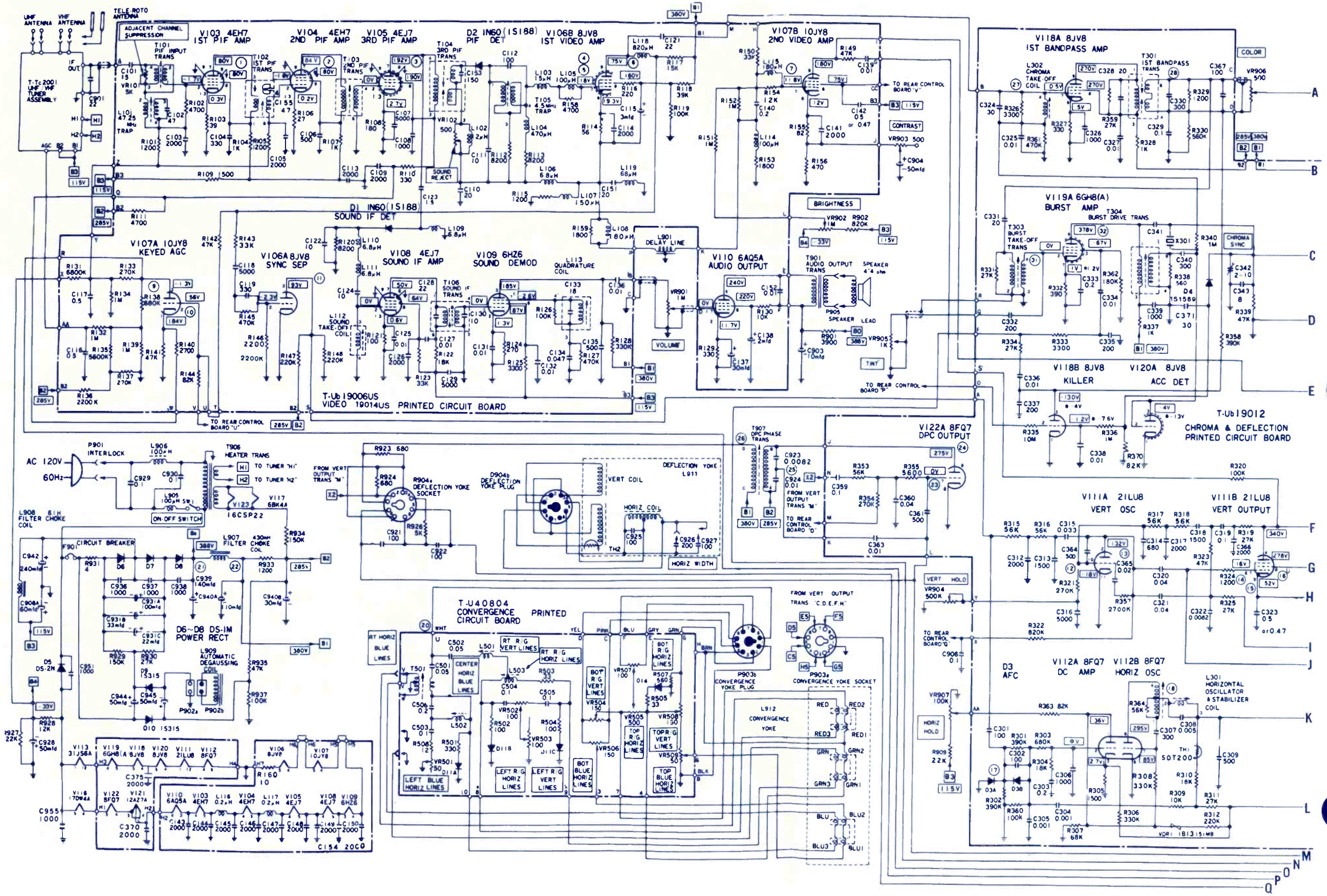
COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS
AND TECHNICAL INFORMATION FOR 6 NEW SETS

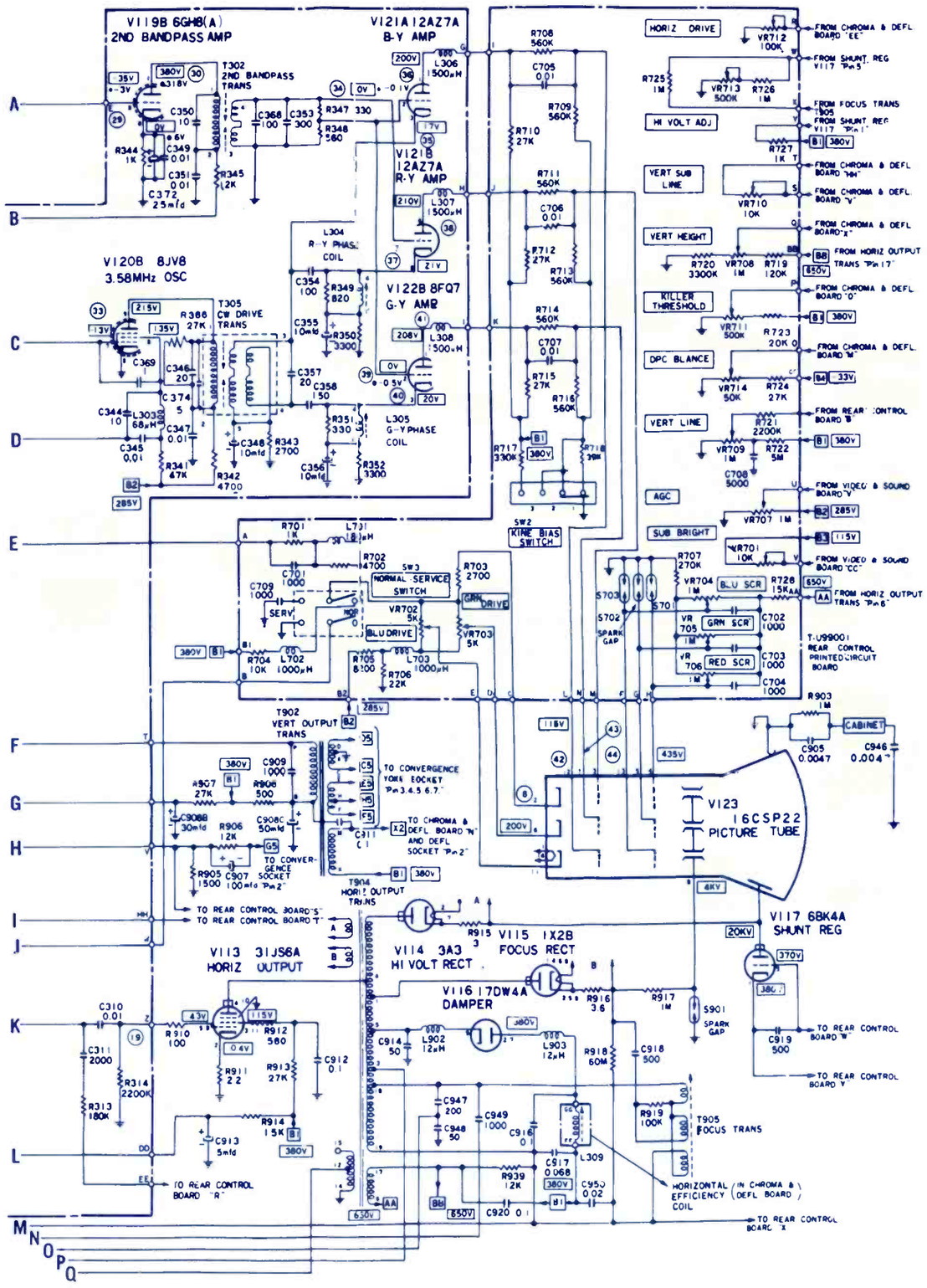
SEPTEMBER • 1968

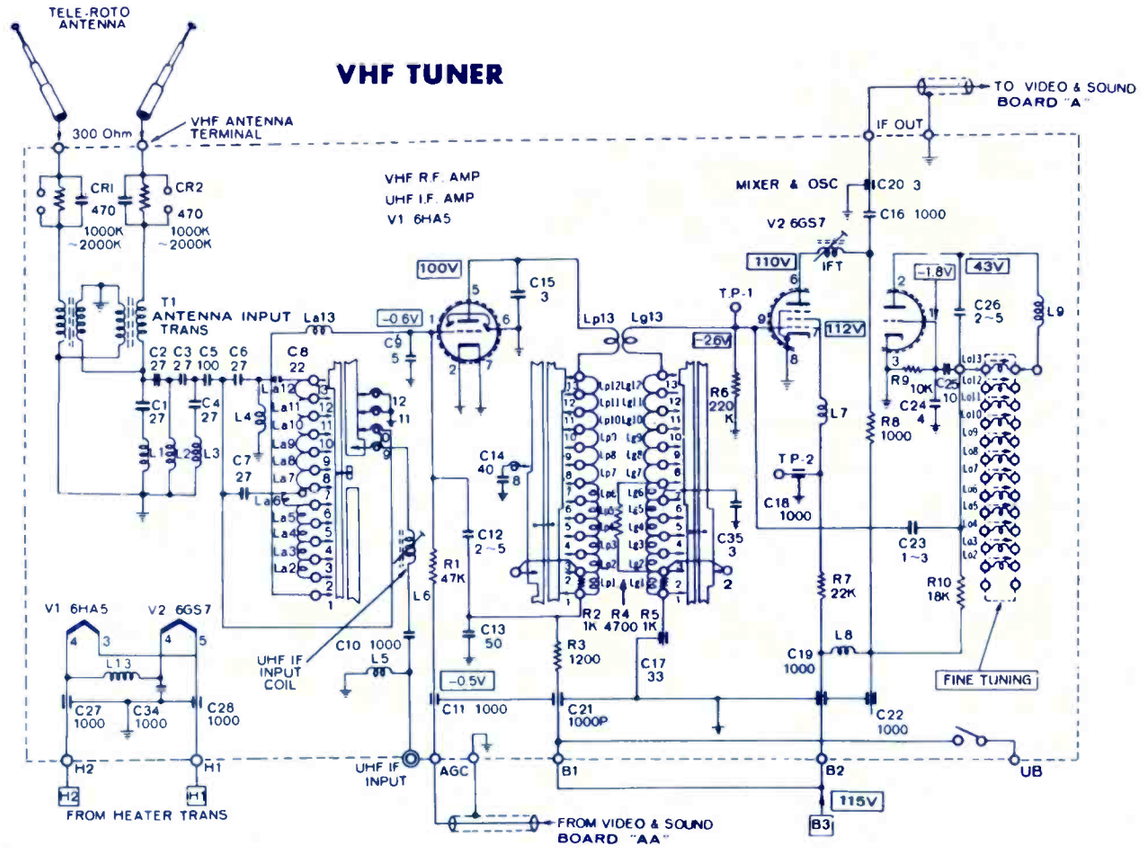


NOTE :

1. All resistance values in ohms K = 1,000 M = 1,000,000
2. Voltage reading taken with "VTVM" from point indicated to chassis ground. Tuner on unused channel, Contrast maximum, AGC at full clockwise, other controls at normal, line voltage 120 volts.
   ● Marked voltage readings were taken using a color bar signal, all controls at normal.
3. All waveforms measured with strong signal input. Contrast set to give normal picture and AGC line operating normally.
5. Numbers in circles refer to waveform numbers.
6. Unless otherwise noted in schematic, all capacitor values less than 1 are expressed in mfd, and the values more than 1 are in PF.

TRUETONE
Color TV Model 2DC4815





SYMBOL	DESCRIPTION	TRUETONE PART NO.
T101	PIF input xformer	22-0423
T102	1st PIF xformer	22-0424
T103	2nd PIF xformer	22-0425
T104	3rd PIF xformer	22-0426
T105	4.5MHz trap coil	24-0384
T106	sound IF xformer	22-0427
L101	47.25MHz trap coil	24-0385
L102	peaking coil-A 12µh	24-0386
L103	peaking coil-F 15µh	24-0387
L104	peaking coil 470µh	24-0388
L112	sound takeoff coil	24-0392
L113	quad coil	24-0393
L116, L117	choke coil	24-0394
L118	peaking coil-F 820µh	24-0395
L119	peaking coil 68µh	24-0396
VR101	adj control B-500Ω	14-0191
VR102	adj control B-5K	14-0192
	chroma & deflection circuit board assembly	19-0121
L301	horiz osc & stabilizer coil	24-0368
L302	chroma takeoff coil	24-0367
L303	peaking coil-F 68µh 10%	24-0369
L304, L305	phase coil	24-0370
L304	horiz efficiency coil	24-0372
T301	1st bandpass coil	24-0373
T302	2nd bandpass coil	24-0374
T303	burst takeoff xformer	24-0375
T304	burst drive xformer	24-0376
L502	convergence coil center horiz blue lines	24-0381
L503	convergence coil right R/G horiz lines	24-0382
T501	convergence xformer right horiz blue line	24-0383
L701	peaking coil-F 180µh	24-0378
T901	audio output xformer	21-0130
T902	vert output xformer	21-0131
T904	horiz output xformer	36-0008
T905	focus xformer	24-0359
T906	heater xformer	20-0026
T907	phase xformer	24-0360
L901	defoy line coil	24-0361
L907	filter choke coil	24-0364
L908	filter choke coil	24-0366
L909	degaussing coil	24-0365
L911	deflection yoke	36-0009
L912	convergence yoke	36-0010
	thermistor SDT-200	16-0029
D4	diode 1S1589	32-0063
D5	silicon diode DS-2N	32-0059
C914, C948	cer 50pf 10% 3kv	04-0154
C921, C922	cer 100pf 10% 3kv	04-0145
C918	cer 500pf 10% 7kv	04-0155
C947	cer 200pf 20% 2kv	04-0157
C940, C908, C939	elect con 60+ 50+ 30µf 450wv	06-0072
C942	elect con 200+ 40µf 300wv	06-0073
C931	elect con 100+ 33+ 22µf 350wv	06-0074
R117	carbon film 15K 10% 7w	12-0230
	voltage dependent resistor	14-0190
R704	carbon film 10K 10% 5w	12-0269
R918	carbon film 60M 10% 2w	12-0185
R901	carbon film 3.9K 10% 7w	12-0198
R932	WW 2.2K 5% 8w	13-0017
R933	WW 1.2K 5% 15w	13-0018
R931	WW 411 5% 35w	13-0019
	circuit breaker	18-0006
	control on/off volume	14-0174
	control color	14-0175
	control tint	14-0176
	control contrast	14-0177
	control bright	14-0146
	control horiz hold	14-0178
	control vert hold	14-0179

1179
MOTOROLA
TV Chassis TS592 Series

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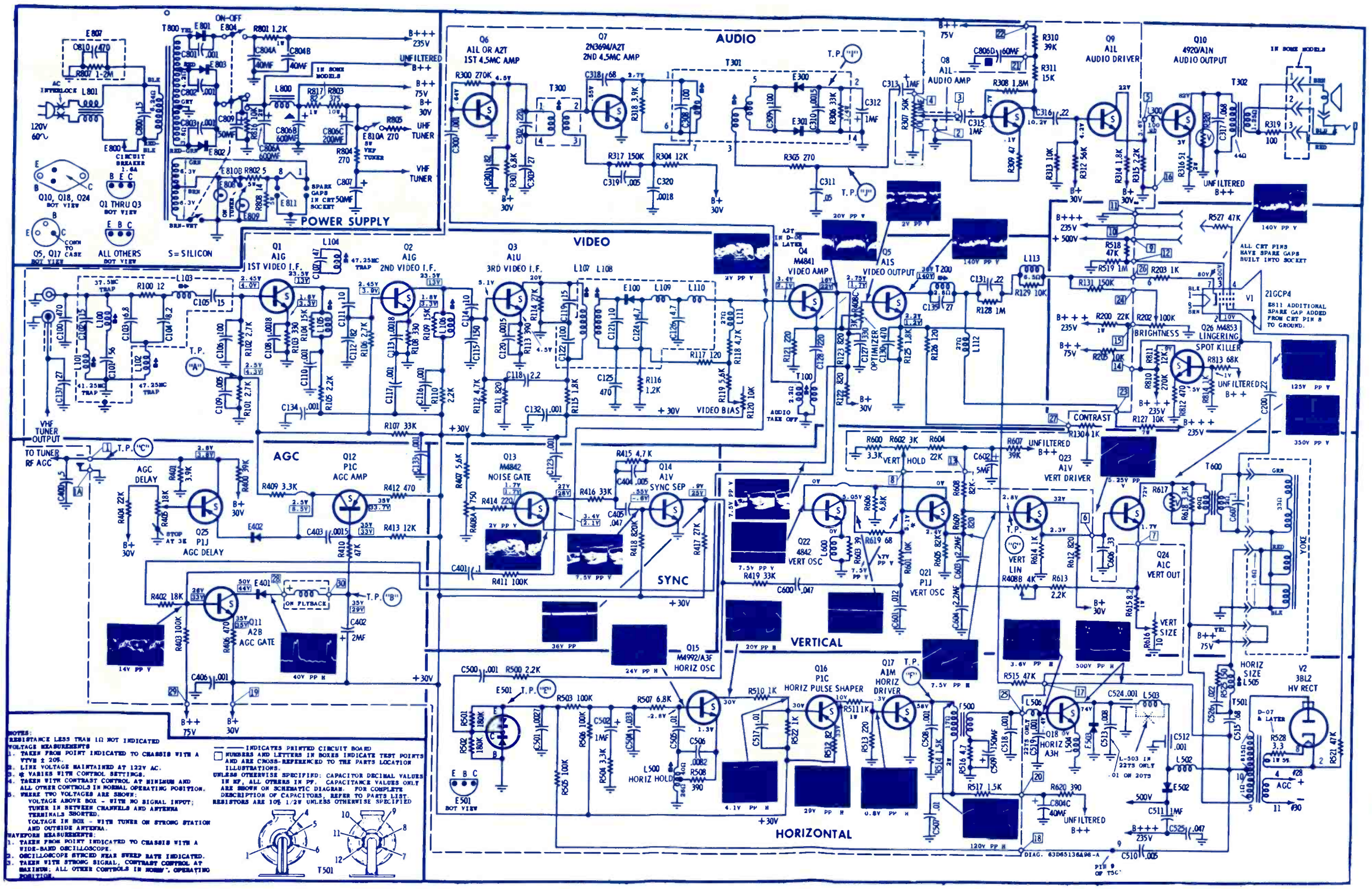
SEPTEMBER • 1968



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SEPTEMBER • 1968

1180

RCA VICTOR

TV Chassis KCS173 Series

COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR 6 NEW SETS

TUBE AND SOLID STATE COMPONENT COMPLEMENT

Symbol No.	Type	Function
KCS160 Chassis		
CR101	1N3194	Low Voltage Rectifier
CR201	Crystal Diode	Picture 2nd Detector
V101	22JR6	Horizontal Output
V102	1G3/1B3	High Voltage Rectifier
V103	17CT3	Damper
V105*	20SP4 or 21GAP4	Picture Tube
V201	6GH8A	Sound I F and Sync Sep
V202	13V10	Sound Detector and Audio Out
V203	4EH7	1st Picture I F
V204	4JC6A	2nd Picture I F
V205*	11LQ8 or 11KV8	AGC and Video
V206	21LR8	Vertical Oscillator
V207	8FQ7	Horizontal Oscillator and Control
*Replace with same type as original.		
KRK127 VHF Tuner		
V1	3GK5	R F Amplifier
V2	5KE8	R F Oscillator and Mixer
KRK120 UHF Tuner		
CR1	1N82AG	UHF Mixer
Q1	35449 (KRK120NA)	UHF Oscillator
Q1	S1037 (KRK120MA)	UHF Oscillator

Symbol No.	Type	Function
Q1	GM770 (KRK120PA)	UHF Oscillator
Q1	S1019/S1044 (KRK120WP)	UHF Oscillator
Q1	S2020 (KRK120XP)	UHF Oscillator
KRK122 UHF Tuner		
CR1	1N82AG	UHF Mixer
Q1	35449 (KRK122AC)	UHF Oscillator
Q1	GM770 (KRK122BC)	UHF Oscillator
Q1	S1019/S1044 (KRK122DC)	UHF Oscillator
KRS29B Remote Control Receiver		
CR1101	(See parts list)	Power Rectifier
CR1102	FD222	16 V. Supply Rectifier
Q901	2N2613	1st Amplifier
Q902	2N2614	2nd Amplifier
Q903	2N2614	3rd Amplifier
Q904	2N2614	Driver Amplifier
Q1101	2N406	Channel Relay Keyer
Q1102	2N406	Volume-Down Relay Keyer
Q1103	2N406	Volume-Up Relay Keyer

SYMBOL	DESCRIPTION	RCA VICTOR PART NO.
C101	4 section elect	114845
C101A	250µf 200v	114845
C101B	400µf 175v	114845
C101C	50µf 175v	114845
C101D	5µf 150v	114845
C109	170pf 5% 4kv N1500 cer KCS 173H	124465
C227	18pf 5% 500v N150 cer	116028
CR101	diode 400PIV 500ma	113998
CPR101	circuit printed	109956
CPR102	circuit printed	109956
CPR103	circuit printed KCS 173H	109956
L103	8.2µh	107385
L104	choke	124461
L110	line choke	114293
L202	AGC	114315
L203	470µh	124271
L204	36µh	116056
L205	2.7µh	107463
L206	250µh	109944
L207	horiz freq	114486
PW200	circuit printed sound video	124478
R118	control vert hold contrast horiz hold KCS 173B, D, E	124278
R118	control contrast vert hold horiz hold KCS 173H	124279
R210	27Ω 5% ½w film	239444
R212	2.2K 5% ½w film	228712
R220	3K 5% ½w film	227097
R223	5.6K 3w	104180
R257	control vert size	121223
R260	control vert lin	121944
R271	910Ω 5% ½w film	228914
R275	68K 5% ½w film	224257
RF101	fuse .35Ω 1.1a	124263
RT102	thermistor 16Ω cold	114480
RV101	varistor 250v at 1ma KCS 173D, E	118506
T102	horiz output	124462
T103	vert output	124274
T104	audio output	124275
T201	4.5MHz	114489
T202	sound IF	118411
T203	quad	118410
T204	47.25MHz	113097
T205	1st video IF grid	113097
T207	video IF	124276
T208	2nd detector	121779
	yoke deflection AL312	125226
	yoke deflection	124245
	VHF tuner	KRK 127AB-AC-AE-AH
	UHF tuner	KRK 120MA, NA, PA

ELECTRICAL SPECIFICATIONS

ANTENNA INPUT IMPEDANCE ..... 75 ohms unbalanced, 300 ohms balanced

AUDIO POWER OUTPUT RATING ..... 1.5 watts maximum

FOCUS ..... Electrostatic, Fixed Focus

INTERMEDIATE FREQUENCIES

Picture I F Carrier Frequency ..... 45.75 mc.
Sound I F Carrier Frequency ..... 41.25 mc.

POWER INPUT ..... 120 Volts AC, 60 Cycle

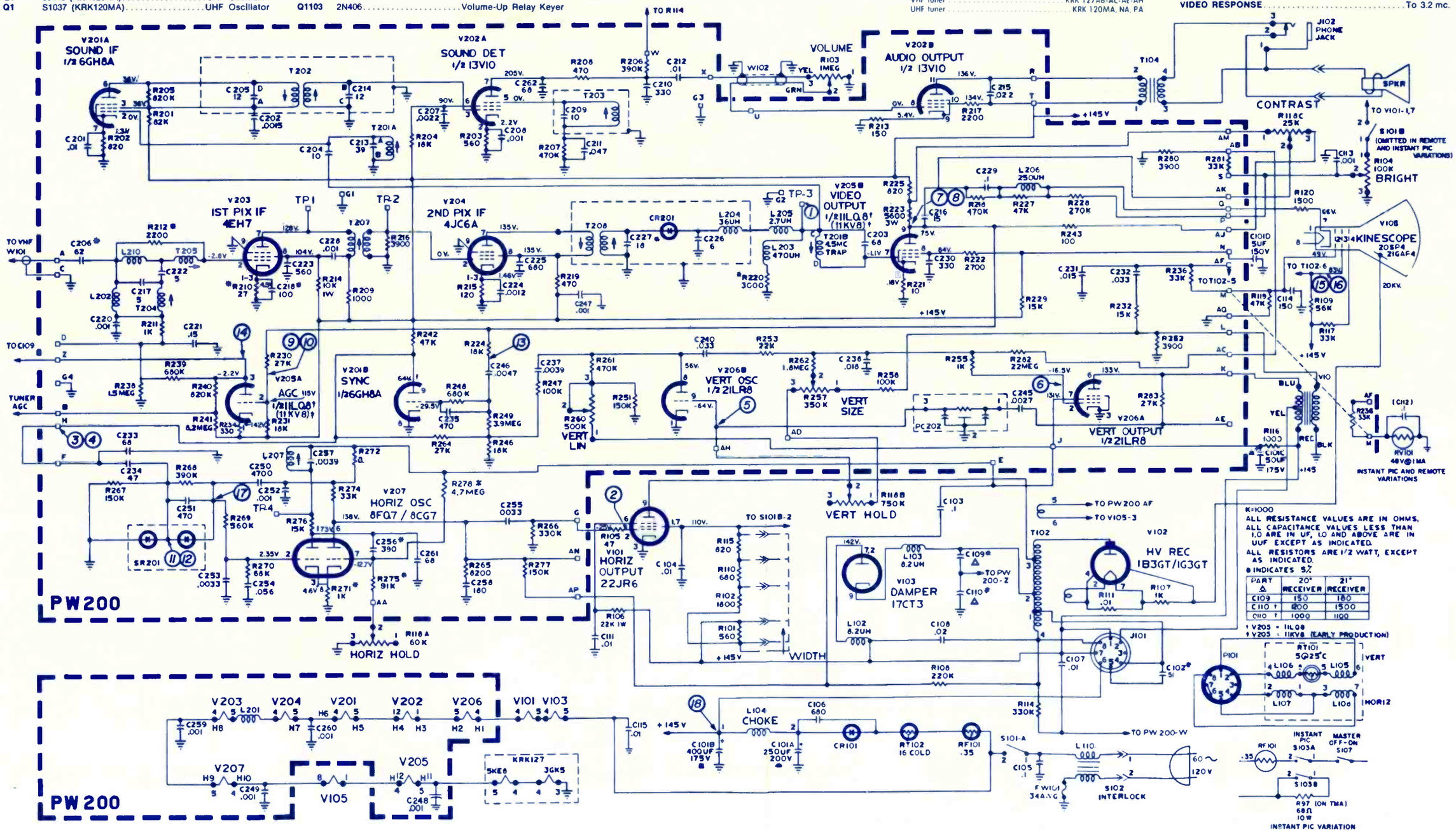
POWER RATING ..... 140 watts Manual, 160 watts Remote

SWEEP DEFLECTION ..... Magnetic

TELEVISION R F FREQUENCY RANGE

Any of 12 VHF Channels ..... 54 mc. to 88 mc., 174 mc. to 216 mc.
Any of 70 UHF Channels ..... 470 mc. to 890 mc.

VIDEO RESPONSE ..... To 3.2 mc.



