ELECTRONIC TECHNICIAN / DEALER

WORLD'S LARGEST ELECTRONIC TRADE CIRCULATION

FEBRUARY 1968

MATV SYSTEMS

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THE TWO-WAY RADIO BUSINESS

B&K MODEL 970 TRANSISTOR EQUIPMENT ANALYST

SERVICE AM & FM AUTO & TRANSISTOR EQUIPMENT AT A PROFIT!

Jobs that used to be unprofitable now go so quickly that you can make good money handling them! There are millions of auto radios and transistor radios in the field—portables, auto and table models, plus hi-fi and communications equipment. Instead of turning them away, you can turn them into money-makers with the B&K Model 970 Radio Analyst.

The 970 is effective because it's *accurate* and *complete*. Using the famous B&K signal injection technique, this all-in-one instrument provides the required dc power, lets you test power and signal transistors in and out of circuit; generates RF and audio signals, and includes a rugged, accurate VOM. Four functions in one compact package—with solid state reliability, B&K professional quality.

LOW INVESTMENT—QUICK RETURN

See your B&K Distributor or write for Catalog AP22-R

Net $199.95

FEATURES:

BUILT-IN POWER SUPPLY

Auto Radios—High current, low-ripple, for transistor, hybrid, and vibrator types.

Transistor Portables—1½ to 12 volts for battery substitution—plus separately variable voltage tap for bias.

QUICK AND ACCURATE TESTING OF POWER AND SIGNAL TRANSISTORS

In-Circuit—stage by stage DC signal injection and sensitive metering of power supply current.

Out-of-Circuit—Direct Beta and Leakage meter scale readings. Easy balancing or matching.

VERSATILE SIGNAL GENERATORS

RF Generators—provide broadcast and IF frequencies for both AM and FM bands.

Audio Generator—for AM or FM modulation of the RF signals, and for trouble-shooting audio circuits.

RUGGED VOM

Volt-OHM-Milliammeter—with rugged, taut band meter—provides correct ranges for easy, fast servicing of all home and auto radios, as well as transistor portables.

B&K

B & K DIVISION OF **DYNASCAN**

1801 W. BELLE PLAINE AVE. • CHICAGO, ILL. 60613

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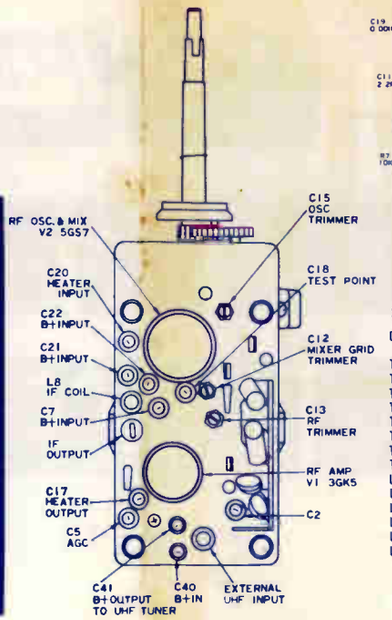
. . . for more details circle 101 on postcard