1181

MAGNAVOX

TV Chassis T915 Series

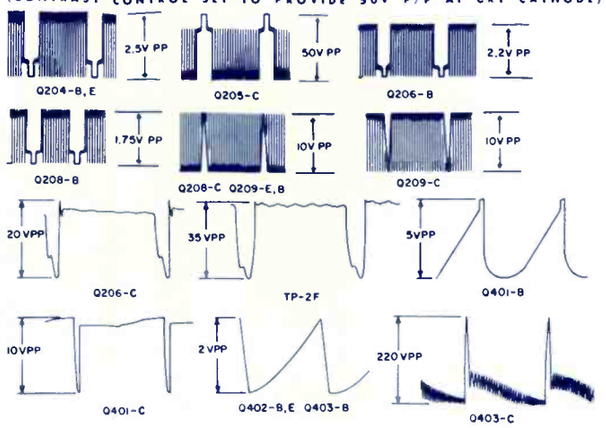
ELECTRONIC TECHNICIAN/DEALER **TEKFAX**

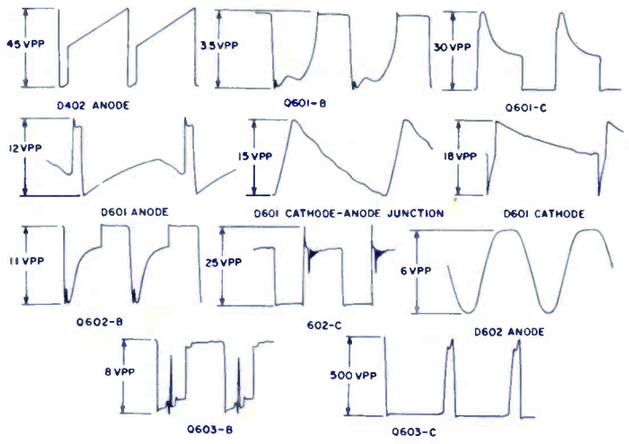
SEPTEMBER • 1968

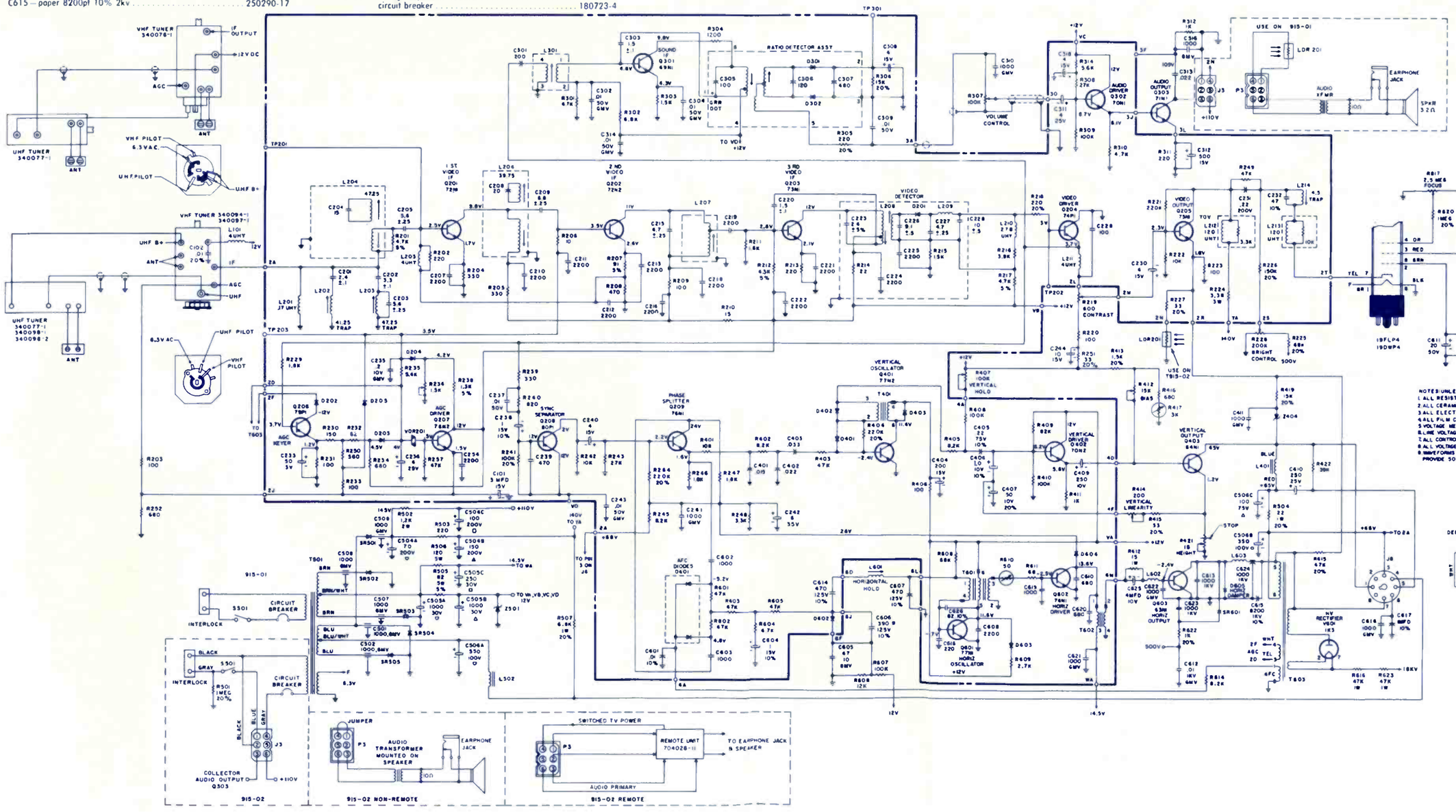
COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR **6 NEW SETS**

SYMBOL	DESCRIPTION	MAGNAVOX PART NO.
T301	audio output xformer (T915-15-FC)	320330-4
T401	vert osc xformer	320322-1
T501	power xformer	300233-2
T601	horiz osc xformer	320323-1
T602	horiz driver xformer	361160-1
T603	horiz output xformer	361308-1
L101	RF choke	361159-1
L202	41.25MHz trap	361152-1
L203	47.25MHz trap	360843-1
L206	1st IF & 39.75MHz trap	361154-1
L207	2nd IF xformer	361155-1
L208	3rd IF xformer	361156-1
L209	tweet coil	361157-1
L212	peaking coil 120uhy	360853-9
L214	4.5MHz trap	360851-1
L301	sound take-off xformer	361149-1
L302	ratio detector xformer	361150-1
L401	vert output choke	320319-2
L502	filter reactor	320321-1
L601	horiz ringing coil	361196-1
L602	RF choke	360676-10
L603	supressor coil deflection yoke	361077-2 361162-3
C223	cer 24pf 5% NPO	250546-2405
C504	elect 70/150/100µf 200v	270021-119
C505	elect 1000/1000/250µf 30v	270021-125
C506	elect 350/350µf 100v 100µf 75v	270021-118
C615	paper 8200pf 10% 2kv	250290-17
R417	thermistor NTC	230171-1
R417	thermistor NTC FC production	230172-3
R505	82 5% 5w WW	240080-147
R506	120 10% 5w WW	240080-51
R610	thermistor NTC	230172-1
R219	600 contrast T915-01, 03, 04, 07, 15	220208-37
R219	600 contrast T915-02, 06, 14	220208-18
R219	600 contrast T915-05	220126-99
R228	200K brightness T915-01, 03, 04, 07, 15	220208-27
R228	200K brightness T915-02, 05	220208-19
R228	400K brightness T915-06, 14	220208-39
R236	1500 AGC AA & AB production only	220182-2
R236	1500 AGC	220217-5
R307	100K on-off vol T915-01, 03, 04, 07, 15	220135-26
R307	100K on-off vol T915-02	220135-19
R307	100K on-off vol T915-05, 06	220126-98
R407	120K vert hold T915-01, 03, 04, 07, 15	220208-41
R407	120K vert hold T915-02, 05, 06, 14	220208-40
R412	15K vert bias	220208-36
R414	200 vert lin	220208-23
R421	15 height	220167-8
R617	2.5M focus	220208-25
R618	10M LDR range adjust	220208-24
D601	dual selenium diode	530045-4
D602	horiz AFC varicap	530112-1
Z404	zener diode	530117-1
Z501	zener diode	530073-13
LDR201	light dependent resistor	230180-1
VDR201	voltage dependent resistor	230173-1
	circuit breaker	180723-4

P/P VOLTAGE & WAVEFORMS
(CONTRAST CONTROL SET TO PROVIDE 50V P/P AT CRT CATHODE)







NOTES: UNLESS OTHERWISE SPECIFIED,
1. ALL RESISTORS ARE 1/2W, ±10%.
2. ALL CERAMICS ARE PF, 500V, ±20%.
3. ALL ELECTROLYTICS ARE MFD, +100%, -10%.
4. ALL FILM CAPACITORS ARE 100V, ±20%.
5. VOLTAGE MEASURED WITH NO SIGNAL.
6. LINE VOLTAGE 120VAC.
7. ALL CONTROLS SET FOR NORMAL OPERATION.
8. ALL VOLTAGES ARE POSITIVE UNLESS MARKED(-).
9. WAVEFORMS MEASURED WITH CONTRAST SET TO PROVIDE 50V P/P AT CATHODE OF CRT.

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

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

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

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

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

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

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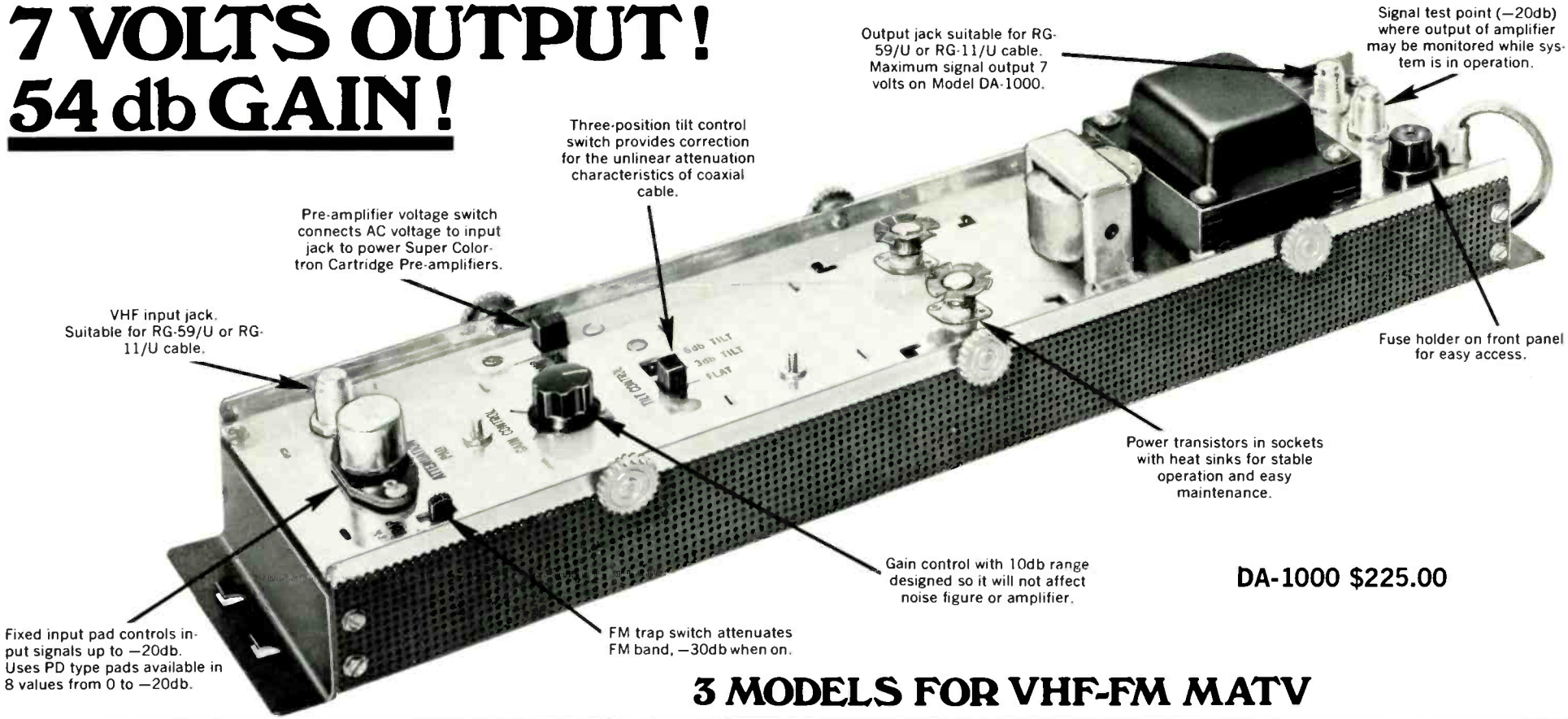

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When it comes to selecting distribution amplifiers for MATV systems, some folks tend to overlook many factors that are just as important as amplifier gain. What about voltage output? What about the noise figure? What about circuit reliability? What about the features that allow you to equalize and control signal levels? Winegard engineers took these—and many other factors—into consideration in designing this new series of transistorized, printed circuit amplifiers. These VHF-FM amplifiers have just about everything you could ask for. Including, of course, reliable performance to give your clients best possible color fidelity and complete reception satisfaction. No matter what size the system.

For full specifications and sample system layouts on the DA-1000 (54 db), DA-900 (40 db) and the DA-800 (28 db), write for Winegard Fact-Finder #253. We promise you'll be impressed.

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ELECTRONIC TECHNICIAN / DEALER

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SEPTEMBER 1968 • VOL. 88 NO. 3

COVER

TV antennas and signal measuring instruments are useful for making MATV installations even in areas of relatively strong signals to insure proper reception.

TEKFAX • 16 PAGES OF THE LATEST SCHEMATICS • **Group 193**

EMERSON: Color TV Model 35P01/35P02
MAGNAVOX: TV Chassis T915 Series
MOTOROLA: TV Chassis TS592 Series
RCA VICTOR: TV Chassis KCS173 Series
TRUETONE: Color TV Model 2DC4815
ZENITH: TV Chassis 13Y12

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ET/D EDITOR'S MEMO

Non-Profit Dealers

If service-dealers continue to have their profit margin on replacement parts sliced to microscopic proportions, they will undoubtedly have to raise their service fees. That, or join the ranks of dealers before them who have dropped out of business.

As in any service business, the profit on TV-radio replacement parts must be maintained to balance labor costs and make a profit.

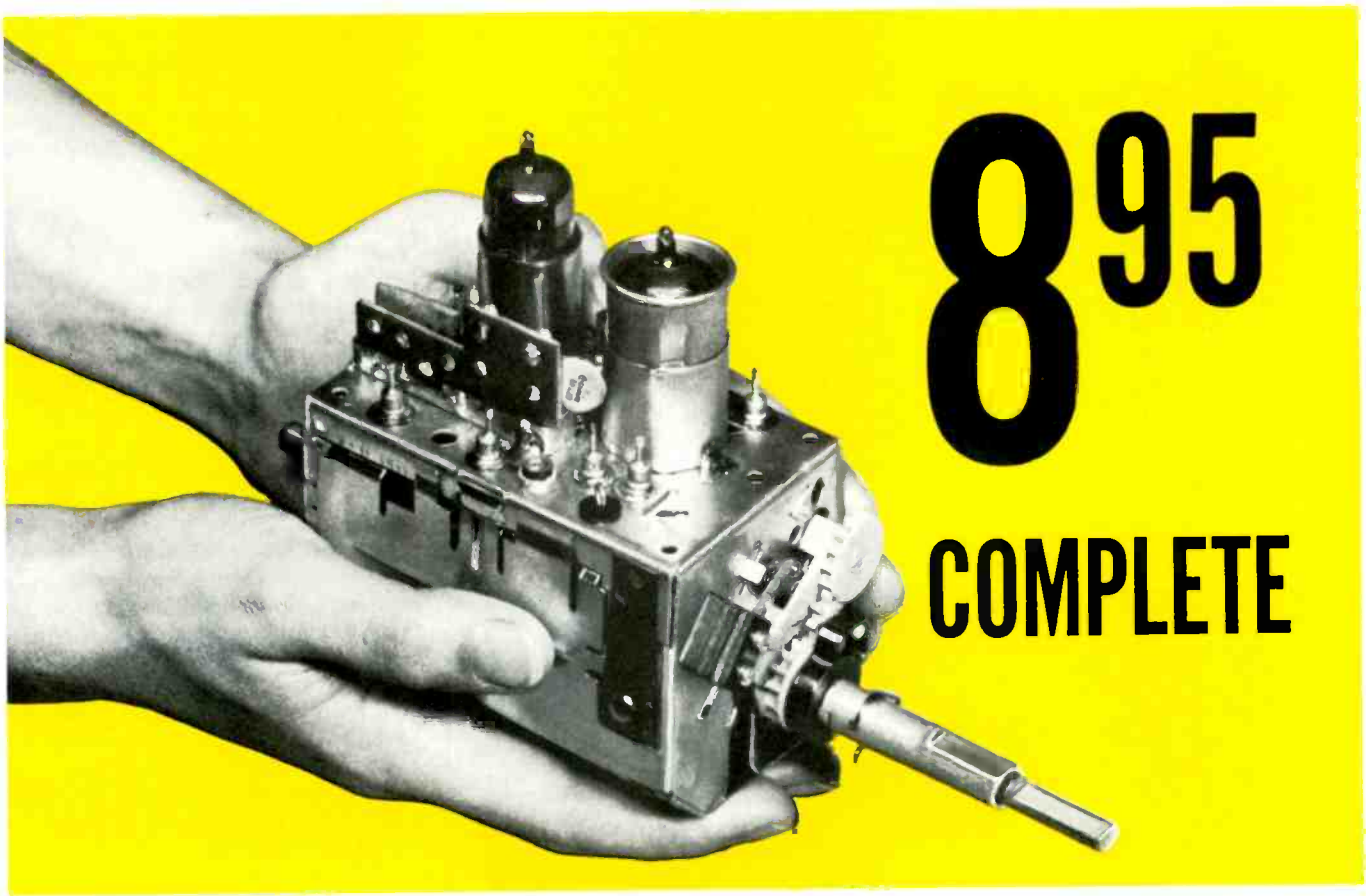
The new warranty program on color TV tubes may be a big inducement for John Q. Public to buy color, but it's looking like so much sand in the dealer's cash drawer.

The new warranty means that a dealer selling a color set can not expect a picture tube sale for the life of the warranty. Of course, if the set does need a picture tube replaced during warranty, the dealer has no choice but to charge a reasonable fee which would include the profit he would normally have made on the tube sale.

This creates a problem. The customer didn't notice the fine print which says that the installation fee is not included as part of the warranty. So, the $65 to $100 for tube installation and adjustment has now provided the dealer with one very unhappy customer. He can be a good Joe and reduce the fee, thereby cutting his profit needlessly. Or, he can try to explain why the service fee is somewhat higher. In any case he will probably lose the customer. And to make a bad situation even worse, the dealer often has to pay more for his merchandise than the chain store on the next block. The nasty truth is, the chain stores can sell for less but the service-dealer has to charge more to repair it — and he has to face the customer.

A warranty is used to compensate for design problems which generally show up within the first few months of operation. Yet many of the TV manufacturers claim that their sets are built so well that they don't need a warranty. And in the same breath they extend the warranty period to sell more sets — at the dealer's expense!

At this rate, the service-dealer will have to cease his service operation and concentrate on quantity sales. In other words, customers will be buying TV and radio sets like disposable clothes — when it stops working they just toss it into the junk because there won't be anyone left who can afford the parts or time to service it.



Castle, the pioneer of television tuner overhauling, offers the following services to solve ALL your television tuner problems.

● **OVERHAUL SERVICE** — All makes and models.

VHF or UHF tuner	$9.95
UHF-VHF combination (one piece chassis)	$9.95
TRANSISTOR tuner	$9.95
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Overhaul includes parts, except tubes and transistors.

Simply send us the defective tuner complete; include tubes, shield cover and any damaged parts with model number and complaint. Your tuner will be expertly overhauled and returned promptly, performance restored, aligned to original standards and warranted for 90 days.

UV combination tuner must be single chassis type; dismantle tandem UHF and VHF tuners and send in the defective unit only.

And remember—for over a decade Castle has been the leader in this specialized field . . . your assurance of the best in TV tuner overhauling.

● **CUSTOM REPLACEMENTS**

Exact replacements are available for tuners that our inspection reveals are unfit for overhaul. As low as $12.95 exchange. (Replacements are new or rebuilt.)

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STOCK No.	HEATERS	SHAFT Min.*	SHAFT Max.*	I.F. OUTPUT Snd.	I.F. OUTPUT Pic.	PRICE
CR6P	Parallel 6.3v	1¾″	3″	41.25	45.75	8.95
CR7S	Series 600mA	1¾″	3″	41.25	45.75	9.50
CR9S	Series 450mA	1¾″	3″	41.25	45.75	9.50
CR6XL	Parallel 6.3v	2½″	12″	41.25	45.75	10.45
CR7XL	Series 600mA	2½″	12″	41.25	45.75	11.00
CR9XL	Series 450mA	2½″	12″	41.25	45.75	11.00

*Selector shaft length measured from tuner front apron to extreme tip of shaft.

These Castle replacement tuners are all equipped with memory fine tuning, UHF position with plug input for UHF tuner, rear shaft extension and switch for remote control motor drive . . . they come complete with hardware and component kit to adapt for use in thousands of popular TV receivers.

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ET/D LETTERS TO THE EDITOR

Sample Budget Can Ruin Us

In reference to your article "How To Make More Money and Live Better," ET/D June 68, it certainly doesn't help me to convince my students that they should go into electronics when you show part-time office help makes $4160 per year and two technicians working full time make only $12,480 per year split between them.

At this rate, the office help would make $8320 per year full time and our electronic technicians are struggling along at $6240 per year.

I hope electronic employers reading this article do not take your sample seriously. This kind of publicity can ruin us.

DAVID H. MCNETT
Madera, Calif.

Mr. McNett is correct. There was a slight goof in the figures which appeared in the sample budget column on page 52. The article was submitted by James Sarayiotes at JFD and he informed us that the correct salaries for the technicians should have been $9240 each or $18,480, not $12,480. The owner's salary is just that; it does not include his profit. The correction could not be caught in time. We are grateful to Mr. McNett's sharp eye and can appreciate his concern . . . . Ed

No Addresses

I read your "Letters" column every month and you help a lot of technicians. However, why don't you include their street address so we who are interested in helping some of these men can write directly to them without bothering the ET/D staff with letters.

HORACE D. WESTBROOKS
Griffin, Ga.

Mr. Westbrooks has a point, but we don't list the complete address because in many cases it would infringe on the reader's privacy. It must also be recognized that not all the letters the reader might receive would be helpful, or even related to the particular subject. Therefore, to protect our readers we gladly take the time to perform this service unless the author of the letter requests that we supply his address. . . . Ed

Iran Technician Views Antennas

For many years, I have been a persistent reader of ELECTRONIC TECHNICIAN/DEALER. And I must admit that I have learned more from ETD than from my over 15 years of reading other material in the field.

In several past issues the VHF antennas have been tackled in some detail. What surprises me is not the subject of the antennas being discussed or philosophies applied by a variety of people, but the fact that despite the long-term experiments that most technicians in America have been through, most of them still seem to expect the manufacturer to tell them what his antenna is supposed to do, and how to install it!

It is, of course, true that the pickup capability of an antenna is as important to a receiver as the capability of a CRT to display the information, and the loudspeaker to produce the sound. But how many times has it been proven to technicians that it's not the antenna elements alone that determine the quality of signal. In fact, in most cases of poor reception, proper orientation of the same poor antenna elements and proper lead-in dressing gives much better results than putting up one of those expensive fringe-area antennas.

There is, for example, little or no attention directed to the characteristics of lead-in wire itself except that it is 300 Ω. And in most cases it is subjected to the severe influences of a

fast. accurate. versatile.
what else would you want from a tube tester?

money, of course.

We know that swift and sure tube testing makes servicing more profitable. So we created the Dyna-Jet 606 Tube Tester, the professional portable loaded with the most-wanted features. Multiple 13-socket design means only 4 test settings, yet it tests the latest miniature and color receiving tubes as well as older types.

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Few test instruments pack the profit-per-square-inch as does the Dyna-Jet 606. It's another product of B & K electronic innovation . . . of B & K's policy to provide maximum value and maximum quality. And the B & K Professional Servicing Equipment emblem assures you . . . and your customers . . . that you use the finest equipment available. Model 606 Net: $79.95

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ET/D LETTERS TO THE EDITOR

variety of strong signals reaching it from all directions. The enroute signals, if strong enough (and there are always some strong ones around) can cause real distortion in the desirable ones. In this part of the world our antennas don't suffer too much from such problems. I did some experiments on this and found out that I was right.

In one instance where reception was very poor, the TV's front end had been misaligned by a "screw-driver" type technician without the use of proper alignment equipment. The selectivity of the receiver was so broad that it received the same station on 3 or 4 different channels. I corrected the reception by simply wrapping the lead-in (the entire length) in aluminum foil. In another case, I put the lead-in through aluminum wire conduit, from its connection at the antenna all the way down to the receiver. The reception became so good that the owner said it has never been this clear.

I wonder if it would not pay for some manufacturers to think of making cheap lead-ins with an aluminum cover — some flexible type so it won't break by bending?

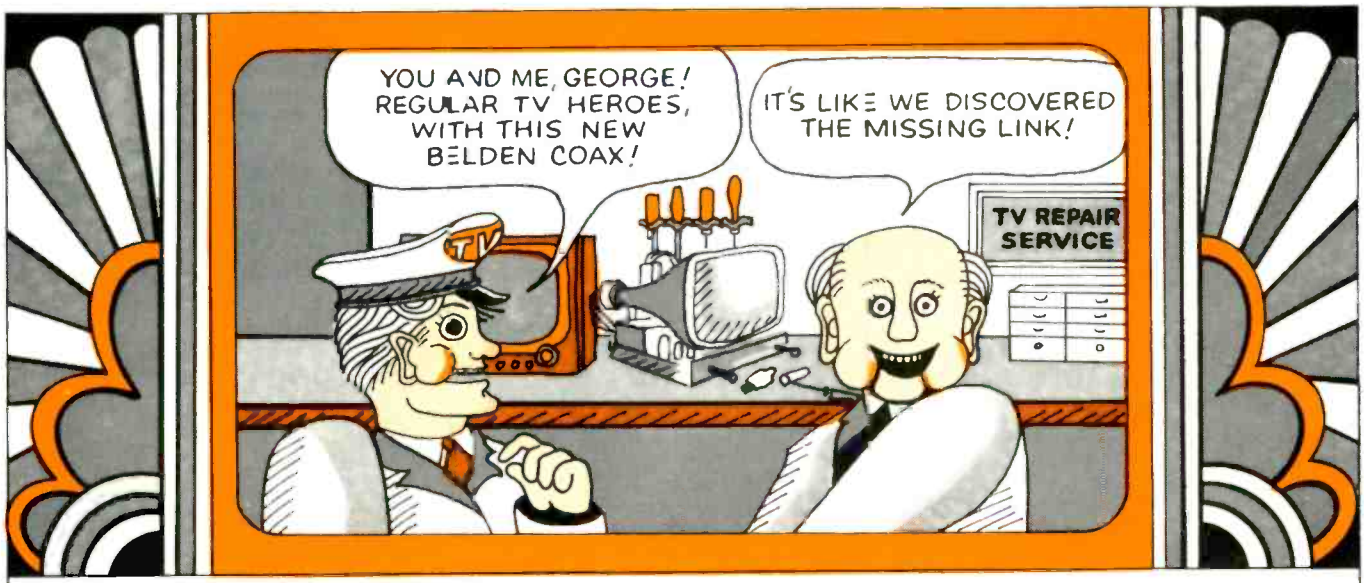
VLADIMIR D. BET-EIVAZI
Tehron, Iran

• *There is a product on the market which approximates Mr. Bet-Eivazi's aluminum covered lead-in. It is an aluminum-shielded twin-lead which has been on the market for some years and made by several companies. The aluminum-shielded twin-lead is low-loss cable used for maximum signal transfer. However, it is more expensive and harder to use than coax which tends to offset the disadvantage of having to install matching transformers with coax. And the advent of low-loss coax has further limited the use of aluminum-shielded twin-lead to special applications. We concede that Mr. Bet-Eivazi's area may be one of those "special application" situations — Ed.*

Another Viewpoint

I would like to comment on the letter to the editor, "Looking to the Future" (ET/D-December 1967).

I do not agree with Mr. Neuman's viewpoint. I agree that there is room for improvement. But I think that it should be in the quality of parts used and in the production line inspection of the manufacturing end of the business. I do not agree that the "hand-wired" circuits are better or



Jacket
Black all-weather PVC .030 nominal wall with a .242" nominal O.D.

Dielectric
Low loss cellular polyethylene, .180" nominal O.D.

Conductor
18 AWG solid, annealed, bare copper.

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4—28 AWG solid tinned copperweld conductors applied spirally and positioned uniformly around the circumference of the shield.

Shield
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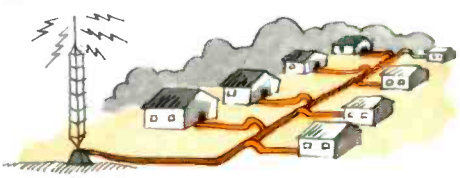

Is CATV coming into your area? DUOFOIL is the perfect underground drop cable. Its exceptional flexibility and moisture resistance assures extra-long service life, and preserves the impedance values of the cable design.

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50	1.5
100	2.1
200	3.1
300	3.8
400	4.5
500	5.0
600	5.5
700	6.0
800	6.5
900	6.9

Available in 100, 500 and 1000 ft. spools. See your local Belden Distributor for full details or to order. For a copy of the reprint article, "Electronic Cable," write: Belden Corporation, P.O. Box 5070-A, Chicago, Illinois 60680.

Don't forget to ask them what else needs fixing?

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any easier to service than the "printed circuits."

It has been my viewpoint when this subject comes up, that the service technicians who do not agree that "printed circuits" are easier to service than the old-fashioned "hand-wired" circuits, are the technicians who can't trace a circuit unless they can grab one end of a wire and trace it to the other end.

I sell and service the No. 1 "printed circuit" set and I have had very few problems that were actually caused by the "printed circuit." I agree that some manufacturers make a cheap set that uses cheap "printed circuits" and these give problems. But these same manufacturers used to make a cheap "hand-wired" set that gave just as many headaches.

I can service most problems in the "printed circuit" sets with the manufacturer's circuit diagram which comes with the set. The schematic usually has only the numbered parts and the voltages shown.

I sincerely believe that the "printed circuit" set is as far ahead of the hand-wired set as the new automobiles are ahead of the model "T." I would like to say that the particular handwired set that this writer is speaking of is a very good set, but the hand wiring has very little to do with it. If more rugged inspections were made in the assembly lines at the factories and higher quality parts were used, it would eliminate a lot of the headaches for all of us.

RAYMOND M. RYALS
Atkins, Ark.

Au Revoir

I've been involved in practically all phases of electronics since 1921 excluding computors. Now, after 47 years I have decided to shut the door and go fishing.

Any young feller who is interested in having his own complete TV-radio shop can contact me for full particulars. He can be the boss, manager, janitor, bench man, antenna man, secretary and crying towel-holder for 16 hours a day. I'm going fishing.

My best to all and thanks a million for all the fine information ET/D has given me. AuRevoir

C. R. WILLIAMS
5929 Marluth Ave.
Baltimore 6, Md.

Miscellaneous Schematics, Manuals

Perhaps an ET/D reader can help me locate service information on an old RCA communications receiver. It is a Model AVR-11, drawing number 64A. It covers a frequency range of 200kHz to 60MHz.

EARL GOFF
Colorado Springs, Colo.

Would you please include in your "Letters" column that I have two volumes of TV-radio TEKFAX, No. 103? I'd like to swap them for volumes 102 and 104 to complete my files.

ALBERT TATRAULTS
Northport, N.Y.

I am in need of a schematic for a Candle TV, Model MT-510 (made in Japan). Can an ET/D reader help me?

S. COMEAUX
San Francisco, Calif.

I have a Philco universal color bar and dot generator Model 7100, serial number 3490. I need an instruction manual for this unit and would appreciate any help your readers can offer.

ROBERTO BERTRAN
Bronx, N.Y.

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COLOR VECTOR

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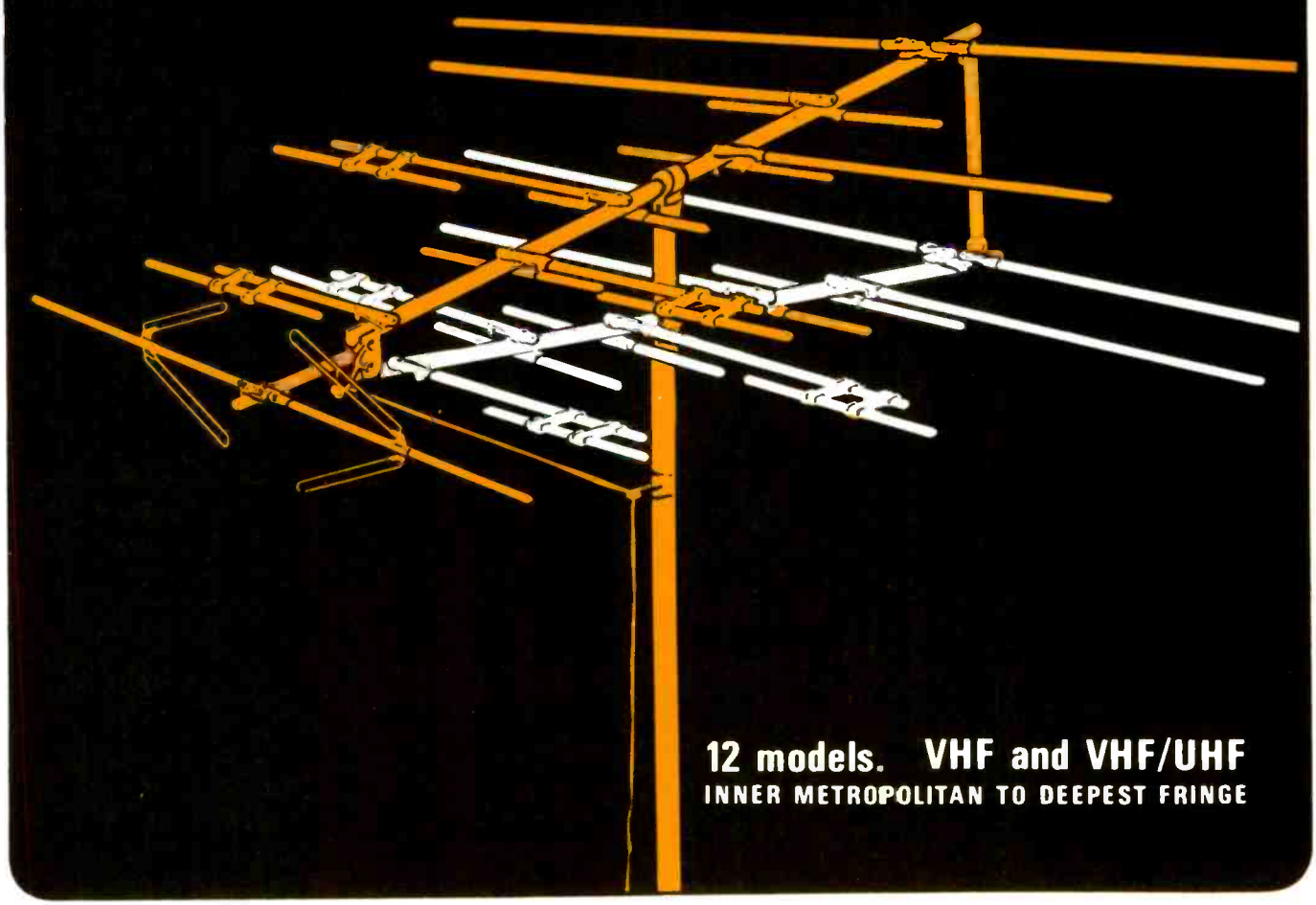

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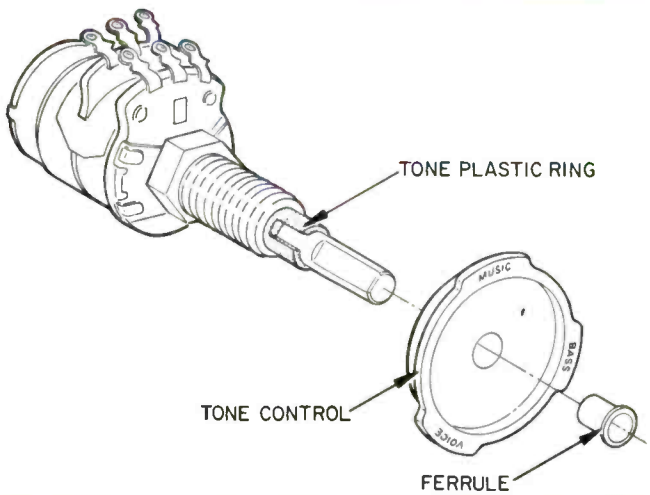
DELCO-RADIO

1968 Olds Radio — Loose Tone Control 681-2

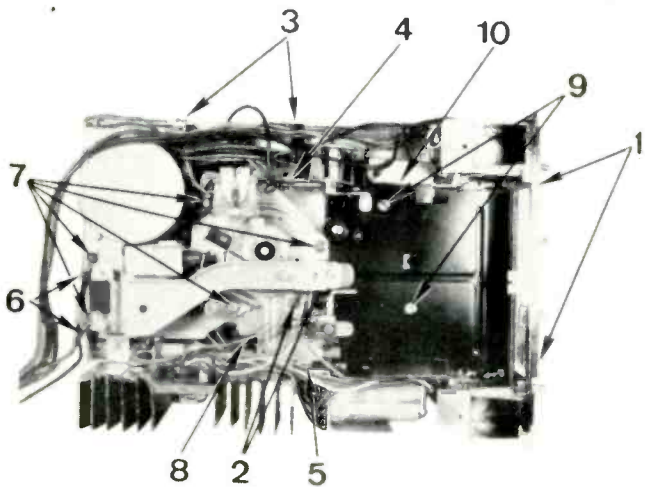
Complaint: In the early production 1968 Olds radio, the tone control shaft may feel like it is broken, or turns with no effect on tone and possibly rattles. *Cause:* This problem cannot be solved by removing the radio; therefore, make your Olds dealer aware of this fact. The tone control inside



diameter is too large. The detent does not fit properly in the slot. This allows one or more of the symptoms described. *Control:* Dealers are being made aware of a correction for this particular problem. A short metal ferrule is being inserted between the plastic tone ring and the metal volume control shaft, as shown. The dummy control is affected in the same manner.

Tape Player Model T200 — Replacing Cartridge Plate

Problem: Some tape cartridges have an "out-of-round" pinch roller that when played in early production 1967 T200 tape players, causes the tape to wow. This problem can be recognized easily because a good tape will play



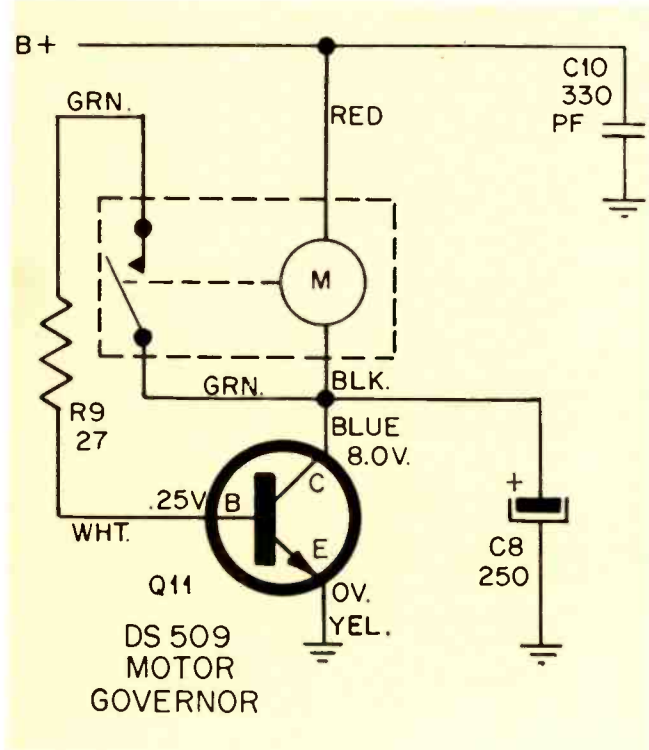
normally in the player. **Remedy:** If the cartridge plate is coated with Teflon, the tape cartridge will slide easily, allowing it to "breathe" with the variations in an "out-of-round" pinch roller. Later production players come factory-equipped with this coating. To allow an early production player to play these bad tape cartridges, a new cartridge plate (part No. 7305814) with a Teflon coating may be installed.

The procedure is as follows: 1. Remove both covers and escutcheon. 2. Remove the tape guide and automatic track change switch. 3. Remove two mounting screws from input choke mounting bracket. 4. Remove the rotary on/off switch assembly. 5. Remove the mounting screw from the capacitor mounting bracket. 6. Remove two screws at rear of tape player and remove heat sink assembly (be careful of attached wires). 7. Remove cam plate assembly (5 screws). Be careful of attached wires. 8. Remove mounting screw on upper left hand corner of preamp board. 9. Remove the two flat head screws in the cartridge plate. 10. Exchange cartridge lock arms and spring, replace cartridge plate and reverse above procedure.

In extreme problem cases or on a player where a customer insists on playing cartridges with high tape strand tension, a new cartridge lock spring (7307539) may be needed.

Tape Player Model T400 — Circuit Change

The spike suppression diode, D3, has been removed from the T400 tape players. In its place a high frequency noise suppression capacitor — 330pf is being used. The capacitor



is connected from the red lead of the motor to ground. The capacitor part number is 7273840. A schematic of the revised circuit is shown.

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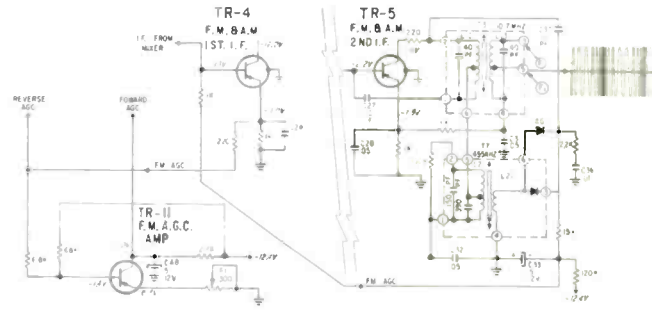
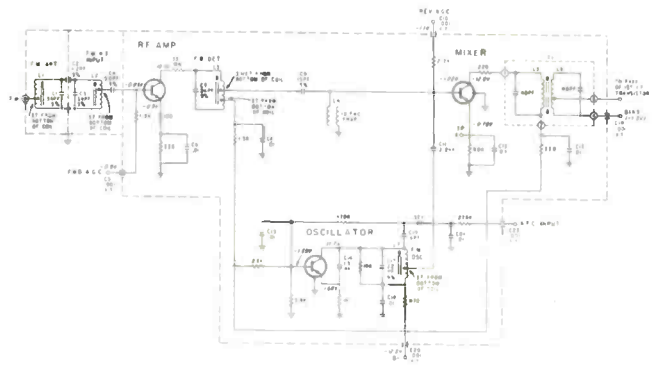
FM Multiplex Receiver Chassis 25ZT120 — FM/AGC Circuit Description

Under no signal conditions the 1st IF transistor receives its base voltage of −1.3v through a parallel voltage divider network. One leg consists of 120K resistor in series with a 15K resistor, in series with an X6 AGC diode and the secondary of T7, 455kHz IF transformer to ground. The other leg consists of 120K resistor in series with a 1K resistor that connects to the base of the 1st IF transistor through T1 and T8. The mixer transistor obtains its base voltage from the emitter of the 1st IF. This feeds through a 220Ω and a 2.2 K resistor in series applying approximately a

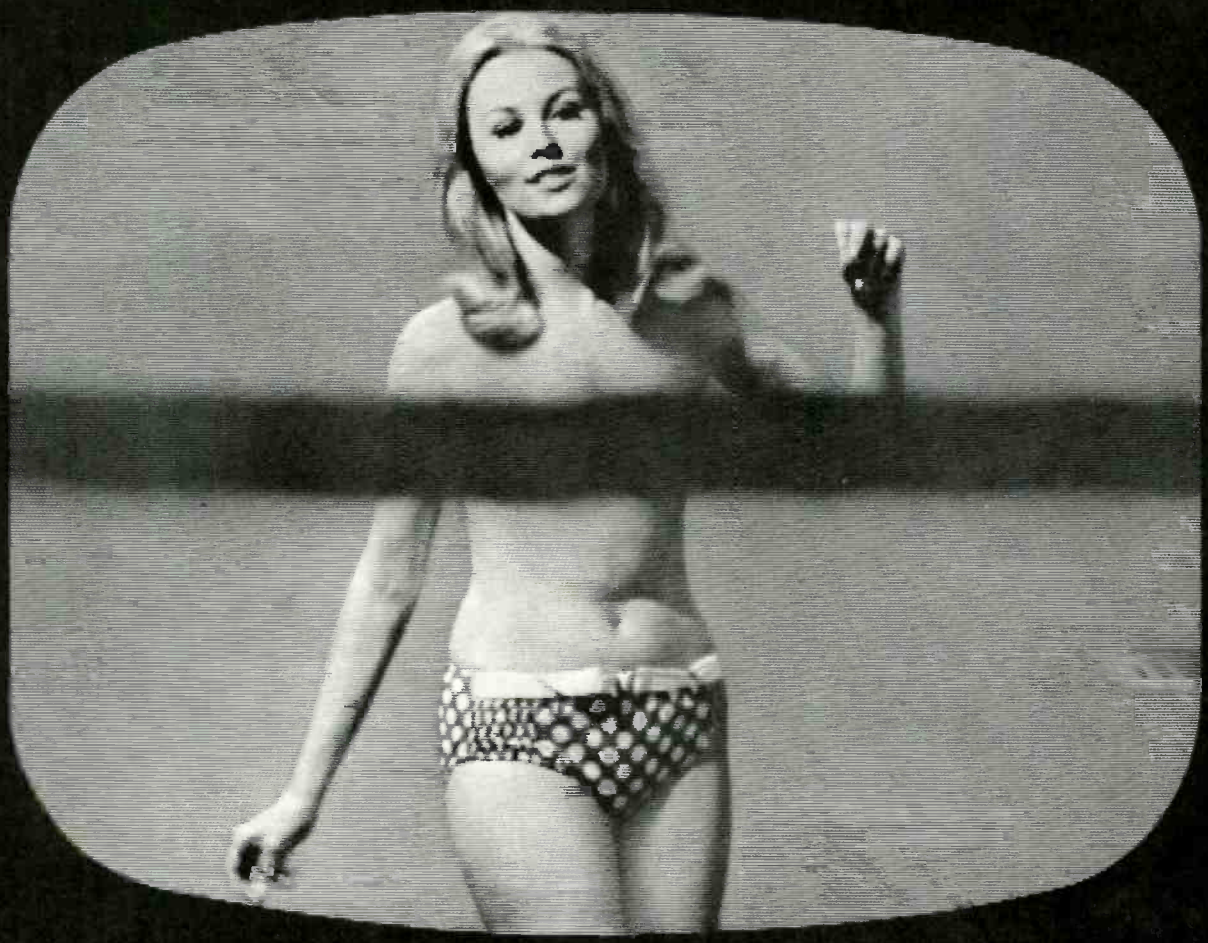


−1.02v under no signal conditions at the base of the mixer. In addition, the RF amplifier also obtains its base voltage from the emitter of the 1st IF amplifier. The voltage at the base of the AGC amplifier is a combination of the voltage from the 1st IF emitter through the 220Ω , and 68K resistor from B− resulting in approximately −1.4v at the AGC amplifier base. The actual RF amplifier base voltage is obtained from the collector of the AGC amplifier; the gain of the AGC amplifier is adjusted by potentiometer R1. This control is adjusted so that under no signal conditions the voltage on the collector will be −1.0v.

When an FM signal is received, a 10.7MHz IF signal is available in T3 2nd IF transformer. A portion of this signal is removed from the 2nd IF transistor collector through C30 and 10 pf capacitor. This FM modulated signal is detected by diode X6 and produces a voltage that reduces the forward bias on X6. This reduces current flow which in turn reduces the negative voltage at the junction of the 15K and 120K resistors. With a power supply voltage of 12.4v and with no RF signal at the FM tuner, one could expect a base voltage at the first IF of approximately −1.30v. With 60μ v of RF signal, into the FM tuner, this would be reduced to approximately −1.21v and with 100kμv at the input of the RF tuner, the voltage would be approximately −.52v. Even with extremely strong signals the voltage on



There's nothing wrong with the set.



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the 1st IF amplifier will always be negative. This voltage can be considered as a positive going negative voltage. This IF transistor can then be considered to be controlled by a reverse AGC voltage. In other words, the forward bias of this transistor is being reduced. As the bias is reduced on the base of a PNP transistor, the gain of the transistor is also reduced and so is the magnitude of the IF signal at the collector. IF amplifier overload with resulting distortion will be eliminated. To prevent other sources of overload, with resulting distortion, AGC must also be applied to both the RF amplifier and mixer transistors. Since the mixer transistor obtains its base voltage from the emitter of the 1st IF transistor, then as the gain of the 1st IF is reduced, so will be the negative voltage available at the emitter of the first IF. See illustration. As a result the −1.02v at the base of the mixer will be reduced to something less than this. Again we have a positive going negative voltage being controlled by the developed AGC. If we reduce the forward bias of a transistor, we reduce its gain. The base of the AGC amplifier receives its voltage from the 1st IF emitter and since this now a positive going negative voltage, the −1.4v on the base of the AGC amplifier will also be reduced. When this occurs we are reverse biasing this AGC amplifier, the gain of the amplifier is reduced and the current in the collector circuit is also reduced. When the collector current is reduced, the voltage at the collector rises to something greater than a −1.0v and we now have a negative going negative voltage applied to the base of the RF amplifier. Since we now have a forward AGC bias on the RF amplifier, we drive it into saturation causing its gain to be reduced. Perhaps at this point an explanation of forward bias will be in order.

The gain of a transistor can be reduced by forward biasing it into saturation. If transistor gain is strongly dependent on collector voltage, then gain may be reduced by lowering the collector voltage. Usually this done by increasing emitter current and including a large dropping resistor in the collector. At high current, the IR drop across the dropping resistor reduces the collector voltage, thus reducing gain. Forward AGC on the RF amplifier accomplishes several purposes. First, the gain of the RF transistor is reduced. As the current increases in the collector circuit, its impedance becomes extremely low and there is a complete mismatch between the collector and its tuned circuit. As a direct result of this mismatch the gain of this circuit is reduced. In the base the current has also become quite high and its impedance becomes extremely low — in effect it acts as a swamping device across the FM-RF input coil. It would be the same as putting a short across this coil extremely reducing its "Q."

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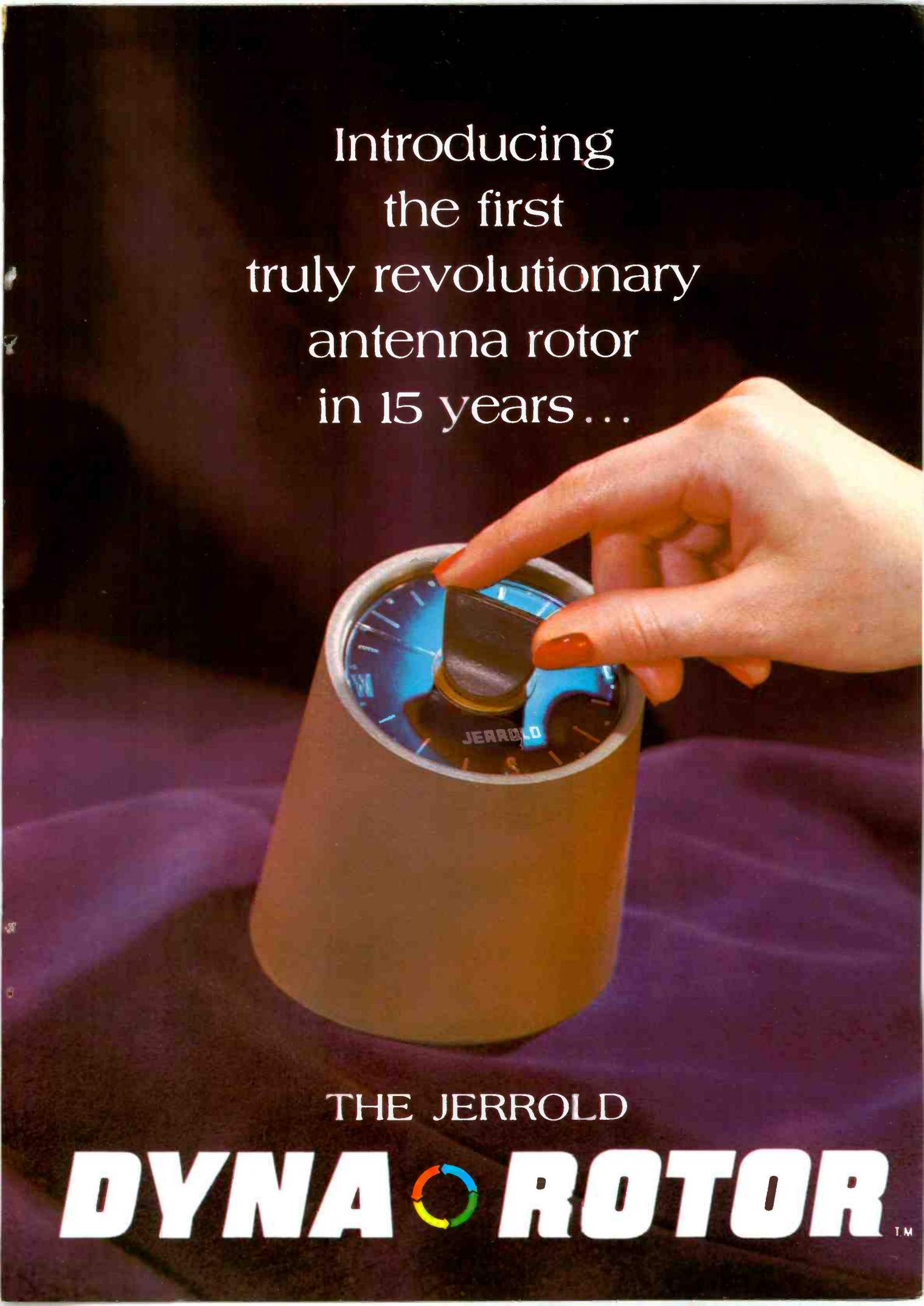
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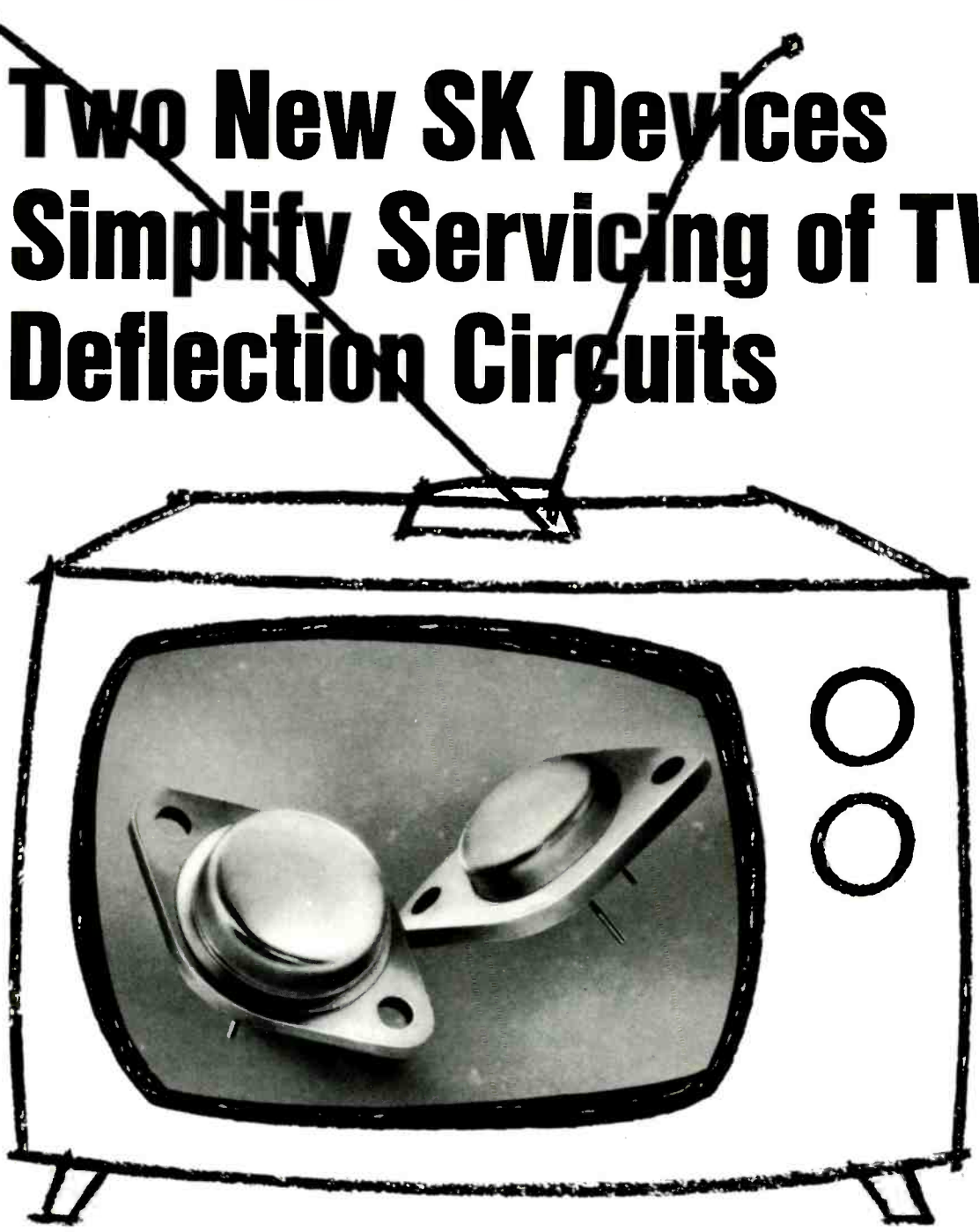

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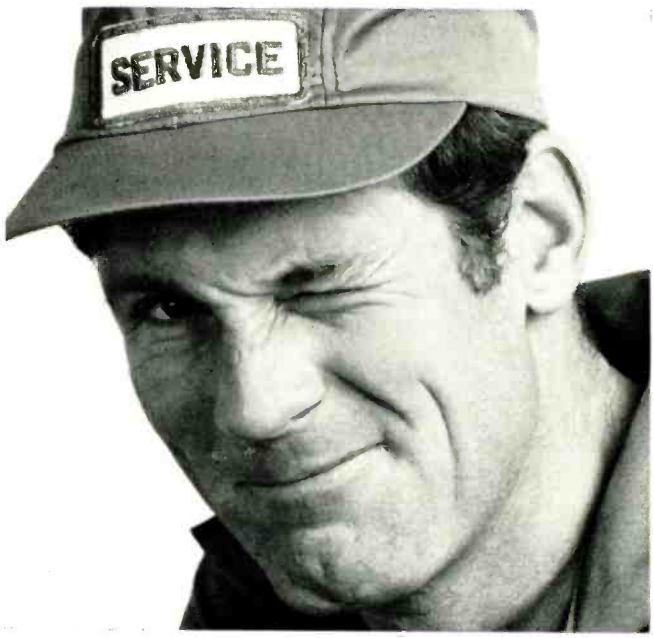

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SEPTEMBER 1968

SERVICING THE COLOR 'TIGERS'

Use a scope to tame your color TV tiger

■ Unusual color TV problems can often be tough to isolate. Efficient use of a scope is one way to tame this tiger. We'll see how this works out in the following case histories.