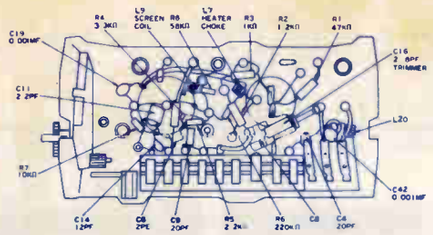
ELECTRONIC
TECHNICIAN / DEALER

TEKFAX

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

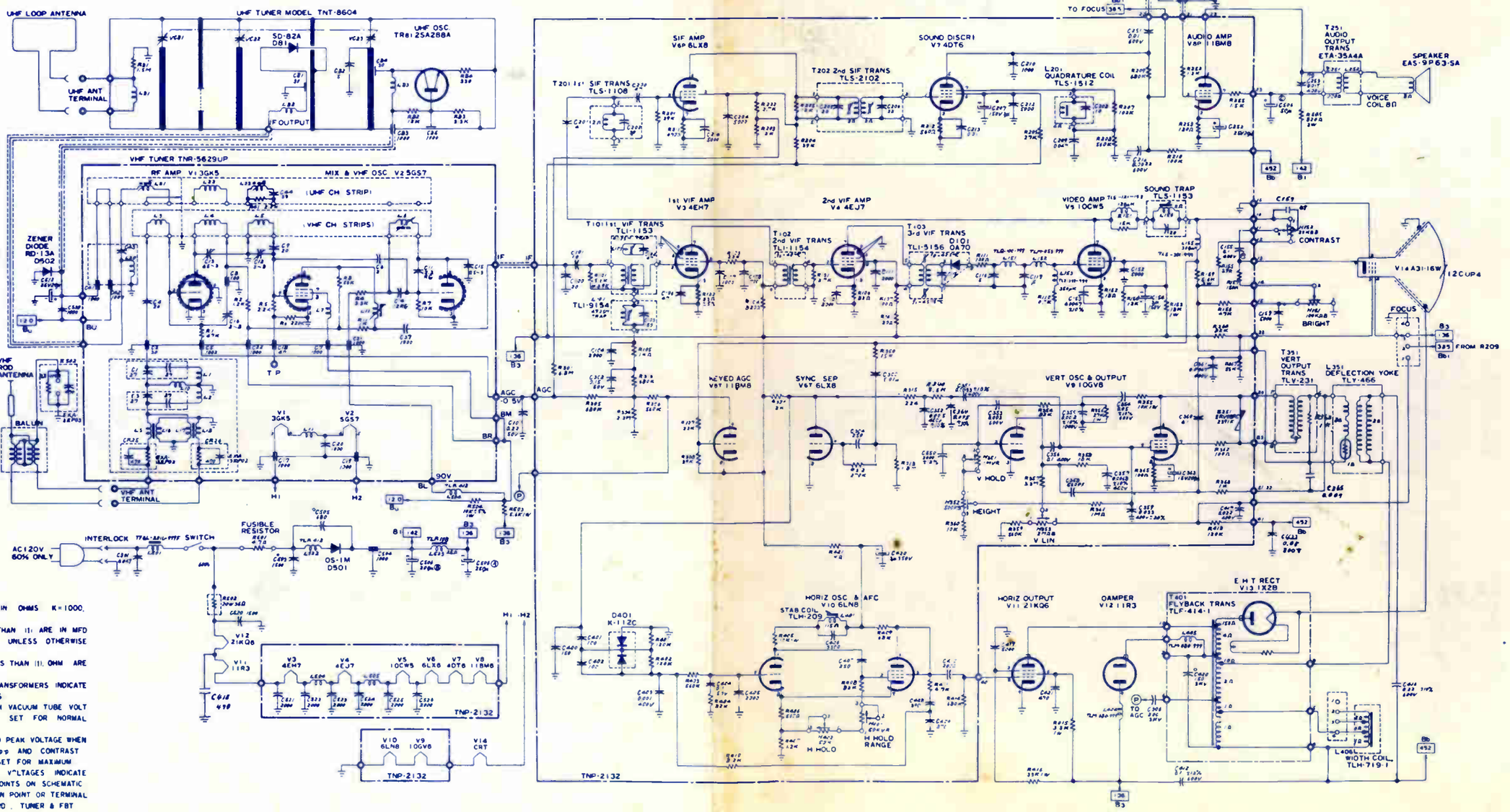
GROUP 186





VHF TUNER

SYMBOL	DESCRIPTION	PACKARD BELL PART NO.
D401	phase discriminator, diode	TVM-K-112C
	XFORMERS & COILS	
T101	1st VIF xformer	TLI-1153
T102	2nd VIF xformer	TLI-1154
T103	3rd VIF xformer	TLI-5156
T201	1st SIF xformer	TLS-1108
T202	2nd SIF xformer	TLS-2102
T251	audio output xformer	ETA-35A4A
T351	vert output	TLV-231
T401	flyback xformer	TLF-414-1
L101	47.25MHz trap coil	TLI-9154
L156	4.5MHz trap coil	TLS-1153
L201	quad coil	TLS-1512
L152	peaking coil	TLM-053-999
L153	peaking coil	TLE-351-999
L351	deflection yoke	TLY-466
L401	horiz stab coil	TLH-209
L501	filter	TPQL-201D999F
L502	filter	TLP-412
L503	filter choke	TLP-108
L504	heater choke	TLP-407
	RESISTORS	
R159	5.6K 3w, metal oxide	ERG-3P5K562
R355	10K, ±10% 1w carbon film	ERD-1PZK103
R356	27K ±10T 1w carbon film	ERC-1PZK273
R501	4.7Ω 4w fusible resistor	ERU-4P4R7
R502	18Ω 6w WW	ERM-6P180
	CONTROLS	
H151	100K bright	EVV-M0AL26B15
H152	20K contrast	EVE-D0AL26B24
H251	1M volume	EVC-B0BL26A16
H351	1M, vert hold	EVD-06AS20B16
H352	500K, vert linearity	EVT-V0A00B55
H353	2M, height	EVT-V0A00B26
H401	50K, horiz hold range	EVT-V0A00B54
H402	50K, horiz hold	EVD-06AS20B54
Z351	varistor	EVR-08RC3391K
	CAPACITORS	
C506A	250μf elect	ECE-M175HBX1Z
B	200μf elect	
C	59μf elect	
	C-R COMBINATIONS	
Z501		EXA-3ZP03
Z502		EXA-3ZP03