Burning 6JS6

A Zenith color set was brought in with a past history of burning 6JS6 tubes. (See schematic, Fig. 1). The same unit had been in the shop with a similar problem before, but no circuit defects were found.

The control grid drive to the 6JS6 horizontal output tube was checked with a scope for the proper drive pulse and a VTVM measured proper drive voltage at negative 60dc. Screen voltage checked out normal. The pulse voltage at plate of the horizontal output tube also looked normal when checked with a scope and voltage divider capacitance probe.

The probe was moved to the screen grid — pin 3 or 11 of V19, and revealed the presence of vertical pulses. A few more scope checks in this area showed that C123, a 40μf electrolytic capacitor, had opened up. It could be that this capacitor may have been intermittently shorting and then finally opened. Possibly the screen grid had actually burned from excessive current. With a new capacitor installed in the screen grid circuit, current checked out at 15ma. However, with the capacitor open, the screen current rose to over 25-ma. One quick way to check this current is to read the voltage drop across the 100Ω resistor in the screen circuit. Then use Ohm's Law to determine the current (I = E/R).

After replacing this capacitor, be sure to reset the CRT anode HV and the horizontal sweep output tube current to the proper level.

Horizontal Modulation

A color TV set uses high level modulation — but not in the screen grid of the horizontal output tube. However, that's what was happening in an RCA CTC-17X color chassis. Fig. 2 shows a partial schematic of the horizontal sweep stage. The picture on the screen looked a little keyston-

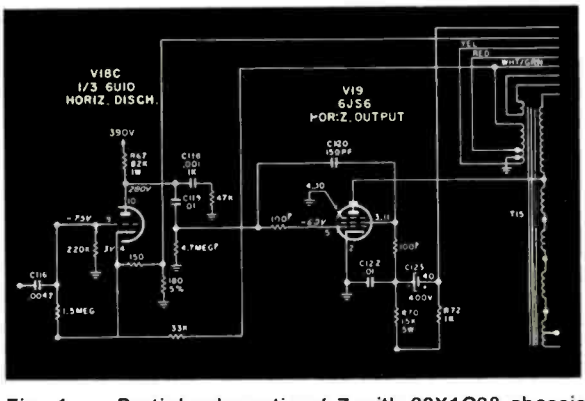


Fig. 1 — Partial schematic of Zenith 20X1C38 chassis schematic.

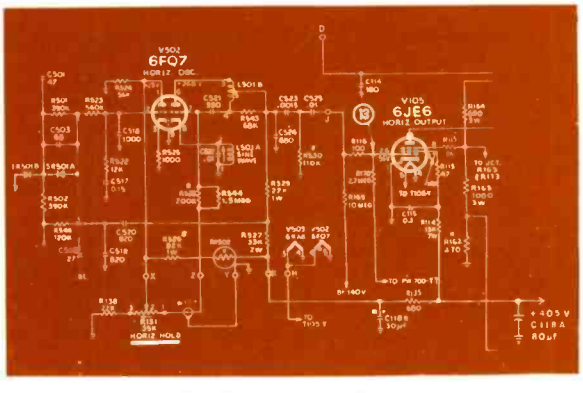


Fig. 2 — RCA CTC17X chassis schematic.

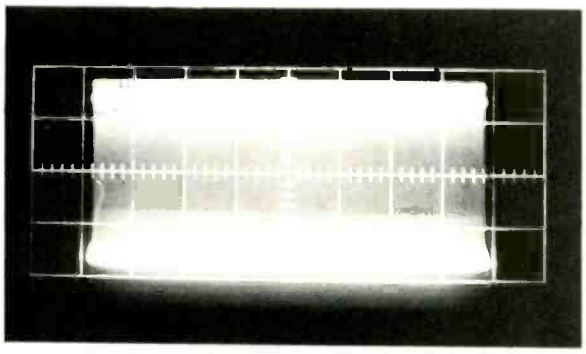


Fig. 3 — Scope waveform at grid of horizontal output tube taken at vertical rate.

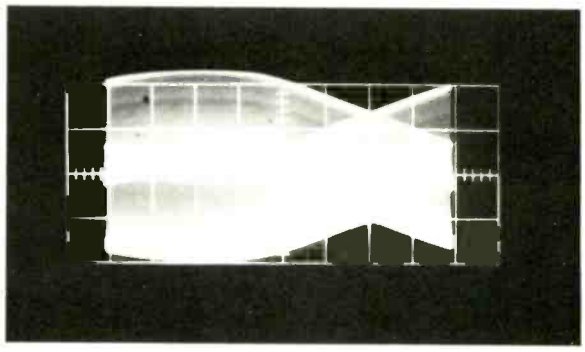


Fig. 4 — Hour-glass waveform at plate of horizontal output tube at vertical rate.

ed, but a new yoke didn't cure the problem. We rolled the scope up to the chassis. It was noted that the raster was smaller at the bottom than at the top. This called for a look at the 15.75kHz waveform in the horizontal sweep section, but the scope was set for a vertical scan rate. Because the horizontal scan lines were shorter as the sweep went to the bottom of the CRT, it was necessary to see these waveforms at a vertical rate.

The scope probe was connected to the grid of the horizontal output tube and the pattern was straight at the top and bottom which is normal (Fig. 3). We needed to see the waveform on the plate of the horizontal tube. *Caution* — there is a 5kv pulse on the plate cap which can damage test instruments or probes. Use either a HV capacitance divider probe or clip the scope probe into the plate cap lead insulation. This will give you the waveform, but not the correct amplitude.

When the probe was clipped to the plate cap lead, we observed an hour-glass or wedge-shaped waveform (Fig. 4). The cathode of the HOT is grounded; all that is left to check is the screen grid. And remembering to scope places where we are not suppose to see a signal, the probe was connected to the screen grid. The scope pattern at this point looked somewhat like a sawtooth (Fig. 5) voltage and was in effect modulating the sweep output tube.

The problem was traced to a defective dual section filter in the 405 volt B+ line. They are designated C118A and C118B in the schematic (Fig. 2).

Zenith Blanking Diode and Video Transistor Failure

An electronics designer found that semiconductor devices were being destroyed in a power-supply regulating circuit. When he inspected the waveforms in this circuit by a limited bandwidth scope he found no reason for the semiconductor failures. He then investigated the waveforms with a fast "rise-time" wideband and found that brief transients of high amplitude and energy were the cause of this destruction. This example serves to illustrate the capability of the wideband triggered professional oscilloscope.

We used a wideband scope to check out a semiconductor failure problem in the video "Y" amplifier stage of a Zenith 20Y1C38 color chassis (see Fig. 6). The video driver transistor, TR1, and blanking diodes, X2 and X3, had a very high failure rate. When TR1 fails, the screen goes blank and most set owners — when questioned — noted that a crack, snap or high voltage arc was heard before the picture went out. In some sets the transistor would be found defective. It was noted that in most of these sets, a HV arc would occur through a pin-size hole in the filament leads of the HV rectifier to the 3A3A plate cap or to the chassis HV cage ground. To prevent this arc, new filament leads with thicker insulation should be installed. Dress the leads away from the cap of the HV rectifier. This HV discharge (arc) induces a high transient spike pulse back into the blanking winding of the sweep transformer (yellow lead) and then on to blanking diode, X3, sometimes shorting it out, then feeds this spike pulse to the emitter of the video transistor, TR1, destroying it.

Transistor, TR1, was pulled from its socket and a wideband triggered scope connected to the emitter pin. With the HV popping and arcing, the high energy spike pulses were viewed on the scope CRT as shown in (Fig. 7). Of course, the first procedure is to stop the HV from arcing and it may be that in later set productions VDR varistors or other protective devices may be installed in the emitter circuit. Some of these sets with diode and TR1 failure had been hit by lightning at the antenna (balun coil burned) and possibly damaged by a high transient spike.

'Spooks' in the Burst Amplifier

The burst amplifier stage picks off the burst pulse, amplifies it and delivers a burst signal on the order of 100 volts P-P to the burst amplifier plate coil — see Fig. 8. The signal is then fed through dual capacitors to the 6JU8 diodes to develop operational dc control voltages. See simplified burst amplifier circuit Fig. 9. To be sure you are receiving color burst through the tuner and video IF amplifiers, make a scope check at the video detector.

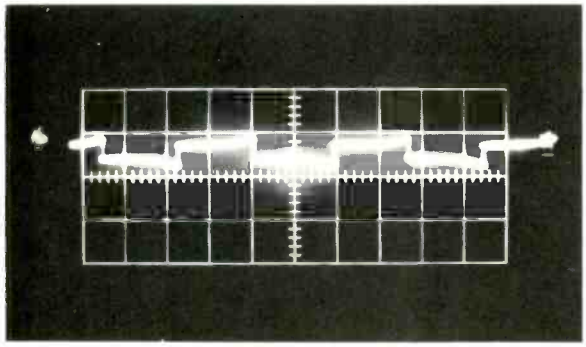


Fig. 5 — Sawtooth voltage on screen grid of horizontal output tube.

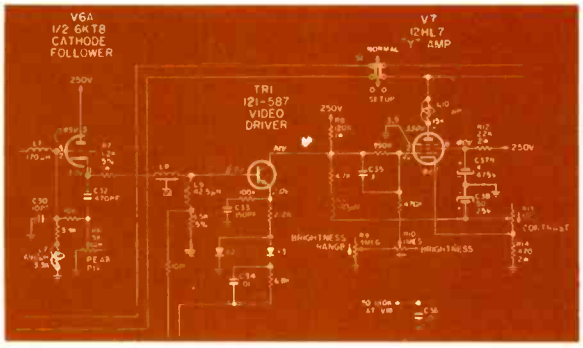


Fig. 6 — A partial schematic showing the video "Y" amplifier stage of a Zenith 20Y1C38 color chassis.

The burst amplifier tube is driven into conduction 15,750 times per second whether or not burst is present. The fact that burst is there is merely coincident with color programing. However, the stage is pushed into conduction at regular intervals by a horizontal keying pulse. By using a dual-trace triggered scope, the horizontal keying and color burst pulse can be accurately checked for correct coincident. Should no burst be present, the stage merely amplifies the random circuit noise and produces a "spook" whose amplitude is on the order of 25 percent of the burst pulse amplitude. Since "spook" noise is the residual operating condition of the circuit, it has no influence on either color killer action or control of the 3.58MHz oscillator.

This "spook" condition, however, takes on the appearance of "burst" if scope gain is turned up. Be sure the scope is accurately calibrated to recognize the "spook" in comparison to the useful burst signal.

Burst Amplifier Problems

The use of a wide-band triggered oscilloscope can be helpful for testing many circuits of the color system.

Chroma information that appears on the plate of the first chroma amplifier is the burst pulses followed by color bar information of one horizontal scan line with the scope set at a horizontal rate.

The 15,750 flyback "keying" pulse, with chroma information added, is shown in Fig. 10 on the grid of the burst amplifier tube. Bias on the burst amplifier grid is such that at 40v only the tip of the keying pulse contains burst information, allowing the tube to conduct. The amount of "chroma" information displayed may depend upon the sensitivity of the scope being used.

Burst Amplifier Output

Fig. 11 shows the "burst" pulse as it appears in the plate circuit of the burst amplifier. If you have trouble observing the narrow burst pulse, you might try taking a lead from the "external sync" binding post and dressing it over the yoke area of the TV set to "pick off" horizontal pulse information. Switch the scope sync to the "external" position for added stability.

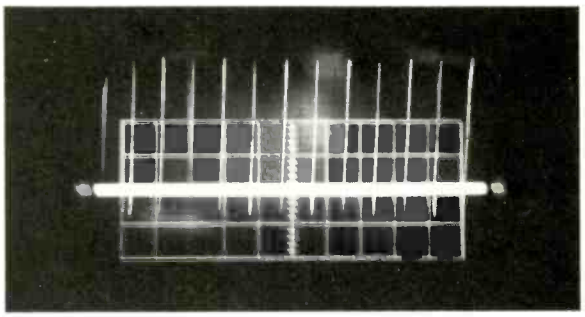


Fig. 7 — High energy "spikes" at the emitter socket of TR1.

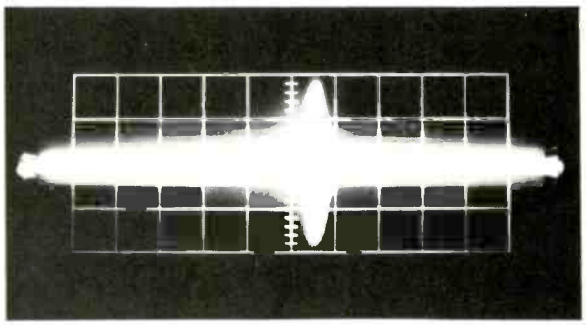


Fig. 8 — Color burst signal (5x expansion) taken at burst amplifier.

Zenith AFC 3.58MHz Description

Burst pulses from the burst amplifier plate coil are fed through the dual .001μf capacitors, with one side of each burst pulse passing to the ACC color killer function of the 6JU8 — refer to the schematic, Fig. 12.

The other side of each dual capacitor passes burst pulses to pins 7 and 9 of the 6JU8 AFC color section — again the old faithful horizontal phase comparison action with burst on each end of the diodes and the 3.58MHz CW signal inserted in the middle. The phase relationship is compared and detected as a dc voltage.

There is one important difference between this

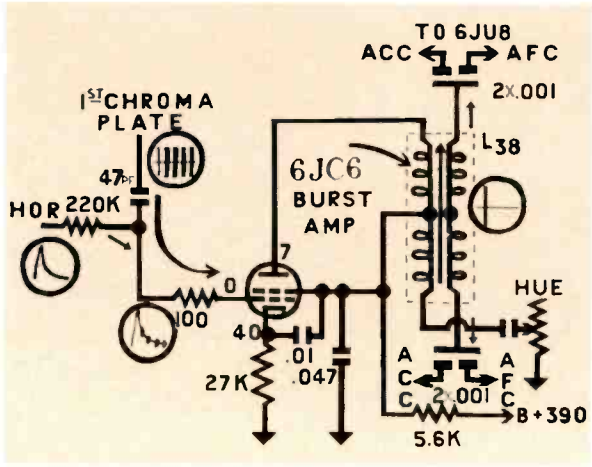


Fig. 9 — Simplified Zenith burst amplifier schematic.

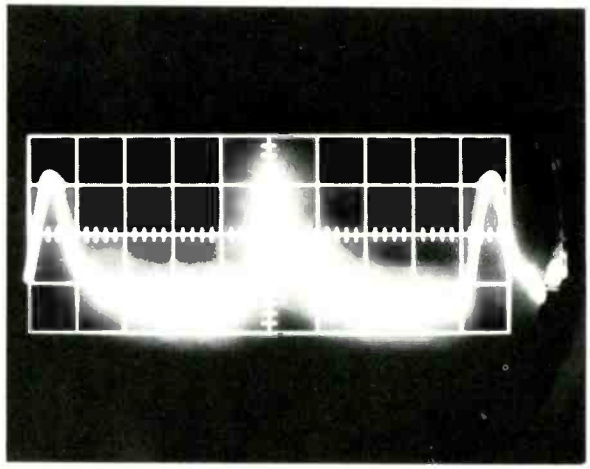


Fig. 10 — Color burst signal.

diode pair and the ones used for color killer operation. In the killer circuit, 3.58MHz and the burst signals are in phase. As a result, the output voltage is always negative, becoming more or less negative depending upon the presence, or absence, of burst signal.

The 3.58MHz signal is inserted in *quadrature,* or with a 90deg phase shift compared to the color burst. The 90deg shift causes a dc voltage which can be either plus or minus and acts to cancel any "on" frequency signals, thus permitting control of the 3.58MHz oscillator.

The dc output at the diode junction, pin 8, (test point W, Fig. 12) has a range of approximately 5v which is applied to the 3.58MHz oscillator circuit as variations in grid bias on the reactance control triode section of the 6GH8A tube.

Pin 9 of the 6JU8 has been identified as test point "V." A scope or VTVM connected to point "V" to set up the injection transformer maximum and minimum voltage split for proper operation of the color demodulators. The circuit acts as a "peak detector." The injection or demodulation transformer must feed back at the correct phase and 3.58MHz CW signal amplitude to the 6JU8 AFC circuit to properly control color sync.

Double Trouble

A Zenith 23XC38 color TV chassis was found to have poor color sync and finally lost all color. The schematic for this chassis is shown in Fig. 13. The chassis was pulled and the first bench check was to disable the color killer circuit by grounding test point K. Test point W (color AFC control voltage) was grounded and the 3.58MHz oscillator was tuned for a zero beat. The color looked good and strong. The test point W ground lead was unclipped and the 3.5MHz color oscillator went way off frequency.

Pin 9 of V17A, the reactance control tube, should read about zero volts with a VTVM. As the 3.58-MHz oscillator drifts, it will swing from a few volts positive to a few volts negative. Pin 9 of V17A in this unit measured 6v positive. It seemed logical that there was a defective component in the AFC phase detector circuit. The color burst amplifier was checked with a scope and appeared to have a normal waveform. Color burst was then checked at pins 7 and 9 of the AFC phase detector, V15B. Normally, the waveform should contain a 3.58 MHz burst pulse of the same P-P amplitude — but not so in this unit. All components in the AFC circuit tested normal. The burst and phase detector transformer seemed to be the culprit. Pin 8 of V15B must have a proper 3.58MHz CW signal for phase comparison and this signal is tapped off the injection transformer, T12. The CW signal on this set was found to be low and the oscillator signal at pin 6 of V17B was scoped at 80v P-P — about 60v low — which could indicate a defective detector transformer (L38) and/or injection transformer. Both components were replaced in hopes this would solve the problem and satisfy an impatient color set owner. The transformer was installed and tuned but did not solve the problem — in fact the color picture appeared worse.

The replacement coil, L38, was also installed — still no color sync and about 8v positive found at pin 9 of V17A.

However, the scope now displayed a balanced 3.58MHz burst pulse at pins 7 and 9 of V15B, but the 3.58MHz CW signal at pin 8 was almost unreadable. The replacement demodulator transformer was obviously defective. Another new one was installed and after complete alignment the color set was operating normally. Note: A 2.2 M resistor will be found at pin 8 of the 6JU8A AFC color phase detector. For a faster and more stable color "lock in" this resistor can be changed to 100K. The cause of the problem in this particular set was a defective L38 color phase detector coil. Replacement of the injection transformer first, which happened to be defective, simply complicated the original problem.

New part substitution, or the old process of elimination, will not always work. ■

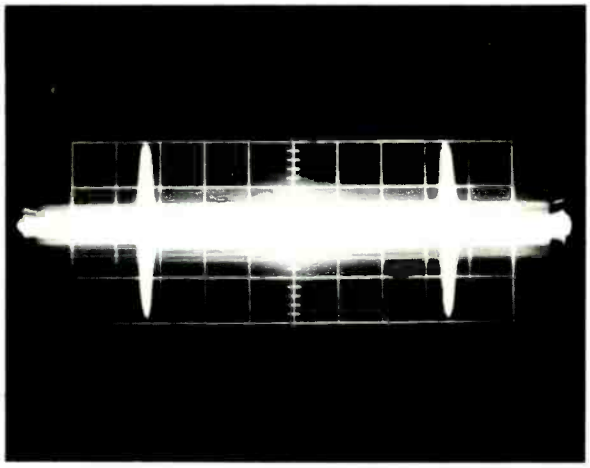


Fig. 11 — "Spook" burst signal.

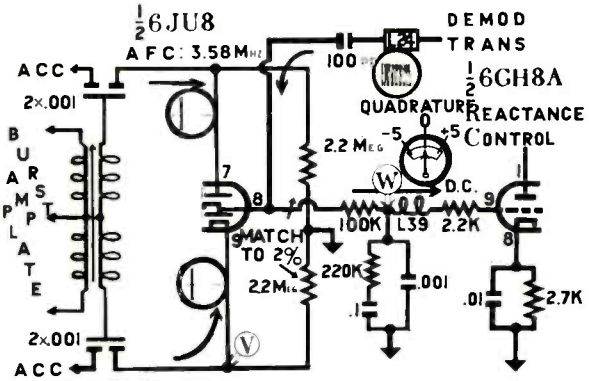


Fig. 12 — Zenith AFC 3.58MHz schematic.

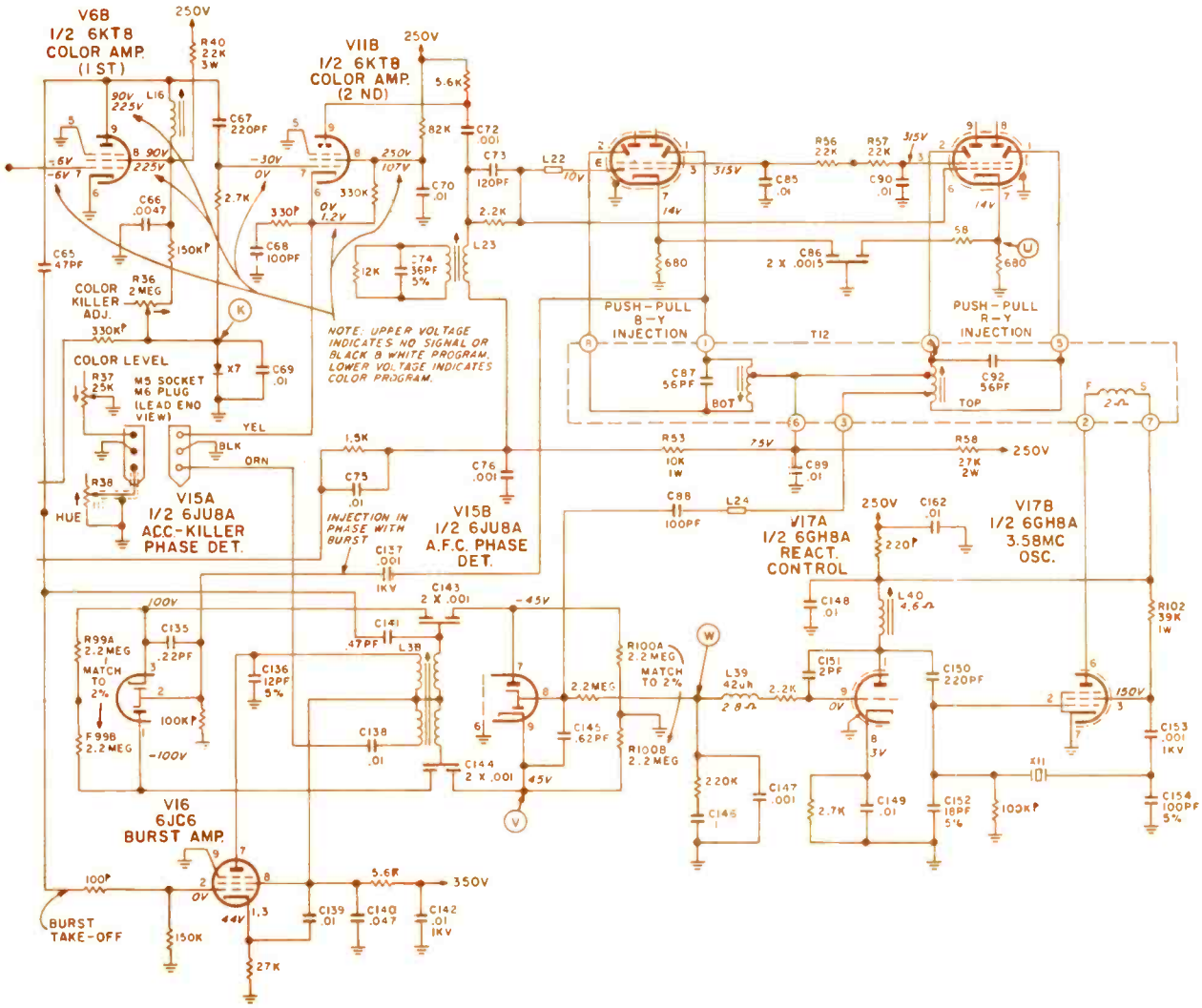


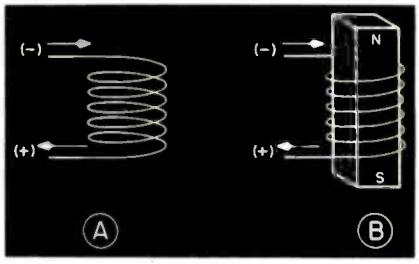
Fig. 13 — Zenith 20XC38 color section schematic.

The 24th article in a continuing series

SEMICONDUCTORS FROM A TO Z

Effective servicing requires an understanding of ac circuits used to power solid-state electronic products

Fig. 1 — Current flowing through a coil produces a magnetic field that can be concentrated by placing a soft iron core within the coil.



■ Electronic products serviced by electronic technicians contain a power supply of some kind, whether powered by batteries or an external ac voltage source. And whatever their application, these power supplies contain basic circuits designed to perform one or more of the following functions: ac voltage regulation, ac current regulation, ac-to-dc power conversion, dc-to-ac power conversion, dc voltage regulation, dc current regulation or filtering.

AC Voltage Regulation

A component most frequently used for obtaining desired ac voltages is the transformer. It contains one or more coils that function on the same basic principles as the coils shown in Fig. 10, 11 and 12 in the October 1967 article. When current flows through a coil, a magnetic field is produced (Fig. 1A). This field can be concentrated (Fig. 1B) with a soft iron core.

Each cubic inch of soft iron contains millions of microscopic permanent magnets (called domains) formed by iron molecules. When the core is not magnetized, these domains are orientated in random directions, each canceling out the other's magnetic field (Fig. 2A). An external magnetic field magnetizes the soft iron by lining up these domains (Fig. 2B). [*With appropriate equipment, one can hear the flopping of these domains as they line up.*] These domains will remain aligned (the metal will remain magnetized) until they are disarranged by thermomolecular motion (heated molecules bouncing around and knocking the domains out of alignment), physical blows (such as a hammer tapping the iron) or an external magnetic field of alternating polarity that is drawn away from the magnetized iron.

When the domains are aligned (Fig. 2B), the north magnetic pole of each domain faces the south magnetic pole of an adjacent domain. When two magnetized rods are bent into a shape somewhat resembling a horseshoe (Fig. 3), the alignment of north and south magnetic poles will still remain the same — north magnetic poles facing south magnetic poles. The two vertical portions of the transformer core are shown split merely to demonstrate that although the domains remain aligned, the direction of alignment in the vertical left portion of the core is opposite that in the vertical right portion.

Two iron-core coils, like the one shown in Fig. 1B, are used in the transformer shown in Fig. 4. (Terminal 1 on the left coil corresponds to terminal 3 on the right coil, and terminal 2 corresponds to terminal 4 — one coil being an upsidedown version of the other.) When a negative potential is connected to terminal 1 and a positive potential is connected to terminal 2, a current flows through the coil producing a north magnetic pole at the upper portion of its core and the lower portion of the right core.

As had been indicated in the October 1967 article, when the applied current increases the strength of a magnetic field, the magnetic field induces a current that flows through the coil in a direction (from terminal 2 to terminal 1) opposing that of the applied current (from terminal 1 to terminal 2). The increasing magnetic field also induces a current in the same direction (from terminal 4 to terminal 3) through the secondary coil.

When there is a reduction in the amount of applied current, the strength of the magnetic field decreases and a current is induced in the opposite direction (from terminal 3 to terminal 4 in Fig. 4) through the secondary coil (refer to Fig. 10 in the October 1967 article).

By reversing the direction of the applied current (from terminal 2 to terminal 1 in Fig. 4), the polarity of the magnetic field produced is also reversed. However, as the applied current increases the strength of the reversed magnetic field also increases. The induced current still flows through the coil in the same direction (from terminal 3 to terminal 4) as before (refer to Fig. 11 in the October 1967 article).

Fig. 16 in the October 1967 article showed that when an ac voltage is applied across a coil, the current lags 90deg behind the voltage. The same relationship exists (Fig. 5) between the voltage applied across the transformer's primary coil (top curve) and the resulting applied current (middle curve) through that coil. The directions that the induced current (bottom curve) flows through the secondary coil as a result of these changes in

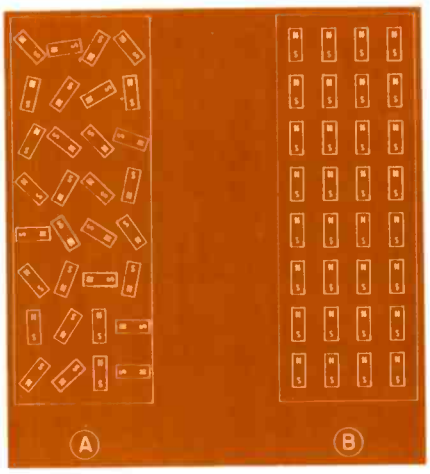


Fig. 2 — Soft iron contains magnetic domains that are aligned only when the object is magnetized.

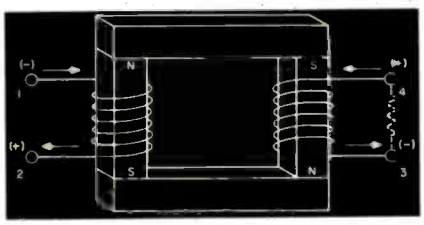


Fig. 4 — Changes in current through the primary winding of a transformer induce current through the secondary winding.

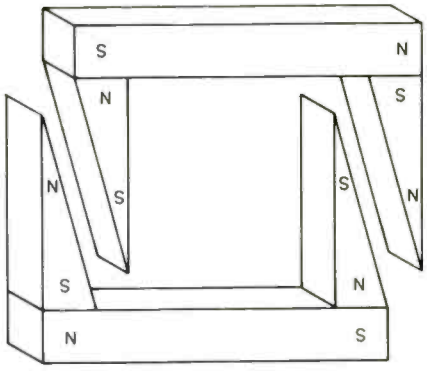


Fig. 3 — Magnetic fields in the primary and secondary portion of a transformer core are aligned in opposite directions.

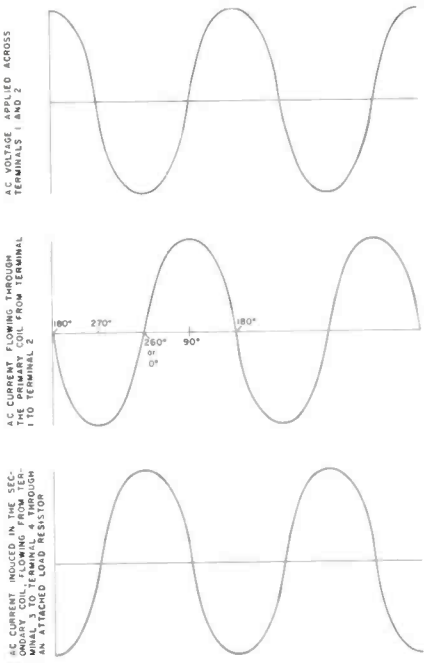


Fig. 5 — There is a relationship between the phase angles of an ac voltage applied to a transformer's primary winding, the ac current through that winding and the current induced in the secondary winding.

the applied current (middle curve) are also shown in Fig. 5.

The October 1967 article also indicated that sinewave voltages (and currents, too) change more rapidly at 0 and 180deg than they do at 90 and 270deg. During the intervals that there are more rapid changes in the applied current, there are also more rapid changes in the magnetic fields produced — resulting in a larger induced current. The induced current (bottom curve in Fig. 5) is the greatest when the phase angle of the applied current (middle curve) is around 180deg and 360 or 0deg.

No current, of course, will actually flow between the terminals (3 and 4 in Fig. 4) of the transformer's secondary coil unless some circuit (or load) is connected to it. Otherwise, only a potential voltage would exist between the two terminals. When a resistor (R) is connected between these terminals, the amount of current (I) flowing through the resistor will depend on the familiar equation:

$$I = \frac{V}{R}.$$

Since there is no difference in phase angles between the current through a noninductive resistor (a carbon resistor or other resistor that is not made from a coil of wire) and the voltage drop across it, the secondary voltage across the terminals (3 and 4) and the resistor (R) is in phase with the induced current (bottom curve in Fig. 5) and 180deg out of phase with the applied primary voltage (top curve).

Measurements indicate that the ratio of primary coil turns (N_p) to secondary coil turns (N_s) is the same as the ratio of the ac primary voltage (E_p) to the ac secondary voltage (E_s).

$$\frac{N_p}{N_s} = \frac{E_p}{E_s}.$$

If there are twice as many turns in the secondary coil as there are in the primary coil, the ac secondary voltage will be twice the ac primary voltage. (Since dc primary voltages do not produce changes in a magnetic field that could induce a secondary current, dc primary voltages do not produce secondary voltages.)

When a relatively stable ac line voltage is available, a transformer can be used to provide a relatively stable ac voltage — the desired ac voltage being obtained with a transformer having the required ratio of turns in its primary and secondary coils. And if the transformer is rated at an adequate wattage, moderate changes in the ac secondary current will have little effect on the ac secondary voltage delivered by the transformer.

There are, however, occasions when the ac line voltage is not sufficiently stable. "Constant-voltage" transformers can then be used effectively to reduce these changes to less than 1 percent. These transformers are particularly useful in solid-state power supplies since semiconductors need not then absorb excess power whenever the line voltage becomes greater than normal. "Constant-voltage" transformers generally use a capacitor to help improve their ac secondary voltage stability.

When a capacitor is substituted for the resistor (R) shown in Fig. 4, it will absorb electrons at terminal 3 during one-half cycle and then return them to terminal 3 during the following half cycle. Electrons are thus able to flow through the coil between terminals 3 and 4 without actually being conducted through some external circuit. Virtually no electrons pass through the capacitor from one terminal to the other, and the capacitor, therefore, does not consume a significant amount of the

induced energy. The induced energy is used only to increase the strength of the magnetic field of the coil's core — aligning more domains.

When the transformer core's domains are all aligned in one direction and the applied ac primary voltage alternates, causing the domains to all become aligned in the opposite direction, the electrical energy induced is absorbed by the capacitor (C). When the capacitor discharges this energy through the secondary coil, a magnetic field is produced that is strong enough to align most of the domains again in the first direction — the capacitor and coil consuming only a small portion of the induced energy, the balance of the energy remaining to realign the domains.

As the applied ac primary voltage again alternates and provides a magnetic field to align all the domains in the first direction, the capacitor across the secondary coil also supplies energy for producing a magnetic field capable of alinging most of the domains in the first direction. The total magnetic field produced by the primary and secondary coils is stronger than the field required for aligning all of the domains. It is this magnetic "saturation" of the core that is used for controlling "constant-voltage" transformers.

Although we wish to saturate the secondary portion of a "constant-voltage" transformer, we do not wish to saturate the core in the primary portion of the transformer since that would in turn reduce the impedance of the transformer's primary coil. (This effect will be shown in our description of reactors for current regulation in a following article.) For this reason, the core of a "constant-voltage" transformer (Fig. 6) differs slightly from that of a regulator transformer (Fig. 3). It contains two rods of soft iron separated by a small gap located between the primary and secondary portions of the transformer core. The magnetic attraction between these two rods, in effect, shorts part of the magnetic field produced in the primary portion of the core from the secondary portion of the core and part of the magnetic field produced in the secondary portion of the core from the primary portion

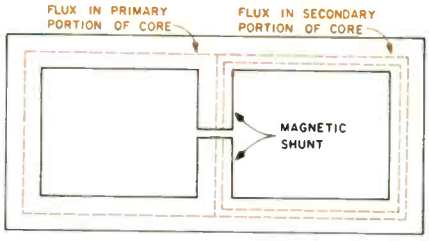


Fig. 6 — "Constant-voltage" transformers contain a magnetic shunt designed to restrict magnetic saturation to their secondary core.

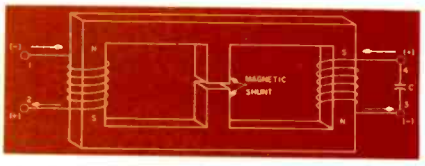


Fig. 7 — Primary and secondary coils in a "constant-voltage" transformer are basically the same as those in a regular transformer.

of the core. With this shunt, the magnetic field in the secondary portion of the core can be saturated without saturating the magnetic field in the primary portion of the core.

The primary and secondary coils in the "constant-voltage" transformer (Fig. 7) are basically the same as those in the regular transformer (Fig. 4). With each half cycle of applied ac primary voltage, the alternating magnetic field that is produced realigns the iron domains in the opposite direction — the change in their alignment inducing nearly enough energy across the capacitor to align all of the domains in the opposite direction on the following half cycle. The magnetic field produced by the applied ac primary voltage is greater than that required to align the balance of the domains, even when this applied ac voltage is less than the normal line voltage. When the ac line voltage is normal, or becomes even greater than normal, the resulting primary magnetic field produced is even greater than what is required on the following half cycle to align all of the domains in the secondary portion of the soft iron core.

Most of the magnetic field produced by the transformer's primary coil travels through the soft iron core to the secondary coil — only a relatively small portion traveling through the air. Since increases in the ac voltage across the primary winding will only increase the small portion of the magnetic field traveling through the air (the secondary portion of the core already being saturated), the voltage developed at the secondary winding is nearly independent of any changes in the ac voltage applied at the primary.

A schematic of the "constant-voltage" transformer is shown in Fig. 8A. If a second coil is wound in the secondary portion of the transformer coil (Fig. 8B), the voltage induced across it will also be affected by the saturation of the magnetic field in the secondary portion of the core. The output voltage across this coil will also remain relatively stable as the ac line voltage at the primary winding changes.

A taped secondary coil (Fig. 8C) will function in the same basic manner as the two secondary coils (Fig. 8B). Measurements indicate that the energy absorbed by a capacitor across this coil is also able to saturate the secondary portion of the "constant-voltage" transformer core, even when a moderate load is applied across the taped portion of the secondary coil.

Another ac voltage regulating component used in solid-state power supplies is the thyrector (Fig. 9). Whenever an applied ac voltage excedes its zener breakdown voltage (Fig. 13 in the June 1968 article), the semiconductor's internal resistance drops and it conducts sufficient current to load down the applied ac voltage, reducing to normal the voltage across any circuit connected in parallel with the thyrector. The zener breakdown voltage varies according to the particular thyrector type selected.

AC Current Regulation

Early circuits, designed to control the amount of ac current flowing through a circuit to regulate the amount of applied power, merely contained a large variable resistor (Fig. 10). Some of the electrical power was absorbed by the resistor and converted to heat, thereby reducing the amount of power applied to the load.

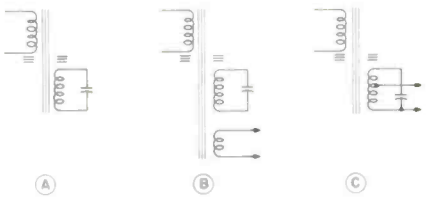


Fig. 8 — Schematic equivalents of three "constant-voltage" transformers.

Fig. 9 — Excess ac voltages are shunted from the load circuit by the thyrector.

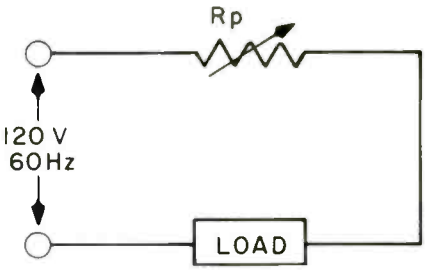


Fig. 10 — High-wattage variable resistors can be used for controling ac currents applied to a load circuit.

There were two major disadvantages of such a circuit. Useful energy was lost in the power-regulating resistor, and the resulting heat had to be removed before it damaged neighboring components.

Solid-state ac current regulators have eliminated these problems. They control the amount of power applied to an ac circuit (motors, lamps, heaters, etc.) with the use of switching diodes, which regulate the average ac current applied. One such ac current regulating circuit is shown in Fig. 11.

The average ac current flowing through this circuit is controlled through the use of capacitor time constants. (Capacitor time constants are described in the September 1967 article of this series.) The application of these time constants can be more readily understood with the use of a simplified diagram (Fig. 12) showing a portion of the power regulating circuit.

When terminal 1 is more positive than terminal 2 (Fig. 12), electrons flow from one plate of the capacitor (C_1) through the variable resistor (R_1) and to the positive terminal (1). The rate of electron flow (amount of current) through the resistor (R_1) determines the rate that a voltage is developed across the capacitor. Since the resistor (R_1) restricts the amount of current into or out of the capacitor (C_1), it (R_1) can be varied to change the rate at which a voltage will be developed across the capacitor. After a sufficient period of time, the voltage across the capacitor (Va) will equal the applied ac voltage (Vs).

If the resistance (R_1) in series with the capacitor (C_1) is reduced to zero, the voltage developed across the capacitor (V_{a0}) is the same as the applied ac voltage (V_s). (The V_{a0} curve would then be the same as the V_s curve in Fig. 13.)

When there is some resistance between the applied ac voltage and the capacitor (C_1), the resistor (R_1) restricts the current to the capacitor (Fig. 12), and the voltage across the capacitor (V_{a1} in Fig. 13) does not increase as rapidly as the applied ac voltage (V_s). The applied ac voltage has already passed its peak by the time the capacitor voltage (V_{a1}) has reached its peak — the instant the two voltages are equal.

By increasing the resistance (R_1), there is a further delay in the voltage developed across the capacitor (V_{a2}), and the applied voltage (V_s) is even further past its peak when the two voltages become equal — resulting in a smaller capacitor voltage than before.

A further increase in the resistance (R_1) results in even a greater time lag in the voltage developed across the capacitor (V_{a3}), and this voltage is even less than before.

Triacs were described in the July 1968 article of this series. From their equivalent circuit, shown in Fig. 12 of that article, we can see that any voltage at the gate, resulting from leakage current, is not as great as the voltage applied across a triac. Two equal resistors can be used as a voltage divider to supply a voltage corresponding to the voltage present at the gate of some triacs. (Voltage dividers are described with Fig. 3 in the April 1968 article of this series.) To simplify our explanation of how the thyrector functions in the ac current regulating circuit (Fig. 11), voltage divider resistors (R_2 and R_3) were substituted for the triac (Fig. 12). These resistors, of course, do not function like a triac, but do supply

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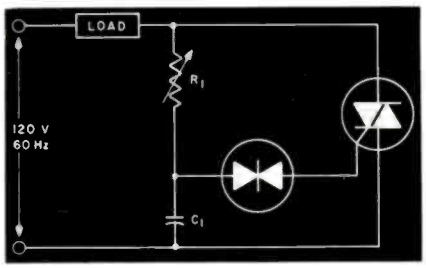


Fig. 11 — A solid-state circuit for controling the ac current applied to a load.

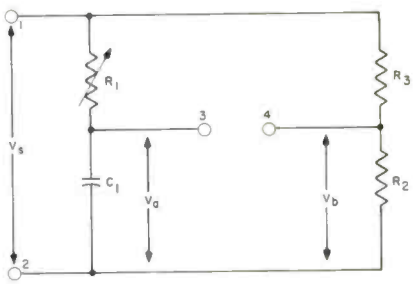


Fig. 12 — The basic capacitor-time-constant circuit in an ac current regulator.

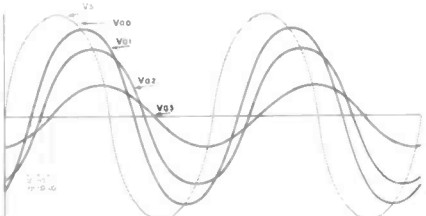


Fig. 13 — The relationship between the supply voltage (V_s) and capacitor voltage (V_a) varies with changes in the series resistance.

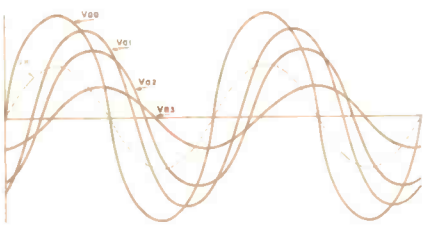


Fig. 14 — The voltage across the thyrector ($V_a - V_b$) varies with changes in the series resistance.

TEKLAB REPORT ON TEST

Eliminate guesswork in color servicing by employing accurate and proper test

Amphenol Model 857 CRT Commander

■ Amphenol's new CRT tester meets the demands of the technician by testing every performance characteristic of a B/W or color CRT. The tester and rejuvenator is capable of checking practically all of the B/W and color tubes you may encounter. There are a number of new features in the tester, that should keep the unit from becoming obsolete in a few years.

The instrument features a continuously variable heater voltage which enables setting to the correct valve regardless of line voltage conditions.

The biases for G1 and G2 are continuously variable. G1 voltages up to 100v are available and G2 voltages to 300v, effectively duplicating operating conditions of the CRT.

Another valuable new feature is the second anode leakage test which will enable the technician to detect leakage and breakdowns occurring in the CRT when HV is present.

Because of the need for closer HV adjustments (to prevent the X-radiation) the tester includes a voltmeter to aid in the troubleshooting and adjustment of HV circuits.

When used with a 10X high voltage probe, measurements of potentials up to 50kvdc are possible. Without the probe, full scale ranges of 1 and 5kvdc are available.

If measurement of the TV 2nd anode voltage is planned, use a HV probe such as the RCA WG297 with a 900M multiplier resistor, such as RCA WG210.

Various other functions can be performed such as rejuvenation, welding open elements and removing shorts. Also included are tests for emission, shorts, tube life and gas.

The instrument comes in a durable luggage type case and is priced at $99.95.

Amphenol Model 865 Color Commander

Amphenol's color commander incorporates features for the professional in a compact, lightweight, luggage-type case. The generator is a solid-state portable unit powered by batteries or ac to provide all the signals needed for color alignment.

A single crossbar pattern is available for raster centering before starting convergence and other adjustments. This is done by generating a signal containing the necessary horizontal and vertical sync pulses with video modulation of one horizontal and one vertical bar. The single crossbar

Amphenol Model 857 CRT Commander.

INSTRUMENTS

instruments

pattern is generated in the proper time placement so as to appear in the electrical center of the screen.

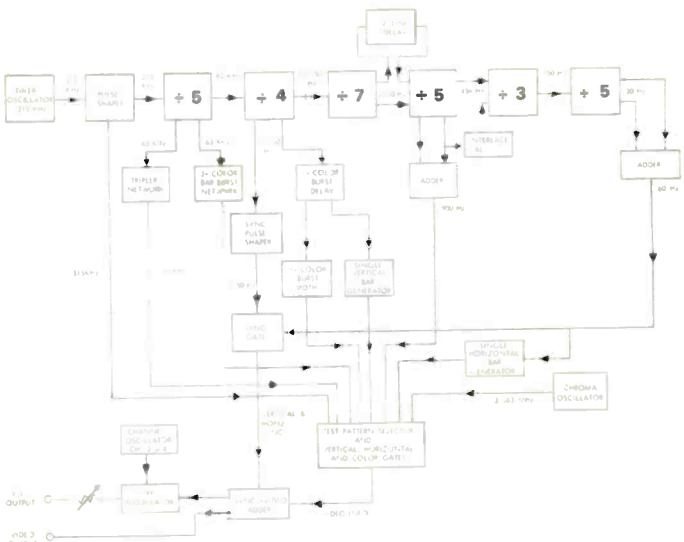
For a better all-around job of setting static or center convergence, a single dot pattern is available and can be adjusted to any part of the TV screen.

The color commander generates three different color patterns to simplify alignment of color receiver demodulators. These patterns are the conventional 10-bar rainbow, a 3-bar pattern and a single calibrated bar continuously adjustable through 270deg of color phase.

The generator is said to be the only unit available with a pattern permitting precise adjustment of this type of demodulator using the null technique. This is the single-color bar pattern which may be set for any phase between 30 and 300deg.

Silicon transistors are employed, powered by a series-regulated supply. Both the timer and chroma oscillators are crystal-controlled and all timer frequencies are derived by a division from the timer oscillator.

Other features include a color-coded control panel, two preset channels, built-in killers with lead piecing clips, laminated glass-epoxy circuit boards and automatic shut-off. ■



Block diagram Model 865 color Commander.

Amphenol Model 865 color Commander.

SOLID-STATE GARAGE DOOR OPENERS

Fig. 1 — Typical VHF solid-state garage door opener transmitter and receiver.

Dealers cash in on home construction boom through electronic garage door systems

■ Garage door opener sales and service are profitable and ideally suited to servicing by the electronic technician. With the boom in home construction, GDO systems have become a big, wide-open business. Since most GDO units are now solid-state devices, they must be serviced by a qualified electronic technician.

These systems consist of a transmitter, receiver and a motor assembly. The transmitter is a portable hand-operated unit. Both the receiver and motor control assembly are ac operated and located near the garage door.

System Operation

The GDO transmitter is compact enough to be clipped to the sun visor, located in glove compartment or clipped under the auto dash. When the transmit push button is depressed, the transmitted signal is picked up by the receiver to operate the motor control assembly. Effective range is from 20 to 100ft.

The operating frequency of GDO units is from 5kHz to 465MHz. Within this range, some systems operate in the CB band of 26.97 to 27.255MHz, some in the 200 to 260MHz band (Fig. 1) and others in the 465MHz VHF band. The main advantage of operating in the VHF range is freedom from man-made noise such as neon signs, auto ignition, lightning and other undesirable signals that might accidently trigger the GDO receiver.

Transmitter Circuits

A circuit diagram of a one transistor, 210 to 260MHz transmitter, is shown in Fig. 2. The circuit of Fig. 3 shows a three-transistor unit which has greater range. Transistor Q3 is the RF stage while Q1 and Q2 provide audio modulation.

Transmitters are normally pretuned at the factory with their corresponding receiving unit, however, it may be necessary to touch up the transmitter frequency adjustment for greater operating range. Some GDO transmitters are crystal-controlled. Often, these same units have plug-in type channel frequencies for audio modulation. By inserting different audio channels the transmitter can be operated on several audio channels on the same carrier frequency.

Transmitter Service

The first test on a defective transmitter should be for weak batteries. Use a regular battery tester or check the battery in the circuit with a voltmeter. Depress the transmit button and if the voltage drops from 1 to 2 v., the battery should be replaced. In case of short transmitting range, suspect a weak battery or corroded battery terminals. Most transmitters operate from 9 and 22.5v batteries.

To quickly check the performance of the transmitter use an RF field-strength meter. One can be made by forming a coil from several loops of hookup wire with a 1N34 crystal diode connected in series to a VOM as an RF indicator (Fig. 4). A coil of only three to six turns of hookup wire should be sufficient to check the RF output of a VHF transmitter. Use from 10 to 20 turns of hookup wire to check out a transmitter operating in the CB band.

Place the coil of the field strength meter near the transmitter. Depress the transmit button and notice the reading on VOM. If the meter gives no indication, the transmitter is probably not operating.

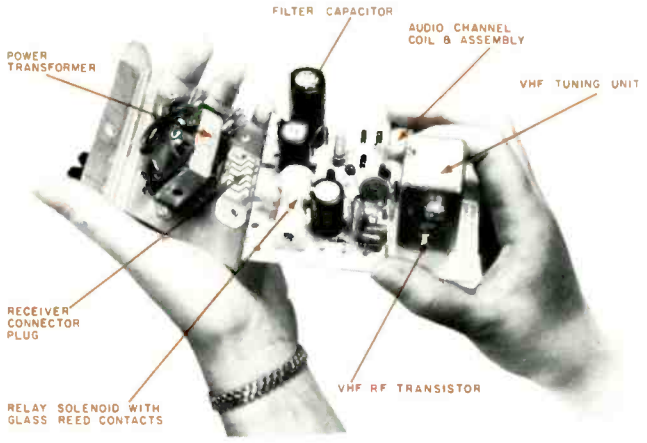


Fig. 6 — Interior view of VHF receiver showing audio channel plug-in, relay and components.

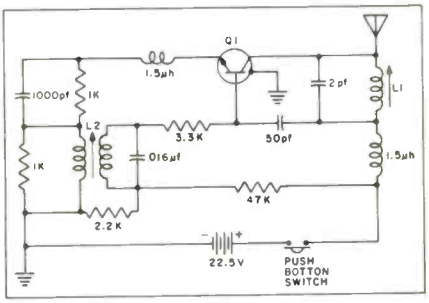


Fig. 2 — Single transistor transmitter for 210 to 260MHz.

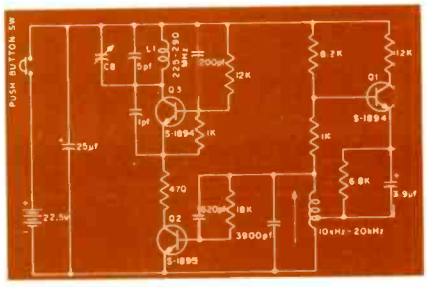


Fig. 3 — Three-transistor transmitter provides greater range and optional audio channel frequency.

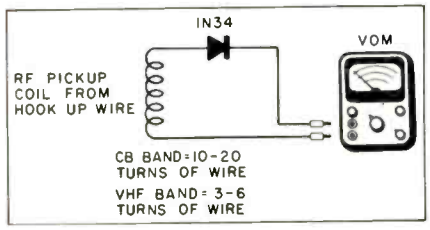


Fig. 4 — Simple RF field strength meter for transmitter output tests.

Make voltage and resistance checks of components within transmitter. Transistors can be checked with an in-circuit beta transistor tester. If the RF transistor shows a very high leakage, simply unsolder the collector terminal from PC board and take another check.

Most troubles found in these transmitters are the result of weak batteries, poor push-button contacts, transistors and tuning adjustments. Do not overlook the possibility of a broken or cracked PC board and corroded battery terminals.

Receiver Circuits

The solid-state GDO receiver may consist of from 5 to 12 transistors and several diodes. A typical GDO receiver circuit for 210 to 260MHz is shown in Fig. 5.

In the VHF receiver a short dipole antenna picks up the transmitter signal. Most CB band receivers use a piece of wire approximately 8ft long as receiving antenna. Be sure all antennas are installed away from large metal objects. With long wire antennas do not cut off or add to the antenna length. Run the full length of wire out toward the overhead door and mount with TV stand off insulators.

The transmitted signal is picked up by the antenna and fed to the RF stage of the receiver. This particular receiver utilizes 11 transistors in a superhetrodyne circuit. The convertor stage is crystal-controlled and feeds a 455kHz IF amplifier. A detector and tone limiter stage precede a plug-in channel selector coil. The following stages are AF amp, pulse detector, pulse counter, DC amp, voltage clamp and relay driver. A glass-enclosed relay-reed switch is located inside the solenoid coil (Fig. 6.).

The ac power supply consists of one or two silicon diodes with an RC filter network. Some power supplies are zener regulated, while other models contain a bridge-rectifier circuit with large input filtering capacitors.

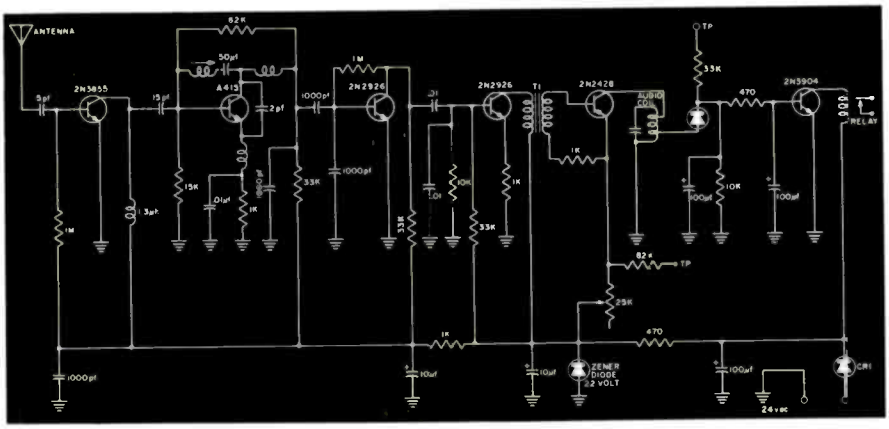


Fig. 5 — Schematic of 210 to 260MHz GDO superhetrodyne receiver.

Receiver Troubleshooting

There are various tests points found throughout the receiver to check operation. Follow the manufacturer's testing procedures. When the transmitter is "keyed," the receiver relay should close to operate the garage door mechanism. The receiver relay can be heard as a "click" when it operates. If the receiver relay closes and the motor control does not operate, check the relay contacts and motor wiring.

Transistor Voltage Checks

Shorted or leaky transistors are best checked with an in-circuit beta transistor tester. Clip the small test leads to the transistor and take both beta and leakage checks. If you get a normal beta reading, the transistor is not open or shorted. Take leakage tests and watch for high leakage valves in transistors with coils or directly coupled circuits. Remove the collector lead from PC board and take another reading.

For low resistance or voltage checks, use either a VTVM or FET VOM. Emitter, base and forward bias voltages are very low and accurate low voltage measurement is necessary. Collector voltages are quite high relative to base and emitter voltages.

Be sure to check the low voltage power supply. If there is no output voltage, suspect a silicon diode, open dropping resistor or leaky filter

Fig. 8 — Typical motor control assembly wiring diagram.

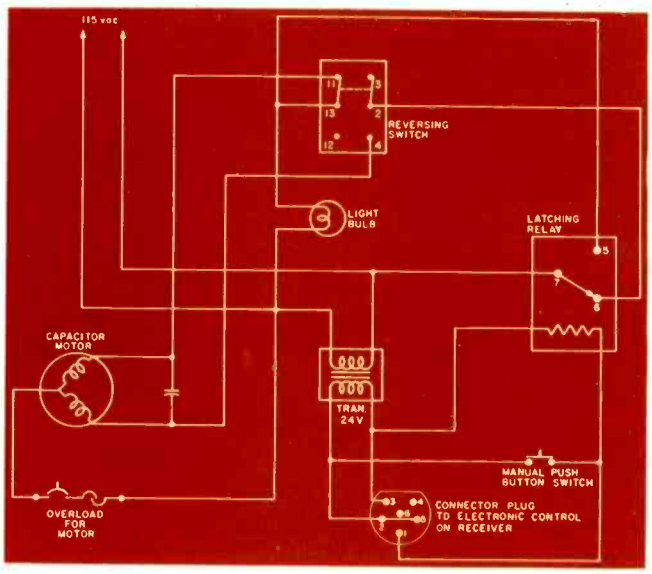


Fig. 7 — Complete GDO assembly with motor assembly and indicator light.

capacitor. Check the silicon diode with an ohmmeter. You should measure 10 Ω in one direction and a very high resistance with the leads reversed. The front-to-back resistance ratio is usually 10:1. Check each diode separately in a bridge rectifying circuit.

Motor Control Circuits

A complete motor control unit is shown in Fig. 7. When the motor is in operation, the light bulb comes on. It shuts off after door stops in either the up or down positions.

A typical motor control schematic is shown in Fig. 8. When manual push button is depressed, or the receiver relay contacts close, the latching relay will send 115vac through the reversing switch to one field of the motor. When the door is full open, the reversing switch is thrown to the opposite position to route the ac to the other field winding of motor. When the manual button or receiver relay contacts again energize the latching relay, the motor's reversed field will close the garage door. The latching relay, manual button and receiver solenoid contacts operate in a 24vac circuit.

Fig. 9, shows a motor control unit with an electronic clutch system to provide smoother and quieter door operation. An electronic device senses the speed of the motor's output shaft so that clutch slippage is synchronized with door motion. The door accelerates smoothly from a dead stop without jerking or bouncing.

Most manual switches are conveniently located on the garage wall. The manual button is used to operate the doors from within the garage or for emergency use should the transmitter or receiver become inoperative. Two or more manual buttons can be install d on any motor control unit by paralleling the manual switch terminals (Fig. 10).

If the receiver relay contacts or manual switch will not start control motor, check reversing the switch and latching relay circuits. Check for dirty or broken contacts in relays and switches. Seldom does a control motor burn out. Be sure and check lubrication of track and control motor when servicing a GDO unit. Do not make any adjustments on the receiver until the receiver is completely checked out.

Alignment

When a new receiver or transmitter has been added to a system, alignment may be necessary. Also, touch up alignment may be needed after replacing coils, IF transformers or RF transistors. Always follow the manufacturer's recommended procedures.

Most receivers can be aligned with an RF signal generator loosely coupled to the receiving antenna. Set the signal generator to the receiver frequency and align the RF, converter and IF stages with meter connected to the proper test point. The RF signal generator can also be used as a signal tracer.

You can also check signals from the detector to the relay circuit with a coupling capacitor and earphones. Clip one earphone terminal to chassis ground and go from stage to stage with the capacitor in series with the remaining earphone lead. Simply place the transmitter near the receiving antenna, press button and listen for an audio tone in earphone. A regular audio type signal tracer is ideal for making stage-to-stage signal tests. Once the defective stage is located, make voltage measurements and transistor tests to isolate the defective component.

Short range operation may be due to poor RF and audio transmitter alignment. This is especially true if the transmitter has been dropped. As previously indicated, make sure the battery in the transmitter is up to par. Aligning the transmitter to the receiver may be accomplished with the receiver on the bench or mounted in its permanent location.

Connect a VOM to the receiver test jack. In some portable transmitters it may be necessary to only touch up the RF adjustment, Insert alignment tool and adjust for highest reading on RF meter (Fig. 11).

For correct audio alignment in some models, it may be necessary to detune the audio frequency before RF alignment. After RF alignment, with the transmit button depressed, adjust the audio frequency core until a sharp dip is noted in the voltmeter reading. Carefully adjust the core back and forth until the lowest meter reading is obtained.

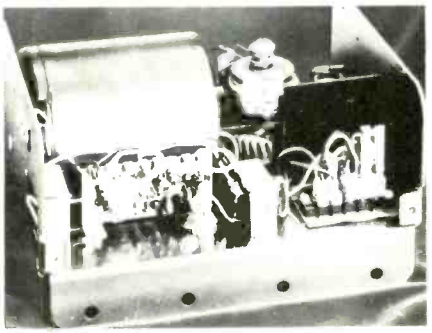


Fig. 9 — Motor contol unit with an electronic clutch system.

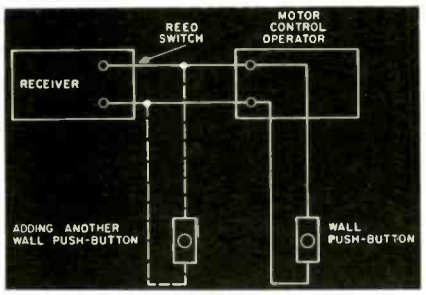


Fig. 10 — Wiring diagram showing addition of manual push buttons.

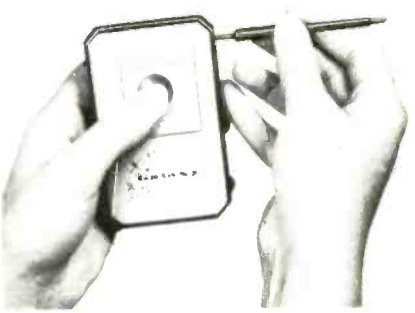


Fig. 11 — Transmitter power output is aligned with tuning tool inserted through access hole in case.

Then check transmitter at distances from 25 to 50ft.

Case Histories

We had replaced the battery in a G-370 transmitter but the radiated signal on the RF meter read zero. Removing the back cover on the transmitter, we found a defective push-button switch. The switch had been pushed so hard that the contacts did not meet. Alignment of the switch contacts put the GDO transmitter back into operation.

In another GDO transmitter we found that the transmitter would work only when turned on end. It just wouldn't perform in upright position. Inside we found a poor clip connection between the audio plug-in channel coils and the PC board — possibly because the clip unit was dropped (Fig. 12). Bending the clip holders together restored operation.

Each spring we received a call from one particular customer complaining of short distance operation. A car-top fishing boat was stored in the garage hung from the ceiling. When the boat was removed in the spring, the GDO receiving antenna was torn or cut.

In another system the complaint was an intermittent receiver. The power supply voltages were checked and found good. Using the signal tracer method we traced the audio signal from detector to pulse counter and checked voltages on the dc amplifier, voltage clamp and relay driver.

The receiver operated normal at first with all voltages checked. However, after several hours on the service bench the collector voltage of the dc amp went up to 16vdc. Since the emitter voltage is normally 15vdc and base a 19vdc, the collector voltage should have been close to zero. We suspected a leaky dc amp transistor (Fig. 13).

The transistor was removed from circuit and checked on the beta tester. The transistor checked normal. We sprayed the transistor with a cooling solution; it still held its own. But after several hours on the transistor tester it became intermittent.

We had a receiver brought in to be checked which appeared to be completely dead. Upon checking the power supply circuits we found a leaky 90μf electrolytic capacitor which had a leakage valve of 40Ω. ■

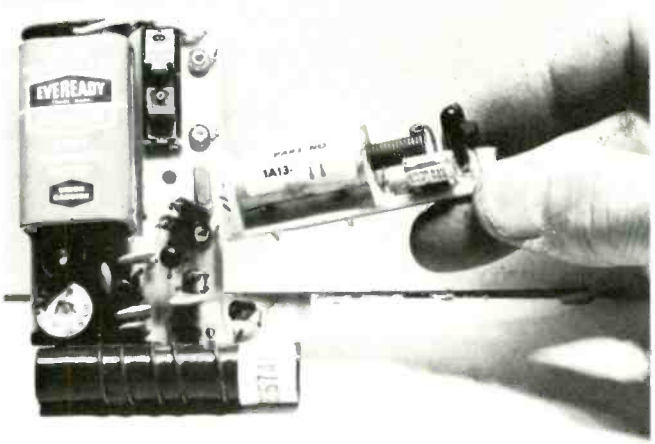


Fig. 12 — Audio plug-in channels must make proper connection to PC board.

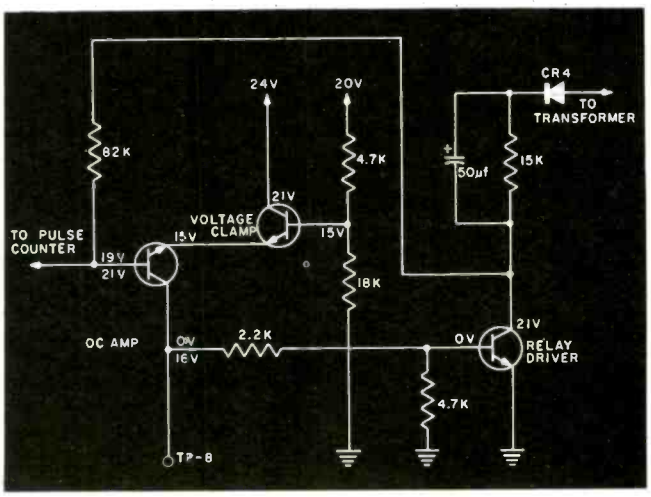


Fig. 13 — Partial schematic diagram of GDO receiver showing intermittent dc amp.

Selling by Service Reputation

Good customer relationship and service policies pay off for this rapidly expanding service/dealer

■ Most service/dealers feel the service department should be a money maker along with sales. But our ET/D reporter interviewed a very interesting gentleman who feels the service department can operate at a break-even point to promote sales.

Gerard Kiwus is the proprietor of one of the largest home entertainment service/dealer businesses in northern Minnesota.

His interest in electronics started as a hobby in Germany when he was 9 years old. Most of his education was obtained in Germany and he worked in various electronic plants before coming to the United States. He opened the door to his first shop in Kalamazoo, Michigan, later moved to Denver, Colorado and came to Minnesota in 1952. In Virginia, Minnesota he opened a shop on 8½ St. and named the shop Brownie TV. After a few years he outgrew the location and selected a larger building on Chestnut Street in the heart of the city. Virginia is centrally located among a number of iron range cities, with a total population of about 40 thousand people.

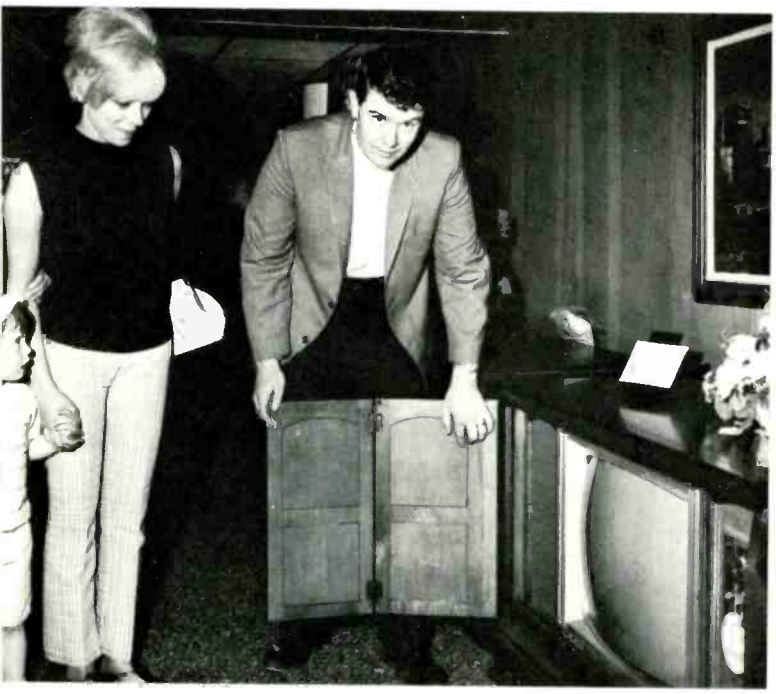
At this point Mr. Kiwus was asked about the secrets of his rapidly expanding business. "The days of a hole-in-a-wall type showroom with one or two sets are gone. When people make up their minds to purchase a set they want to have several to choose from and if you don't, they will buy some place else. Also, the showrooms have to be neat, attractive and comfortable. A business is built mainly by good reputation and service after the set is sold.

"We have customers coming in from about a 40-mile radius because of our large selection of sets.

"I started by doing just service for about 15 years and five years ago started selling home entertainment and white goods as a service-dealer," he adds.

Adequate Floor Space

"We have about 3600 sq ft of floor space on three levels. In our main showroom on the ground level we display Sylvania, Magnavox and other brands of home entertainment equipment so cus-



Salesman Don Israelson explains the features of a color set to a customer and our ET/D reporter.

One of the attractive color TV viewing rooms where a great number of sets are in constant supply.

Jay Kiwus, proprietor of Brownie TV, writes up a service call.

tomers get an idea of what we stock. During the summer months when television sales are down, we move white goods up to a portion of the main floor along with the entertainment pieces. Often a customer shopping for a refrigerator ends up buying a TV set.

The office is located to the right of the floor and the service center and warehouse at the rear of the building making loading and unloading of merchandise easier," Mr. Kiwus explains.

Once the customer decides on the brand of set he wants, he is led to one of three separate showrooms each displaying a particular brand with most of the models available to choose from.

Stereos are separated from the television sets in another display room because, as Mr. Kiwus explains, "you can't demonstrate a stereo with TV sound blaring out."

Our ET/D reporter was greatly impressed with the attractively decorated showrooms with their colored lights, imitation trees and flower arrangements. Mr. Kiwus smiles and says, "We sell the decorations, too, and often throw them in as a part of the deal."

The showrooms are paneled and carpeted, and chairs and tables are provided so the customer can relax while viewing and shopping for a particular set.

About 250 home entertainment units are displayed on the three different floors.

Word-of Mouth Advertising

Gerard Kiwus believes that his service policies have resulted in a generous supply of word-of-mouth advertising which brings in a continuous stream of customers. "Our advertising is modest. We spend about 2 percent of our gross income advertising in the local newspaper and very little on radio or television.

"Being right in the shopping area, the traffic created by the other stores helps our business a great deal," he explains. "When approaching our store from almost any direction you will see large billboard signs promoting our business in a co-op advertising plan with the manufacturer.

"I would say word-of-mouth advertising and our service reputation make up about 75 percent of the advertising," Mr. Kiwus states.

No Home Demonstration Selling

Our ET/D reporter asked Mr. Kiwus if he believed in home demonstration type selling, to which he quickly replies, "Definitely not. It involves a lot of time and money for the percentage of sales closed. Our average was about one sale for every ten sets in the home. When a customer comes in for a color TV, for instance, we can show him a selection in almost any cabinet style or price. If you have a good reputation, you can sell a set without even turning the set on because the customer knows you have good service and will maintain the set properly. It takes proper service along with set quality to have a good picture. If the sale is closed without a demonstration, we don't have a price shopping situation. Normally, for the first couple of weeks the customer has a hard time adjusting the TV or he may view a poor color program and blame the set. Then the set has to be picked up and we end up with a number of used sets," he concludes.

Donald Israelson, a full-time salesman at Brownie TV, has all of the essentials for selling. He has a pleasing personality and uses a soft approach. He

Brownie TV storefront as viewed from Chestnut Street.

Secretary Lee Bidle does the bookkeeping and all-around dealer/ service store duties.

also keeps up on his knowledge of home entertainment to explain all features of the equipment. Mr. Israelson was asked about his sales approach. He explains, "With a large selection of sets to choose from and the service we can offer after the sale, I don't find selling our equipment too difficult. About half of our customers come here because we were recommended by previous customers. Actually, when we are busy, all of our employees are salesmen. They have enough training and experience to do a good job of selling."

Service

The service department, with a three-man crew, operates at a break-even point. But as Mr. Kiwus explains, "If our service promotes sales and keeps the customer happy, I am happy."

Like most other service/dealers, Mr. Kiwus notes that the big push for color production has apparently resulted in lowering the quality of the set. "We spend a lot of money and time repairing minor problems on a new set. Now we operate the set for awhile before delivering it, to catch any minor service problems so the customer doesn't get the wrong opinion of the set."

Brownie TV employs an unusual unique method of receiving service calls. As the calls are received they are placed on a large board filled with clips. The board is divided by city or location, kind of call and time service is desired. This system eliminates the troublesome chore of sorting calls when routing the service technician each day. Also, if additional calls can be made, the technician has no trouble locating the urgent ones.

Three service vehicles are used, each stocked with the essential parts for a normal service call. If an outside call some distance away is received, the technician tries to anticipate the trouble and takes additional parts and test equipment along to eliminate unnecessary travel and time.

When asked if the trucks were radio dispatched, Mr. Kiwus explains, "We do not feel radio-equipped trucks would be of a great advantage to us. Most of our calls are only a five- or ten-minute drive from the service center. We try to group our calls to a specific area and if they are completed early, the service technician will check in by phone for more calls in his general location.

"Calls which are a long distance away are also grouped, and we make them once a week," he explains.

"Most of the service work we do is on home entertainment equipment," Mr. Kiwus continues. "Awhile back we serviced two-way radio equipment, but this type of service is a specialized field and we could not find enough work to merit the cost of specialized equipment, so we dropped it.

"We do enough antenna work to keep a man busy full time — sometimes two men on bigger jobs. An antenna installation is a must with color TV here since we are located in a valley with high terrain around us. We strongly encourage a new antenna and lead-in wire on old installations for best picture results. UHF translator stations used in Virginia are working out very well and we encourage the use of more of them."

"We do not have a fixed bench rate. We work on so many kinds of equipment, mostly tube types. But we are getting into more hybrid and transistorized types. On some of the transistorized and hybrid equipment we have to charge more than our normal rate and less on simple bench jobs, depending on the service requirements.

Mr. Kiwus went on to explain, "The biggest problem here, as in other service shops, is acquiring personnel. Our starting salary for a good bench technician is about $150 per week. Even if the living costs are less here, it seems that nobody likes to move to a smaller city."

Credit Policies

Our ET/D reporter asked Mr. Kiwus how he collected his delinquent bills. "That's always a problem in business," he replies. "We sell mostly big ticket items which are handled through the bank or finance company, that is, items over $75. Anything under this we carry ourselves after the customer is checked out with the credit bureau. He went on to explain that "the bank has better ways of collecting bills without creating hard feelings toward my business and we keep the customer happy. If we try to collect, we might lose a customer, and adding a fee for past due accounts just doesn't work with us.

Trade-In Policy

"Trade-in allowances are tough. We don't encourage them, but sometimes we allow a small amount to swing the sale.

In most cases, when a shopper asks about trade-in sets, he is told frankly there is little market for used B/W sets and the small amount of money we can offer most of them makes him decide to keep his old set.

"Many of the trade-ins we accept are not worth fixing but a few good parts can be salvaged to rebuild the better sets, keeping the repair costs down. In this way we break even or better. After the sets are rebuilt we put them in a display room on the third floor reserved for used sets, "Mr. Kiwus explains.

Essential Instruments

"We may not have the fanciest test instruments, but we do have all the essential ones which allow us to handle any service problem we may encounter. With all the instruments advertised, a service/dealer can become confused and equipment poor unless he knows what to buy and whether its uses will make it practical.

"We assemble test instruments in kit form to obtain certain features sometimes not found in the higher price range commercial unit. We remodeled a color bar generator to get a smaller dot." ■

BURGLAR ALARMS

-A PROFITABLE DIVERSIFICATION

Small-town operator makes local thievery pay

■ Jack Large and his father, Jack, Sr., run Large's TV in New Ringgold — deep in the hills of Pennsylvania. And Jack, Jr., recently discovered that selling electronic intrusion alarms is highly profitable. This came about almost by accident.

Jack was having lunch in the nearby "White Diner," when the owner, Earl Wester, called him aside.

Earl Wester's White Diner had been burgled — broken into, robbed and vandalized — three times. And the insurance company had advised Mr. Wester to get a burglar-alarm system to avoid an insurance rate increase. And, of course, the insurance he collected never covered losses 100 percent.

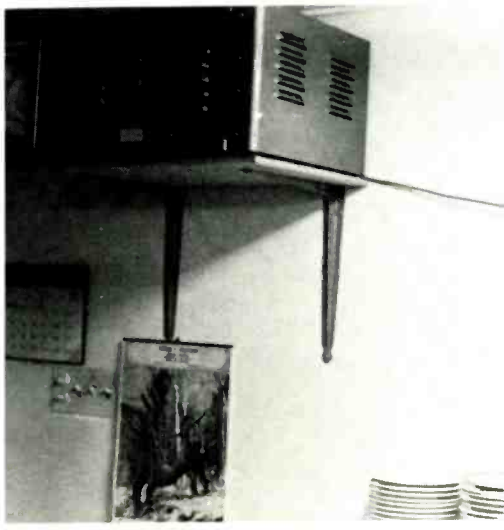
In a small town like New Ringgold (it's not even on the map), you must be all things to all customers. Jack had installed an MATV system in Earl's home, set it up for Hi Fi stereo, put in air conditioning and serviced his washer and dryer. Mr. Wester is obviously a valued customer.

So Earl turned to Jack Large because he knew Jack's father had installed an ingenious alarm system to protect their store. Earl's inquiry actually started Jack off in a new business.

Getting into the Business

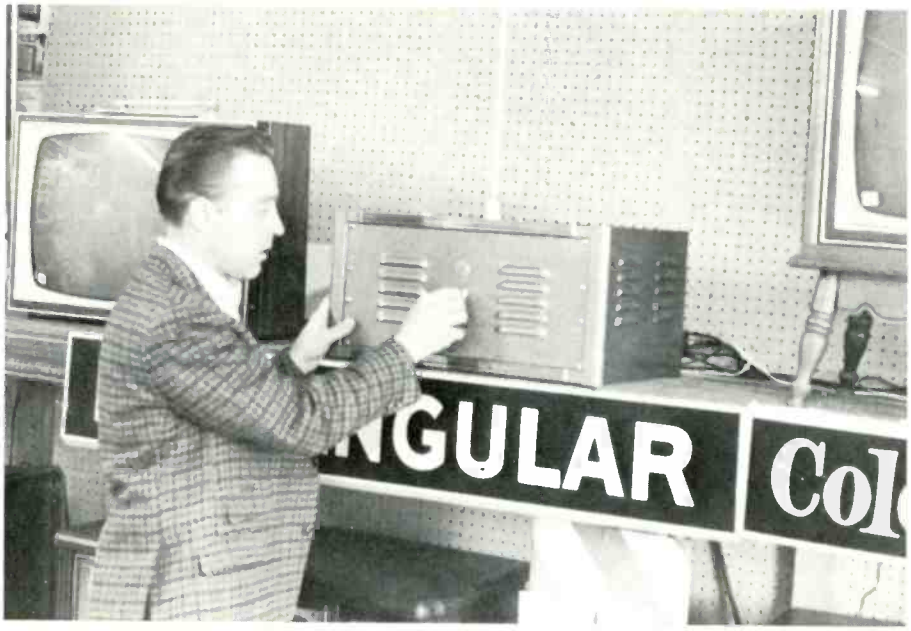
Jack Large, Jr., decided to investigate the various types of alarm systems available. He decided on one electronic system, ordered a unit, tried it out and was impressed by its performance. Then he showed it to Earl Wester. In the meantime, Mr. Wester had been approached by a competitive burglar alarm manufacturer who offered to wire up all his doors and windows for $600.

Remote detector mounted on ceiling near the center of the White Diner.



Control unit mounted on a shelf in the White Diner kitchen.

BURGLAR ALARMS



Jack Large, Jr. demonstrates burglar alarm in TV showroom.

Fire sensor installed on rafter in Heisler's Dairy Bar Warehouse.

Jack Large, Sr., prepares to make house call in one of two service trucks operated by the company.

The system Jack Large decided to sell cost $695 installed. But he ignored the difference in price and pointed out to his customer that the unit he was promoting protected the entire diner, no matter where a burglar attempted to enter the building. He also reminded his prospective customer that some competitive systems could be defeated with a jumper wire. But his system was foolproof.

When Mr. Wester had bought the system and it was installed, he was delighted with the protection it gave him. He told people who came into the diner about it and Mr. Large began to get more inquiries. Jack decided to visit the manufacturer's plant that made the system he was using.

He obtained valuable sales and business training from the manufacturer. More enthusiastic than ever, he decided to get an exclusive franchise for the equipment in his area. With the help of a loan from his local bank, he got the franchise for the counties he wanted. Since then, Jack Large has been happy with burglar alarms and they have become an important part of his business.

Promoting the Equipment

His first aggressive promotional effort was a demonstration of the unit before the Tamaqua Rotary Club whose members are primarily business people, doctors and lawyers.

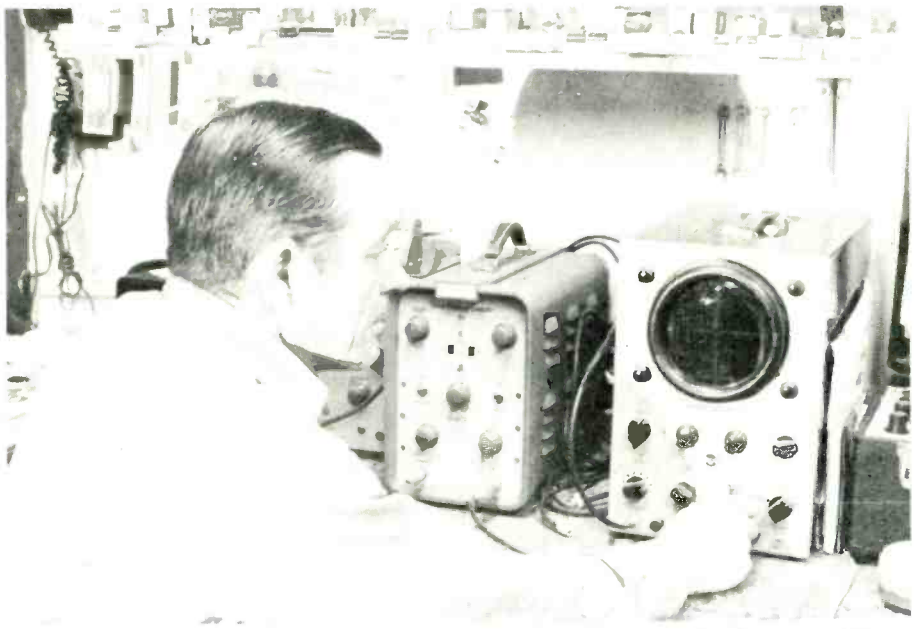
"The reaction was great," Jack smiles. "The members knew our alarm system was going to be demonstrated and it was one of the few Tamaqua Rotary Club meetings ever held which was 100 percent attended.

"I'm not a public speaker. In fact, I had never spoken in public, but my nervousness was overcome by the interest my audience demonstrated.

"I showed them the fail-safe features of my equipment. For example, if you pull the ac plug from the wall or any component in the equipment becomes defective, the alarm goes off. That fascinated them.

"I heard that this was the first time in the Rotary Club's history that the members stayed on after 7:30 p.m. Interest was so keen that most members stayed until 9:00 p.m. that night. My confidence in the unit mounted.

"When the demonstration was over, many of the observers came up to set off the alarm. We had two lights rigged up. The green light was the first alarm and the red light was the second alarm. Then we set the siren



Jack Large, Sr., works at well-instrumented service bench. Service is about forty percent of gross intake.

off, this really "capped" the demonstration. The observers couldn't believe that the unit would generate that kind of noise."

This demonstration was so successful that Mr. Large is planning subsequent speaking arrangements before the Lions and Kiwanis Clubs. A demonstration before the Catholic War Veterans brought additional leads. Even the war veterans bought a unit.

Making the Business Grow

Because he had no prior experience in the alarm business, Jack Large is following the manufacturer's sales plan closely.

"I used to pick up my newspaper just for relaxation," Mr. Large says. "Now, I read it carefully every day to find new leads."

One of Jack Larges' showcase alarm installations is at Heislers Golfland and Dairy Bar, an establishment which attracts 3000 to 5000 visitors on a summer Sunday. Heisler's is currently protected by two remote detectors and several fire sensors, but is planning to add coverage in some of the outlying buildings. The Heisler installation has also given Mr. Large some leads and he hopes for many more once the summer season begins.

So far, Jack Large has done all the selling, but he recently employed a commissioned salesman and expects to add two or three more in the coming months.

Jack expects his new business to mushroom rapidly. He has had no trouble getting leads and adding accessories like fire sensors to his sales. He presently offers a complete line of accessories including telephone dialers, direct-to-police station alarms, hold-up alarms, prowler alarms and outside bells and sirens.

Jack's immediate sales goal is 8 to 12 installations per month. With the direct mail, telephone follow-up campaign he plans to launch, he feels he can keep his salesmen supplied with plenty of leads.

He is even more optimistic about the future of his burglar alarm business, pointing out that the crime rate is growing so rapidly, the police are hard pressed to cope with it.

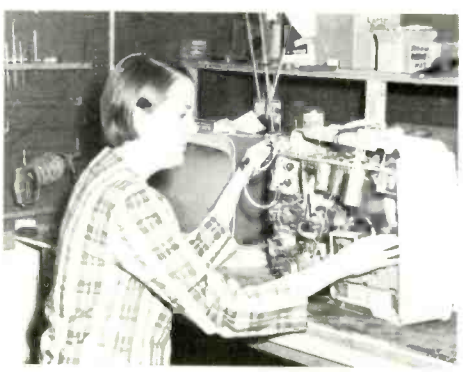
"I feel that this is not only a very profitable business," he says, "but a way to make a meaningful contribution to the community welfare." ■

Jack Large, Jr., replaces module in solid-state burglar alarm unit. No repairs are made on modules. They are replaced and returned to the factory for repair.

MAKING A 'ONE-MAN' GO OF IT

Small TV-radio business thrives on advertising,

The customer will usually give Jim Stutes (left) a friendly hand with carrying in a set.



Owner Stutes' daughter Teresa answers the phone part-time and tackles minor in-shop repairs.

■ Except in a few thinly populated rural areas out in the wide open spaces, you don't see many successful one-man TV-radio shops any more. But we ran into one recently in Overland, Mo., a suburb of St. Louis. And our field reporter wanted to know how Jim Stutes, owner of Vinita Tower View TV, managed after almost 20 years in the business.

How It's Done

"Too many small TV repair shops limp along with the bare minimum in parts and tubes so a lot of valuable time is wasted running back and forth to the distributor," Mr. Stutes says.

But not so at Vinita Tower View TV. It keeps $4000 in parts and tubes in the store and another $2500 worth in the service truck.

"Last year was my most profitable year," Mr. Stutes smiles. "I did $35,000 gross in repair work with a very low overhead. Of course, my wife or daughter takes care of the paper work and my son or another young, part-time apprentice answers the phone occasionally and does simple repairs.

Mr. Stutes' shop is in a fairly low rent area, at 2901 Ashby Road, in Overland.

"But keeping overhead low is only part of a one-man shop's effort toward success," Mr. Stutes continues. "Besides being a good technician, you have to adopt some techniques used by larger operators. For example, you have to advertise, have a full supply of service data and a complete stock of tubes and parts.

"If a set comes into the shop that has a tube I don't have in stock, I order a supply of them even though this particular set does not require the tube. This way, I almost always have the very latest tubes on hand," Mr. Stutes says.

Popular with DIY'ers

Besides expediting repair service, his large tube stock builds his reputation and business with "do-it-yourselfers." An occasional DIY'er will come in after taking his tubes to a large discount house for testing. But the DIY'er often finds that the discount house does not stock the particular tube he needs, so he comes to Vinita Tower View TV, which usually has the tube.

Jim Stutes is popular with DIY'ers and gets list price for all tubes sold over the counter.

know-how big tube and parts inventory

"But when the DIY'er wants to buy the tube at a discount price," Mr. Stutes emphasizes, "I just point to one of the two tube lists I have posted in the shop and tell him that's the established price and I'm not in the wholesale business. The DIY'er seldom walks out without buying the tube."

By getting list price for tubes, Mr. Stutes can justify the time necessary to serve DIY'ers and also to carry the big inventory he has in tubes and parts.

"Besides, by being helpful to the DIY'er, chances are I'll get him as a customer when he gets stuck," Jim Stutes adds. Do-it-yourselfer repair is increasing, Mr. Stutes believes, because there are more sets around and owners are getting bolder. "But I don't let it bother me. Instead I give them help and try to make future repair customers of them," Jum Stutes says.

One-Man Problems

One disadvantage of running a "one-horse" shop is handling house calls. Mr. Stutes manages this handily, repairing eight out of ten sets in the home.

One reason Mr. Stutes does everything possible to fix the set in the home is the inconvenience of bringing it in. To bring in a color set requires getting a part-timer to help him.

"I can usually solve the color set bring-in problem by taking only the chassis," he says. "But there's a problem in the shop of having a color jig (tube and yoke) to fit the color chassis — the setup varying from set to set. I've solved this in part by using a universal B/W jig which is OK for checking anything except color convergence."

Of course, there are other one-man shop problems. How does one man install a large antenna, for example? He doesn't. Mr. Stutes farms out all antenna work.

Jim Stutes has tried to operate with help. "I let my last man go because he wouldn't keep up with changes and he just wouldn't touch a color set. At least, when you're a one-man shop you have nobody but yourself to blame. And you don't have to worry about what the hired help is doing, whether they are losing money for you or even losing a customer, too," Mr. Stutes smiles.

Promotion

Mr. Stutes has locally competitive repair charges: Color home calls, $8.95; B/W service calls, $6.95.

Although Vinita TV keeps overhead low by establishing a minimum payroll and low rent, it doesn't skimp on the advertising budget.

"I spend $100 a month on Yellow Pages advertising, giving me more impact than many larger shops," Mr. Stutes emphasizes. "And it really pays off," he concludes.

As Vinita TV's ad in Yellow Pages declares, it offers about any electronic service: auto and home radio, phonographs, amplifiers, Hi Fi, color TV. And the type of customer is varied. It gets all the electronic work of a local school district. Another big customer is a local TV distributor (Admiral) for whom Mr. Stutes does warranty work, handling sets from a wide area — from southern Illinois and as far as Columbia, Mo., 125 miles away.

"If it's electronic, we'll take a shot at it," Mr. Stutes says. And when he says "We," he means just himself along with $6500 in parts and tubes, 18 years of schematics, a wealth of experience and the aggressive spirit to keep up on everything new. ■

There's a music school nearby and one-man shop operator Jim Stutes tackles anything electronic, including guitar amplifiers.

ET/D DEALER SHOWCASE

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

Dealer Signs 700

Three illuminated indoor signs are introduced. Heading the list is the 12-in. x 20in. sign with a built-in clock which is designed for wall mounting. Also, for window display is a 10in.

x 50in. sign and its companion, a 10in. x 31in. motion sign may be set on a counter, mounted to the wall or suspended from a window with letters that constantly change color. Admiral.

Auto Tape Player 701

A combination package, consisting of a tape player and a pair of stereo speakers designed for fast installation is introduced. The manufacturer claims an experienced employee can install the complete unit in less than 20 min. and the only tools needed are an electric drill and a screw driver. This all-in-one package also is designed to eliminate the problem of where to place the speakers. The player features all controls grouped on the left so that the driver can change tracks, adjust volume, tone and balance, even

change a cartridge album without taking his eyes off the road. An illuminated program indicator in the track selector bar aids album selection. The unit also features double tape guides to prevent program mixing. Head movement for the track selector is parallel to the tape to insure alignment on all tracks. A three-point floating roller suspension is said to assure quality cartridge performance and ease of loading and unloading. The playback speed is 3¾ ips. Orrtronics.

Stereo Phono 702

Announced is a model 1020 portable stereo phonograph. The stereo features a Miracord auto manual turntable equipped with push-button controls, and has an Elac STS 244 magnetic cartridge, matched two-way EMI speaker systems, a special jack for headphones and an auxiliary input

jack. The complete unit measures 15 by 26in. and is 7⅜in. high weighing 30 lb. Retail over $200. Benjamin.

UHF Convertor and Amplifier 703

Introduced is the model CR880 UHF convertor and amplifier. The solid-state convertor features three transistors, two diodes and a high gain amplifier. Another feature is a Local/Distant switch enabling the user to switch from local to long distance which is said to boost signal gain to a full 30db. The CR880 convertor updates any standard VHF TV set to receive any of the 83 UHF and VHF channels. Screw terminals at the rear of the convertor provide easy hook-up of antenna and set leads to the convertor. There are three push-button controls for switching on the convertor and to select either UHF or VHF signal. A pilot light lights up when the convertor is in UHF operation. Selection of UHF channels is made by a single tuning control and calibrated

dial panel. Conversion is made by a single tuning control and calibrated dial panel. Conversion to UHF is made by using channel five or six, whichever is not used in the area. The convertor features a charcoal gray high-impact plastic housing with silver-matte front panel and tuning control. Retail price $49.95. RMS.

TV Antenna Rotator 704

Announced is a rotator for home television antennas. The Dyna-Rotor combines an all-solid-state control unit with a light, fast, accurate home TV antenna rotor. Powered through a spline drive it is said to have fewer parts, higher reliability then conventional or planetary gear drives and develops high starting torque. The unit is designed to be mounted so that the rotor and the sections of the mast below and above it are in a straight line. Housed in a cast aluminum case, the rotor assembly weighs 5 lb. The drive reduces the 6000rpm of the motor to 2 rpm at the antenna, rotating the antennas at the rate of 360deg in less than 40s. The solid-state con-

trol unit is said to have no potentially troublesome mechanical switches, solenoids, relays or motors to cause interference with reception and is silent in operation. A pilot light inside the unit illuminates when the antenna

is in motion. The light turns off when the antenna reaches its aimed position. Suggested retail price $54.95. Jerrold.

Transistor Radio 707

A new solid-state FM/AM transistor portable radio is introduced. The Century (Y851R) is a FM/AM portable featuring a 13 transistor chassis, roto tune band selector (for FM and

AM), tone control, dial light, slide rule tuning, AFC, built-in A/C charger, telescopic FM antenna and ferrite rod AM antenna. It is offered in a black cabinet with a walnut-grained aluminum grill, complete with batteries, earphone and pull-up handle. Suggested list price $59.95. Admiral.

Microphone Mixer 708

Announced is an ac-operated studio mixer, designed specifically for studio, remote and home Hi Fi applications. The model 308TR is a solid-state, stereo-monaural audio frequency mixer/amplifier that operates on standard 117vac, 60Hz house current. It can be used with phonographs, microphones, electronic instruments and/or tape recorders to permit recording sound on sound, music and voice fades, recording voice over music or mixing voice and program sources from several locations. The mixer is said to accept from one to four monaural input signals or up to two stereo input signals, from any combination or type of program source, such as: microphones, tape recorders, stereo or monaural phono pickups, tuners, preamplifiers and musical instruments. It is also equalized for magnetic phono cartridges. Distortion is 1 percent maximum (0.5 percent typical) at 4v output. Frequency response is 20Hz to 20kHz with a minimum signal to noise ratio of 60db, referred to 1mv input. Each program input level is con-

trolled individually by a separate gain control or simultaneously with the master gain control. Other controls on the mixer include an on/off switch, phono equalization switches and a stereo-mono switch. Signals are mixed and amplified up to a 4v level (65db gain on low level inputs) in each channel, then fed to dual low impedance outputs for distribution to recorders, PA and/or musical instrument amplifiers. Because of the low output impedance of the unit up to 2000ft of cable

may be used without degradation of frequency response is claimed. The unit measures 3½ in. high, 12in. wide and 7¼ in. deep. It is finished in satin black enamel with a scratch-resistant brushed aluminum escutcheon plate. Switchcraft.

Sound System 705

A portable sound system for the traveling entertainer capable of producing 585w peak music power (235w RMS) is introduced. Designated model A105, the system consists of a 1200A control console, two 1203A power speakers and two 1201A column speakers. Capable of controlling up to five independent input signals, the 1200A all-silicon-transistorized mixer power amplifier is said to have an output of 145w peak music power (60w RMS continuous power). The reverb is built in and has a switchable, individual control on each of four channels. And for added protection, when the top of the console is closed, the reverb is automatically locked in place to prevent damage. The 1203A power speaker is designed to complement the model 1200A control console by providing an additional power capability of 220w peak music power (80w RMS) per unit. One to ten power speakers may be added to each output jack of the 1200A console, providing as much as 1500w continuous power capability. The 1203A features one 15in. low fre-

quency speaker and one 800Hz cast aluminum sectoral horn driven by a high frequency driver. The 1201A is a compact, portable high-styled speaker system employing two wide-range heavy-duty 10in. cone-type speakers and is said to be capable of handling 30w of power with an impedance of 8Ω. All components of the A105 system are covered with a vinyl lamination providing a measure of protection against handling. Vinyl slip covers are also available as accessories for additional protection.

Stereo Amplifier 706

A solid-state integrated stereo amplifier is introduced. Featured in the Sansui AU777 is SEPP ITL circuitry with an output of 70w music power (IHF), 25w channel RMS power at 8Ω. The unit adopts a new CE dividing system in which silicon transistors are used in the phase reversing circuit, assuring a frequency response of 20 to 50kHz with less than .5 percent distortion over the entire frequency range claimed by the manufacturer. Negative feed-back amplifiers are used in all stages. The main amplifier has a fre-

quency response of 20 to 100kHz. The preamplifier output has a distortion of less than .1 percent at the rated output voltage of 1v is claimed. Other features include dual concentric, two-stage negative feedback tone controls in 3db increments, providing independent adjustment of each channel for boost and attenuations of 15db at both the base and treble ends. The preamp and main amplifier sections are designed to be used independently so that the amplifier serves as a crossover channel amplifier. The unit has a full control complement including: tape equalizer which can be switched from 3 1/3 to 7ips depending upon tape speed; CR feed-back low and high filters; loudness control in 3db increments; presence switch which enables the listener to enjoy a double base "concert hall" effect; tape monitor switch which compares the recorded tape with the program source, headphone jack for private listening; muting switch for interstation noise suppression; speaker selector switch for a choice of speaker systems; and tape recording output. The amplifier is sold with a two-year warranty. Price $279.95. Sansui.

Microphone 709

Introduced is a microphone produced for musical applications, requiring a microphone capable of handling the tremendous sound pressures generated by contemporary music. The D-

1000E comes in a new shaped housing said to be capable of withstanding uncommonly rough treatment. The microphone system and capsule are suspended to overcome shock and high-impaction. It features a mode selection switch (sharp - medium - bass) to attenuate the response of the microphone and includes transformer and silent on-off switch. North American Philips.

COLORFAX

GENERAL ELCTRIC

Color TV Chassis H1— Service Hints

High Voltage Compartment Doors. Late production H1 Chassis receivers contain a high voltage transformer which has the tertiary encased in RTV silicone rubber (ES77X2). These transformers, which are easily recognized by the white plastic cup around the tertiary, offer increased resistance to high temperature and humidity. To allow better air circulation around the transformer, the door on the high voltage can has been eliminated. This was made possible by the special properties of the new type transformer construction.

Receivers which are equipped with the older type, wax impregnated transformers (ES77X89) must have a door on the high voltage compartment. When servicing these receivers be sure that this door is securely fastened before reassembling the cabinet back.

Do not install the old wax type transformer (ES77X89) in an H1 receiver which does not have a door on the HV compartment.

Intermittent Hum Bar. There have been some field reports of an intermittent hum bar in the 10in., H1 Chassis, color receivers. This condition may be caused by a poor ground connection at the black lead from the vertical output transformer.

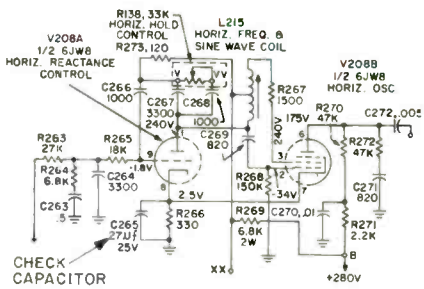
On some sets, this lead is grounded at the same terminal board as the ac line choke. Poor contact with chassis ground because of a loose or stripped screw can cause ac to modulate the vertical sweep, producing intermittent hum in the picure.

Move and solder this black ground lead to the lance on the top right side of the high voltage transformer compartment. The black lead from the convergence assembly is also connected to this point. Check the terminal board screw for tightness. If stripped, replace with a larger diameter screw or solder the lug and screw to the high voltage cage. Be careful not to change the lead dress or damage any wire insulation in this area while soldering.

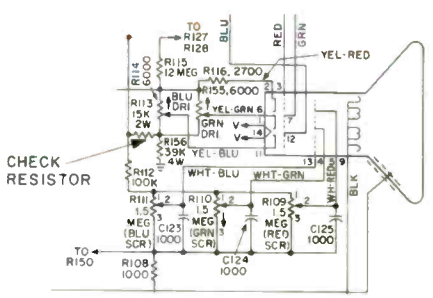
OLYMPIC

Color TV Chassis CTC19/20/21 — Service Hints

CTC19/21 **Problem:** Jittering picture lacking vertically stability. **Correction:** Check R281. If it is a 330K resistor, try a 560K replacement or try a lower value. The best value to use depends on signal conditions. **Problem:** Intermittent arcing from the 3A3 HV rectifier socket to the metal cover on top of the high voltage cage. **Correction:** Remove metal cover, place high-voltage tape inside, covering entire underside of topmost section and re-install.



CTC19/20/21 **Problem:** Picture bends, or may lose horizontal sync. **Correction:** Check and replace if necessary C265, a 27 μf, 25v capacitor in the cathode circuit of V208, the Horiz. Reactance Control tube 6JW8.



CTC20 **Problem:** Excessive blooming, and no brightness cut-off. **Correction:** Check R113 if open. This is a 15K 2w resistor in CRT cathode circuit at input to drive control, located on rear apron adjacent to drive control.

CT910 **Problem:** No high voltage. **Correction:** Check for an increase in value of R802, a 470K resistor in grid circuit of the 31JS6 tube, which may be cutting the tube off. **Problem:** No color, or weak color. **Correction:** Check for open or increase in value of R603, the 47 Ω cathode resistor of V17, (the 6GH8 bandpass amplifier). Replace if necessary.

Marketing axiom number 1:

SELL WHERE YOU BUY.

Chances are you or somebody in your company uses the Yellow Pages regularly to buy supplies or services you need to do business. A study of just manufacturing firms alone proved 9 out of 10 buyers do. That's why the Yellow Pages is such a good place to reach business prospects with *your own* advertising. Sell where you buy. It's good business.

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New Ways to Diagnose Electronic Troubles

Now you can have at your fingertips, this brand-new book, written by noted servicing expert Jack Darr, especially written to show you how to locate troubles—FAST—in *any* kind of electronic circuit. You'll literally chop troubleshooting time to the bone when you put these new methods into action on your service bench.

The author, drawing upon his many years of analysis and experience, explains how almost any service job can be boiled down to a logical troubleshooting sequence. Using typical schematics for tube-type and solid-state radio and TV sets, he shows how you can develop a familiarity with almost any circuit. By analyzing typical schematics, you'll be able to find your way through even the most complicated-looking power supplies and associated circuits—regulators, filters, voltage distribution networks, etc., and you'll be amazed how simple horizontal sweep and high voltage circuits are! Even color sweep circuits—including high voltage supplies—will look much different after you read this book, as will vertical sweep, vertical oscillator, and output stages, video circuits (both B & W and color). You'll discover quick ways to check them and learn to spot actual defects. Color and B & W stages are simplified to the point that locating causes of picture smear, ringing, and other normally difficult troubleshooting jobs become as easy as 1, 2, 3.

The TV tuner, commonly avoided by many technicians because of its "complications," is exposed for what it is—a simple set of circuits, basically. The final two Chapters delve into those troublesome AGC and sync circuits, how they work, why they work (and don't), trouble symptoms, signal tracing, etc. What it all amounts to is, if you want to get to the root of radio and TV problems—FAST—you must have a copy of this book.

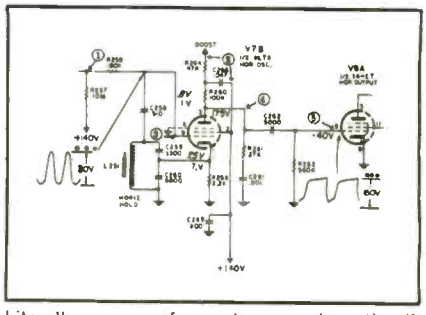
A New Way to Service Color TV

Here is one of the finest, most practical books ever published on the subject —contains the data most needed for servicing color TV receivers! A servicing guidebook by Carl Babcoke, this book emphasizes the practical aspects of troubleshooting and repairing color TV sets—just what you need to get those difficult-to-repair color sets back in top working order—FAST!

Steering clear of the confusing, complex theory on which far too many books dwell, *A New Way to Service Color TV* explains *practical* methods that have been tried by the author (himself a technician of long experience) and dozens of other service technicians around the country. Actual case histories demonstrate the best known techniques for getting color TV sets working again in the shortest possible time in the home or on the service bench!

Profusely illustrated, the book's principal approach is a visual examination from which the reader interprets what he sees (or fails to see). Then he proceeds to localize the trouble to a particular circuit or area. Occasionally, a few measurements are needed, as are further tests to pinpoint the trouble to a single part or two.

Rather than try to cover every make and model, the book concentrates on the RCA CTC16 chassis, and illustrates only significant differences between it and other makes and models. An entire Chapter is devoted to step-by-step setup of color sets, and many black and white photographs of good and bad screen images of color TV sets and oscilloscopes show the technician just what he may expect. Lavish use of schematics helps to clarify the text. Use of this book will really help to increase your color TV servicing efficiency, and cut down on your troubleshooting time!



Literally scores of easy-to-use schematic diagrams are contained in all these new books. (Example shown greatly reduced in size)

The Oscilloscope—Second Edition

Here is the answer to the need for proven, helpful techniques which show you how to operate and use the oscilloscope to diagnose any type of service problem.

This classic text not only teaches you how to operate a scope properly, but also how to interpret waveforms correctly, how to align RF, IF, video, and audio circuits, the proper probes to use, and how to use a scope in diagnosing circuit faults.

If you need practice in using the Scope, the final Chapter will be of special help. Included are experiments which help you understand the relationship between signal and sweep frequencies, effects of sync adjustments, marker signals, pulse voltages, etc. Also gives step-by-step procedures for measuring signal amplitudes, square-wave testing, testing capacitors, checking transmitter modulation, etc.

Truly a useful, needed text for TV service technicians and others who use the oscilloscope in everyday work. Contains just the kind of practical, down-to-earth information you can *immediately* put to use in your everyday service work!

New Ways to Diagnose Electronic Troubles, The Oscilloscope, and *A New Way To Service Color TV,* are handsome, hardbound books, indicative of the many other fine offerings made to Members . . . important books to read

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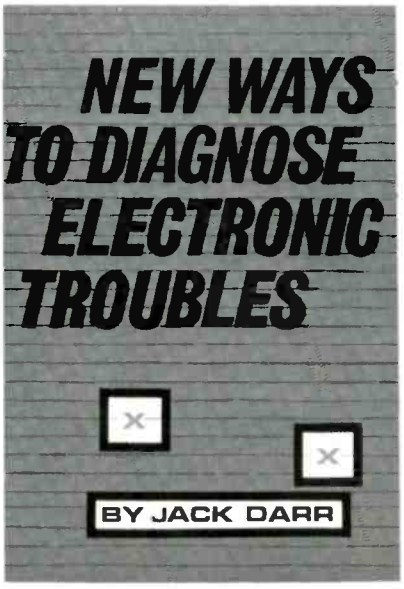

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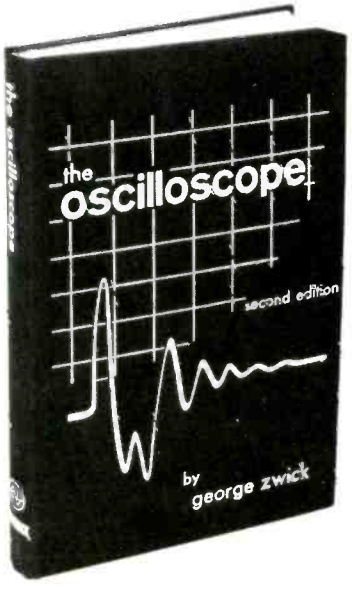

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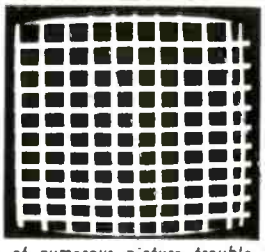

Example of numerous picture trouble photos used as a guide to circuit faults.

Typical Savings Offered Club Members on Recent Selections

Modern TV Waveform Analysis
List Price $7.95; Club Price $3.95
Servicing TV Receiver Circuits
List Price $6.95; Club Price $2.95
Jack Darr's Service Clinic
List Price $6.95; Club Price $2.95
How To Test Almost Everything Electronic
List Price $5.65; Club Price $3.95
Pinpoint Transistor Troubles in 12 Minutes
List Price $6.95; Club Price $4.95
How To Use Your VOM-VTVM & Oscilloscope
List Price $6.95; Club Price $4.95
Modern Electronic Troubleshooting
List Price $7.95; Club Price $3.95
Installing Hi-Fi Systems
List Price $7.95; Club Price $4.95
Repairing Transistor Radios
List Price $6.50; Club Price $3.50
Electronic Circuit Design Handbook
List Price $14.95; Club Price $7.95
Radio Operating Q & A
List Price $8.25; Club Price $6.95
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List Price $7.95; Club Price $6.50
Rapid TV Repair
List Price $6.95; Club Price $3.95
FET Applications Handbook
List Price $12.95; Club Price $7.95
Handbook of Semiconductor Circuits
List Price $7.95; Club Price $4.95
Pinpoint TV Troubles in 10 Minutes
List Price $6.95; Club Price $4.95
TV Troubleshooting & Repair
List Price $6.95; Club Price $3.95
Easy Way To Service Radios
List Price $6.95; Club Price $3.95
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List Price $10.75; Club Price $8.50
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List Price $7.95; Club Price $4.95

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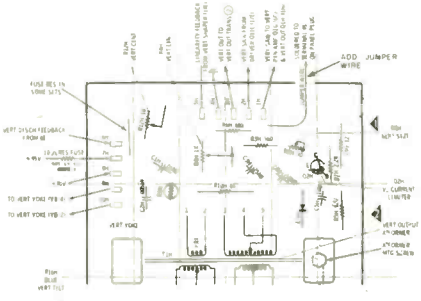
MOTOROLA

Color Chassis TS915/919 — Service Tips

Vertical Retrace Lines Visible at High Brightness. Current production sets are designed to operate properly with the G2 controls set to track near the center of their operating range. Tracking the set with the G2 controls at or near maximum setting can produce vertical retrace lines at high brightness. Tracking the set with the controls at mid-range will eliminate the problem.

To Eliminate Hum in Raster at Low Brightness in TS915 Chassis. 1. Remove and discard R46(L) identified as R16(L) on early schematics. Value of R46(L) varies: can be 6.8K, 7.5K or 8.2K. R46(L) is located between brightness control and ground. 2. Remove and discard C24(E) (500μf) located on contrast control to ground. 3. Remove and discard .05 capacitor located at opposite end of brightness control and ground (not shown on schematic). 4. Connect an 82 Ω, ½w resistor from terminal on brightness control, left open in Step 1, to junction of R54E and contrast control. 5. Pull "L" panel from chassis. Clip and discard C12(L) (.05 capacitor). 6. Replace "L" panel and check set. It may be necessary to readjust ABL for correct brightness level.

Streaking at the Lower Portion of the Raster. Vertical jitter can result from a contaminated "1H" terminal on the convergence panel. It is not recommended that any sharp tools be



used for cleaning. Rather, the convergence panel can be removed and reinserted several times. Two screws which provide mechanical support for the vertical output transformer must be removed to accomplish this. The self-cleaning action of the pins on the five-pin male panel connector usually brightens the 1H contact and prevents distortion of the connecting terminal surfaces.

A positive correction is to add a jumper across contact 1H. Most convergence panels have a male bullet-head connector mounted near terminal

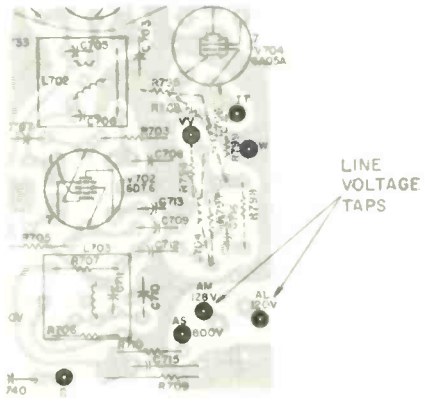
1H. Construct a 6-in. jumper with a female bullet-head connector soldered to one end. Solder the other end of the jumper to the 1H pin of the five-pin chassis mounted panel connector. Be sure to do this on the wiring side of the five-pin panel connector. Engage the bullet-head connectors on the panel. Jumpers which have the appropriate female bullet-head connector already soldered on one end are available from your Motorola distributor under part No. 30V68618A60.

Those panels which do not contain the male bullet-head connector can be drilled to accommodate one. A .05in. hole drilled in the etched circuit which leads to contact 1H will accept the required male connector. Be sure to solder the connector to the etched circuit for good electrical contact. Male bullet-head connectors for this purpose are available from your Motorola distributor under part No. 39S10184A09.

MAGNAVOX

Color TV Models T911/T918/T919/T920 /T931 — Line Voltage Tap

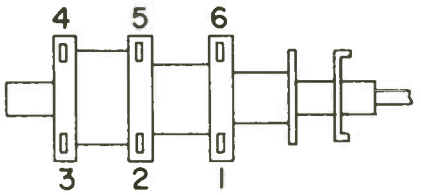
All color TV models using the T911, T918, T919, T920 or T931 chassis are provided with line voltage taps. Although this feature has been employed for some time, apparently some technicians are not aware of it. It is particularly important to see that the tap is in the high line voltage (128v) position if the receiver is to be



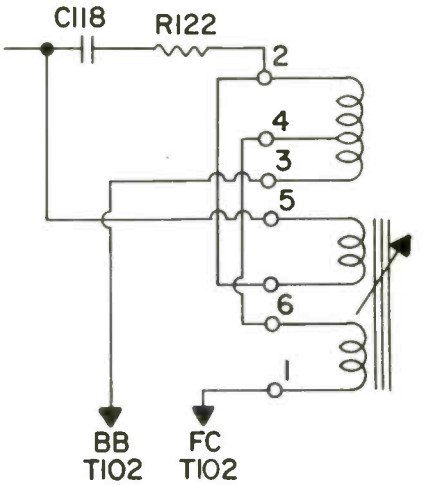
operated under high line voltage conditions. This tap is in the form of solderless terminals on the chroma board adjacent to the power transformer. One terminal is marked "AL120v" (for low or normal line voltage) and the other is marked "AM128v" (for high line).

Color TV Chassis T911/T919/T920/ T931 — New Focus Transformer

Later production of the T911, T919, T920 and T931 color TV chassis uses a new type focus transformer part No.



361306-1. The 361306-1 can be used as a replacement for the earlier transformer (361240-3); however, because of physical differences between the two, the connections are not the same.



Terminal identification and the correct wiring for the 361306-1 transformer are shown in illustration.

ET/D NEW PRODUCTS

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

Metalfinder 710

An electronic metalfinder has been announced. The small hand-held instrument, designated Model ML11, uses a standard 9v transistor radio battery in a 2 by 4 in. plastic case. Pro-

fessional and amateur electronic equipment installers can use it for finding studs, joists, plumbing, electrical boxes, heat ducts, nails and conduit. Just turn the knob until the needle goes upscale, then the needle will drop when metal is located. Price $32.50. G S Electronics.

Tube Tester 711

Announced is a dynamic mutual conductance tube tester capable of checking more than 3000 domestic and foreign tubes. The MU150 provides four-way testing: mutual conductance, cathode emission, 100M grid leakage and internal shorts. For mutual conductance tests, the tester features an automatic biasing system

and uses a 5kHz squarewave for complete analysis of the tube being checked. Meter readings are in actual micromhos. In cathode emission tests, the instrument draws near full rated cathode current as an extra test on power and rectifier tubes to measure their emission capabilities. Grid leakage is measured with a high sensitivity of 100M to find grid contamination defects. In checking for shorts, each element in the tube is checked against all the others. The tester provides space for additional sockets to accommodate new tubes that may have different base arrangements. A new simplified setup book is included. Tubes are listed in the center of each page for easy reading of setup numbers — emission on the left and mutual conductance on the right. The unit is housed in an attache-type case with brushed chrome center section and black vinyl-clad steel cover and base. Price complete is $219.50. Sencore.

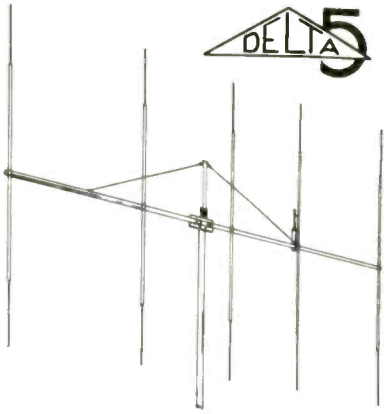
Stereo Recorder 712

Operated on ac in the home, the Uher 4400 report stereo can be used in conjunction with the component system to provide stereo or monaural record and playback. The recorder

converts to battery for portable monaural or stereo recording and playback. Where extended record and playback time is required, all four tracks can be used monaurally at 15/16ips with long play tape to give the user 25½ hr. on a single reel. Some of the features included are: four tape speeds — 15/16, 1⅞, 3¾ & 7½ ips and a frequency response of ±2db at all speeds — 40-4500cps @ 15/16; 40-10,000cps @ 1⅞; 40-17,000cps @ 3¾; 40-20,000cps @ 7½ ips. The unit employs 25 transistors, 5 diodes and has a power output rating of 1w with 4 Ω impedance. It weighs 8 lb and measures 11 x 9 x 3½ in. Martel.

CB Antenna 713

A five-element base station antenna is announced. The Delta-5 is said to have an SWR of 1.5/1 or better and a feed point impedance of 52 Ω. The antenna is said to have a 2db front-to-back ratio and a forward gain of 9.5 db, compared to a reference dipole, or 11.6 over isotropic source; a max-

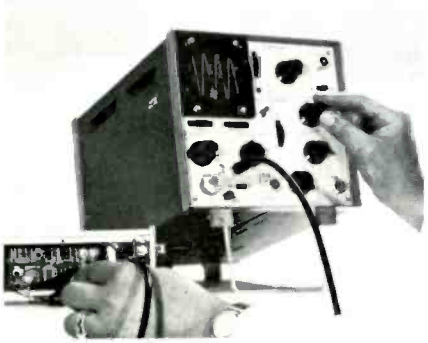


imum element length of 18ft 8¾ in., a boom length of 24ft, with a turning radius of 12ft horizontally mounted or 15.3ft vertically mounted. The surface is 6.16sq ft vertical and 3.9sq ft horizontal. Assembled weight is 20.5 lb. Mosley.

Portable Oscilloscope 714

Announced are two new oscilloscopes which operate for four hours on an internal rechargeable battery and have bandwidths from dc up to 30MHz. Up to 85 percent of the mechanical components are diecastings and the circuit cards are hinged to simplify servicing. The single beam instrument, Type EM101X, weighs 17 lb and the double beam oscilloscope, Type EA102, weighs only 20 lb. Both instruments use silicon transistors, field effect transistors and microelectronic circuits and are said to operate in ambient temperatures between −5°C and 40°C. The EM-101X oscilloscope has a cathode ray tube display area of 5cm x 6cm and the Y amplifier has 9v ranges measuring from 50mv/cm up to 20v/cm with an accuracy of ±5%. The rise-

time is 17ns and the bandwidth is dc or 3Hz to 20MHz, dependent on the setting of the dc/ac switch. The sweep speeds, which are calibrated, are 40ns/cm to 100ms/cm in 18 ranges.



the accuracy is ±5 percent and the sweep expansion is variable from x 1 to x 5. A solid-state preamplifier is an optional accessory and this increases the sensitivity from 50mv/cm to 50μv/cm. Both instruments have built-in voltage calibrators and the display may be triggered by an internal or external positive or negative signal. They can operate from their internal batteries or direct from a mains supply of 95v - 130v or 190v - 260v, 40 - 500 Hz. Optional accessories include an illuminated graticule projector, a rubber viewing hood, Y amplifiers and a probe attenuator kit. The EM101X is 9 in. high, 8½ in. wide and 15in. deep. EM101X price $665. S.E. Laboratories.

Volt-Ohm-Ammeter 715

A heavy current rotary scale snap-on volt-ohm-ammeter is introduced. Called Sperry Snap 9, model SPR-900A is a portable unit with new design. Current measurements, without interrupting service or shutdown, are taken by snap-on jaws. Instant and accurate readings are said to be presented on one scale at a time with 3

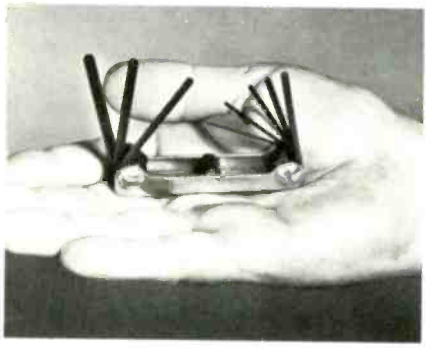
ET/D NEW PRODUCTS

percent accuracy. The meter comes in a grip-fast impact-proof plastic case. Other features include ball pivot jaw mechanism, full jaw opening to 1 21/32in. positive action range selector switch, pointer lock, inner case construction, advanced circuitry and component packaging. Nine ranges are available, 0-10/30/100/300/900a. 0-150/300/750v (self-contained) ac and a 25 Ω mid-scale. Weighing 20 oz, the meter comes with voltage test leads, heavy-duty carrying case, ohmprobe fused battery probe and illustrated operating instructions. Sperry.

Antenna Preamplifier 716

A new all-channel, antenna mounted preamplifier is introduced — the model ACP105L. The amplifier takes the output from a 300Ω antenna and feeds the signals through a 75 Ω cable downlead to the receiver. Frequency response is said to be flat to within ± 5db on any of the 82 TV channels. The unit takes advantage of weak signals by overcoming noise, pickup and downlead losses and is resistant to signal overload from nearby stations. The preamplifier has built-in shielding and circuit protection against lightning surges. Retail price $49.95. Jerrold.

Fold-Up Hex Key Tool 717



A mini-size fold-up hex key tool model 81 for a popular range of the smaller size socket screws is announced. The tool contains eight keys ranging in sizes .050 through 5/32 in., including the newer 7/64 and 9/64in. sizes. Key lengths are from 1 7/16 to 2⅜ in. while the over-all handle length is only 3in. Made from chrome nickel alloy steel, the wrenches are said to be hardened and tempered for maximum durability. Folding up similar to a jack knife, the wrench instantly snaps and locks into a right angle work position. Larger fold-up hex key tools are also available for other popular socket screw sizes.

Roof Tower 718

A complete line of HDT tripod roof towers designed especially for color TV, FM and HAM beam antenna installations is announced. Suitable for mounting on either peaked or flat roofs, the 1¼ in. o.d. tubular steel towers are desirable for the new, heavier, multiple element color TV antennas. Adjustable slides are featured to alter the tripod stance of each tower. This feature permits direct fastening of the tower legs to randomly spaced roof rafters. Another feature of the HDT towerline is the inclusion of pitch patches for each tripod foot. For faster installation a single locking screw and jam nut is used within each heavy-gauge embossed steel mast socket. Mast sockets suit-

able for masts up to 1½ in. o.d. Each tower is said to support a 10ft mast and antenna without guy wires. The 7½ and 10ft models of these towers have an added swing-lock mast socket

feature. This feature permits the placement of the antenna and mast into the mast socket from the side of the tower rather than over the top. The towers are available in either a hot-dip galvanized or gold and baked enamel finish. Sizes available are: 2, 2½, 3, 5, 7½ and 10 ft. South River.

Combination Scope 719

Announced is a new combination wide band scope and vectorscope. The company states that the model PS148 is the only scope on the market that can convert from a conventional wide band scope to a professional vectorscope with the flick of a switch. The

new scope is especially designed for the service shop but has application throughout the electronics industry. New vector patterns enable the service technician not only to view patterns at the chroma detector, but to align the chroma section of the color TV receiver as well. It can also be used to touch up the bandpass amplifier alignment with the use of any standard ten color bar generator. Other new features include even broader vertical amplifier frequency response to nearly 6MHz flat and new viewing hood. Price $219.50. Sencore.

ET/D NEWS OF THE INDUSTRY

Chamberlain Acquires Perma-Power

Chamberlain Mfg. Corp., Elmhurst, Ill., has completed the acquisition of Perma-Power Co., Chicago, it is announced by John A. Hurley, chairman of the board of Chamberlain. This is in accordance with an agreement reached last November. Perma-Power will function as a division of Chamberlain. No changes in management are contemplated.

Low Cost UHF Converters From RMS Electronics

A new low cost UHF converter, introduced by RMS Electronics, Inc., updates any standard VHF TV set to receive any of the 83 UHF and VHF Channels. The converter has a high gain, two-transistor solid-state circuit.

The RMS converter converts to UHF Channels 14-84 on either Channel 5 or 6, whichever is not used in area where installation is made. All connections of UHF and VHF antenna leads and set leads to the converter are simplified by using the screw terminals provided on the rear of the converter. An ac receptacle is also provided for the TV set power cord at the rear. An ON/OFF switch, UHF/VHF antenna selector and a UHF tuning control are conveniently positioned on the front panel of the converter.

Admiral Previews First 12 and 16in. Color Sets

The color TV industry's first 12 and 16in. portable models were previewed here by Admiral Corp. at a national distributors meeting. The Chicago-headquartered company also introduced its first 14in. portable color set.

One of the 16in. sets has wireless remote control, the first color portable in the industry offered with this feature. The multifunction remote control will permit adjustment of color and tint, as well as change stations, adjust volume and turn the set on and off.

Ross D. Siragusa, chairman of the board of Admiral, said that the new color tubes for portables will be manufactured by the company's tube division and will be made available to the rest of the TV industry.

He said the bonded 16in. tube will be priced to manufacturers at $82, while the 14in. tube will have a $77 price tag. Cost of the 12in. tube will be announced later, he added.

With the addition of these new color tube sizes to its line, Admiral will offer the most complete variety of color TV models in the industry — six sizes ranging from lightweight 12 in. portables to big screen 23in. receivers.

Mr. Siragusa said that several of the models in the company's new color TV line are priced under similar models introduced a year ago. For example, the new leader 23in. color console is priced at $469.95, including the three year warranty, while last year's leader model retailed for $499.95, with only the standard one-year warranty.

According to the latest industry statistics, distributor sales since the first of the year are 14 percent above last year's volume. The industry is projecting sales of 6,000,000 to 6,500,000 color sets this year.

Tracor Acquires Littelfuse

Tracor, Inc., scientific research and instrument manufacturing company, and Littelfuse, Inc., Des Plaines, Ill., manufacturer of electro-mechanical products, announce the closing of the plan of reorganization and agreement by which Tracor, Inc., has acquired substantially all of the assets and properties of Littelfuse, Inc.

The transaction involves the delivery of one share of Tracor, Inc., a 75-cent cumulative convertible voting preferred stock, for each two shares of Littelfuse, Inc. common stock.

Littelfuse, Inc., which will function as a Tracor subisidiary, is headed by Thomas M. Blake, chairman of the board, and Jack D. Hughes, president.

Headquartered in Austin, Tex., Tracor, Inc. has branches in nine states and the District of Columbia. It does scientific research in all of the disciplines and manufactures analytical, industrial and medical instruments.

Markel Named Advertising Manager of V-M Corp.

Kenneth E. Markel has been named advertising manager of V-M Corp., Benton Harbor, Mich., it was announced by M. B. (Bud) Cain, marketing manager. Robert L. Stevens, staff assistant at V-M Corp. for the past three years, was appointed assistant advertising manager, reporting to Mr. Markel.

Prior to joining V-M's corporate staff, Mr. Markel was manager of marketing services for National Homes Corp., held a similar position with Brunswick Corp., and held a series of assignments in sales, account service and creative work in the advertising agency field and broadcast media.

In his new capacity Mr. Markel

New Dual Purpose
OSCILLOSCOPE/VECTORSCOPE

PS148

NOW — YOU CAN HAVE BOTH IN ONE INSTRUMENT:

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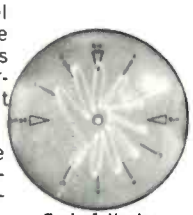
- **A PROFESSIONAL 5-INCH VECTORSCOPE**

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

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



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HELPFUL TUNER SERVICE TIPS INSIDE EACH CARTON!

A valuable booklet on repair and servicing written by one of the world's largest tuner manufacturers is packed with each kit.

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ET/D NEWS OF THE INDUSTRY

will have complete advertising and promotional responsibility for V-M's "Voice of Music" consumer lines of fine stereo phonographs, tape recorders and Hi Fi components. He will also handle the special development programs required for expanding premium and military markets and audio visual product sales in the educational field.

Wanted by FBI

Stanley Elmer Butler, also known as Stanley Edward Butler, Stanley Butler, Earl Day Burger, Earl Dayburger and "Stan" is a fugitive of the Federal Bureau of Investigation. Mr. Butler allegedly defrauded a bank concern in Brunswick, Ga., of several hundred dollars in 1964. He has been employed as a TV repairman, serviceman, or electronics technician in Georgia, Florida and Texas.

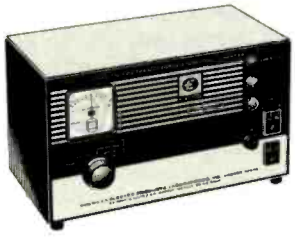
On May 11, 1965, he was indicted by a Federal Grand Jury in Savannah, Ga. Mr. Butler failed to appear for his trial at the U.S. District Court in Savannah and a warrant for his arrest was issued.

The following is a description of Mr. Butler:

Sex	Male
Race	White
Date of Birth	4-27-25
Place of Birth	Bayshore, N.Y.
Height	6ft
Weight	140 lb. (April 1965)
Eyes	Brown
Hair	Brown
Scars and Marks	12in. scar at center of abdomen
Education	12th grade
Military Service	U.S. Navy
Social Security No.	111-52-38
Last known address	Gulfport, Miss.

Anyone knowing of his whereabouts should immediately contact the nearest FBI office. Telephone numbers for FBI offices may be located on the first page of your local telephone directory.

NEW ELECTRO DUAL PURPOSE INVERTER/CHARGER DELIVERS 620 VA OUTPUT



- FUSE OVERLOAD PROTECTION
- AUTOMATIC SHUT-OFF FOR LOW BATTERY VOLTAGE
- POSITIVE REVERSE POLARITY PROTECTION

The new ELECTRO TIC-620 inverter delivers a 620 VA output (120 volts, 5 amp nominal), from a 12 volt battery. It includes a built-in 25 amp charger. Thus the same unit is used to recharge its DC input source. A three position switch provides low, medium and high charge rates.

An automatic shut-off protects both inverter and battery from damage when battery voltage decreases to 10.5 volts.

Positive reverse polarity protection is provided so no damage will result if positive-negative terminals are reversed.

Voltage regulated 60 Hertz square wave output is *frequency stable to ± 0.5 Hertz!*

TI-620 INVERTER ONLY

A model TI-620, without the built-in charger, is also available at a reduced cost. Other specifications are identical to the TIC-620.

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ADVANCED COLOR TV

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A comprehensive training plan for the man who already has a knowledge of monochrome circuits and wants to quickly add Color TV servicing to his skills. DEFINITELY NOT FOR BEGINNERS. It picks up where most other courses leave off — giving you "hands on" experience as you build the only custom Color TV set engineered for training. You gain a professional understanding of all color circuits through logical demonstrations never before presented. The end product is your own quality receiver.

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City _____ State _____ Zip _____

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ET/D NEWS OF THE INDUSTRY

FTC Issues Trade Regulation On Radio Transistor Count

The Federal Trade Commission has promulgated a trade regulation rule regarding deception as to transistor count of radio receiving sets, including transceivers or so-called walkie-talkies. The rule becomes effective Dec. 10, 1968.

The rule provides that "it is an unfair method of competition and an unfair and deceptive act or practice to represent directly or by implication, that any such radio sets contain a specified number of transistors when one or more of such transistors: (1) are dummy transistors, (2) do not perform the recognized and customary functions of radio set transistors in the detection, amplification and reception of radio signals, or (3) are used in parallel or cascade applications which do not improve the performance capabilities of such sets in the reception, detection and amplification of radio signals. It was provided, however, that nothing in this rule would be construed to prohibit, in connection with a statement as to the transistor count (computed without inclusion of transistors which do not perform the functions of detection, amplification and reception of radio signals), a further statement to the effect that the sets in addition contain one or more transistors acting as diodes or performing auxiliary or other functions when such is the fact (e.g., '6 transistors plus one diode')."

The record shows that marketers of radios, especially the less expensive imported sets, have included in the transistor count computation transistors which fall within the three categories prohibited by the rule, the commission said.

Start Appointed Altec Sales Manager for Texas

Raymond W. Start has been appointed Altec regional sales manager for Texas, New Mexico, Oklahoma and southern Louisiana, according to an announcement by William H. Johnson, director of marketing for Altec Lansing of Anaheim, Calif.

Prior to joining Altec Lansing, Mr. Start served as vice president of Railroad Electronics Laboratories of Omaha, Inc., Omaha, Nebr., an Altec sound contractor.

GBC Closed Circuit TV Firm Names Solotoff National Sales Manager

Appointment of Irv Solotoff as national sales manager of GBC Closed Circuit TV Corp., New York, N.Y., was announced recently by Harry Lefkowitz, president of the firm.

Mr. Solotoff, an industry veteran, will direct the company's national sales organization. He brings to GBC extensive experience in the electronics and closed circuit TV fields. He was formerly associated with Blonder-Tongue Laboratories, Newark, N.J., Alpha Metals and Accurate Specialties.

Blystone Appointed Concord Advertising and PR Manager

Concord Electronics Corp. has announced the appointment of Lee Ann Blystone as advertising and public relations manager. Miss Blystone joined Concord in February 1967 as public relations coordinator.

Concord markets a complete line of audio tape recorders and home entertainment systems through its consumer

products division. Video tape recording systems and associated closed circuit television equipment are marketed by Concord Communications Systems.

IRC Announces Marketing And Sales Appointments

IRC, a division of TRW Inc., has appointed Felix T. Troilo as director of marketing, Michael A. Gallucci to field sales manager and Charles P. Boinske to pricing and contracts manager.

Mr. Troilo was formerly manager of product planning, Mr. Gallucci, Chicago district sales manager, and Mr. Boinske, senior pricing analyst.

In announcing the appointments, Stephen J. O'Connor, IRC director of sales and marketing, commented, "These appointments make IRC more responsive to the demands of its customers. These men have been associated with the company and the industry for many years and are familiar with IRC's product lines and customer requirements." Mr. O'Connor pointed out that all these appointments had been from within the company.

Shepherd Elected President of Electronic Industries Assn.

Mark Shepherd, Jr., who in two decades rose from project engineer with Texas Instruments Inc. to president of the Dallas-based firm, has been elected president of the Electronic Industries Assn.

Mr Shepherd was unanimous choice of the board of directors of the national trade association for electronics manufacturers at annual elections during EIA's 44th convention here. He succeeds two-term president, Robert W. Galvin, chairman of the board and chief executive officer, Motorola, Inc.

ET/D CATALOGS & BULLETINS

Home Study Program 401

The Home Study Division of McGraw Hill offers a home study program in electronics to men who work in the electronic industry. These programs, which are prepared and kept up to date with the help of more than 70 leading engineers and scientists, provide specialized education in every major area of electronics. Write for free descriptive book: How To Prepare For Tomorrow's Job In Electronics. CREI, McGraw Hill.

Microphones 402

A 16-page technical publication details the design and construction of various types of microphones and their correct application. Altec Lansing.

Measuring Instruments 403

A 50-page illustrated catalog describes a new line of electronic measuring apparatus. It lists oscilloscopes, multimeters, pulse generators, transistor curve tracers, low frequency measuring systems and instrumentations. Norelco.

Electrical Tapes 404

An eight-page brochure contains 25 photographs and a brief text which describes the many applications suited for electrical tape use. A variety of holding, strapping, protecting, insulating and masking applications are shown in the photos. Specific types of tape are also suggested for each job. Permacel.

SEMICONDUCTORS . . .

Continued from page 49

one lead of the thyrector (shown in Fig. 12 as just two open terminals) with a voltage (V_b) equivalent to the triac's unloaded gate voltage.

Since resistors R_2 and R_3 are equal, the voltage at terminal 4 (V_b) is half the applied voltage (V_s). This voltage at terminal 4 (V_b) is compared in Fig. 14 with voltages that may be present at terminal 3 (V_a) when there are various resistances (R_1) in series with the capacitor (C_1). (The various curves for V_a are the same in both Fig. 13 and 14. In Fig. 14, V_b has been substituted for V_s, shown in Fig. 13. $V_b = \frac{1}{2} V_s$.)

From Fig. 14 we see that with the

larger value of resistor R_1 required for producing voltage V_{a3}, the positive voltage at terminal 3 (V_{a3}) is greater than the positive voltage at terminal 4 (V_b) during about 20 percent of the time that the terminal 4 voltage (V_b) and supply voltage (V_s) are positive. (The negative voltage at terminal 3 is also greater than the negative voltage at terminal 4 during about 20 percent of the time the supply voltage is negative.) As the resistance (R_1) is reduced to produce terminal 3 voltage V_{a2}, V_{a1} and then V_{a0}, this percentage increases to about 40 percent, about 60 percent and then about 100 percent.

The thyrector in Fig. 11 functions as a switch to reduce the flow of current between the capacitor-time-constant circuit and the triac gate. When the difference between the capacitor voltage (V_a) and the triac-gate voltage (V_b) is greater than the thyrector breakdown voltage ($V_{a0}-V_b$, $V_{a1}-V_b$, and $V_{a2}-V_b$ are greater than the breakdown voltage while $V_{a3}-V_b$ in Fig. 14 is not), the thyrector is switched to an ON condition. Current then flows through the thyrector and switches the triac on for the remaining portion of the positive or negative half cycle of the applied voltage (V_s).

The curves in Fig. 13 and 14 show the capacitor voltage (V_a) when no thyrector is included in the circuit. When the thyrector is in the circuit, the current it conducts reduces the capacitor voltage to zero each time the breakdown voltage is exceeded.

By changing the resistance (R_1) in series with the capacitor (C_1), we are able to vary the portion of each cycle that the triac conducts current — controlling the average ac current and power applied to a load circuit.

At zero resistance ($R_1=0$), the triac is turned on at the beginning of each half cycle and an ac current is continually applied to the load circuit. Increasing the resistance (R_1) reduces the portion of each cycle that the triac is on and the average ac current applied to the load circuit. However, when the resistance (R_1) becomes too large, the capacitor voltage (V_a) is no longer sufficient to breakdown the thyrector and turn the triac on. This limits the control range of this circuit (Fig. 13).

The next article in this series will describe ac-to-dc and dc-to-ac power conversion and related regulating circuits. ■

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