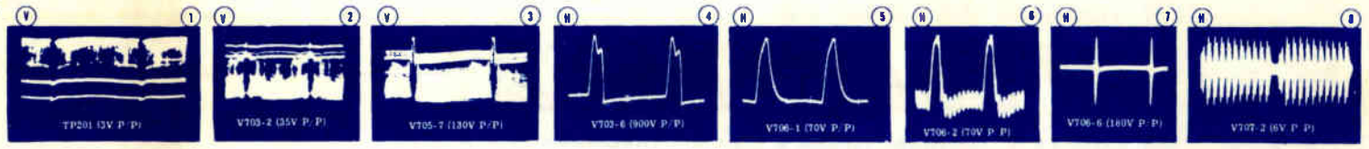
(NOTES)
1. RESISTANCES ARE SHOWN IN OHMS K=1000, M=1,000,000
2. CAPACITANCE VALUES LESS THAN 1 ARE IN MFD AND MORE THAN 1 IN MMFD UNLESS OTHERWISE NOTED
3. COIL RESISTANCE VALUES LESS THAN 1 OHM ARE NOT SHOWN
4. NUMERALS AT CONTROLS, TRANSFORMERS INDICATE NUMBER OF THOSE TERMINALS
5. D.C VOLTAGES ARE READ WITH VACUUM TUBE VOLT METER AND ALL CONTROLS SET FOR NORMAL PICTURE, NO SIGNAL INPUT
6. ALL WAVEFORMS ARE PEAK TO PEAK VOLTAGE WHEN VIDEO INPUT IS SET TO 5Vpp AND CONTRAST BRIGHTNESS CONTROLS ARE SET FOR MAXIMUM
7. NUMERALS BESIDE SUPPLY VOLTAGES INDICATE NUMBER OF THOSE SUPPLY POINTS ON SCHEMATIC
8. MARKS '—●—' INDICATE JUNCTION POINT OR TERMINAL OF THE PRINTED CIRCUIT BOARD, TUNER & FBT

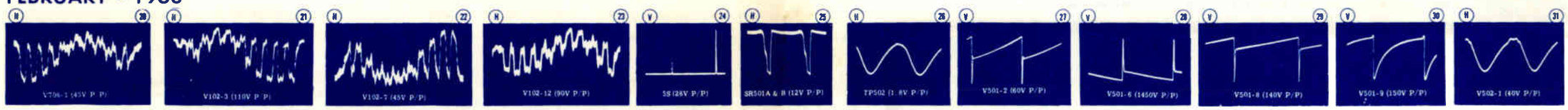
1135
MAGNAVOX
Color TV Chassis
T924 Series

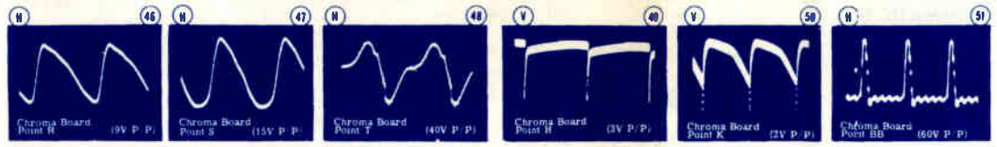
ELECTRONIC TECHNICIAN / DEALER **TEKFAX**

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

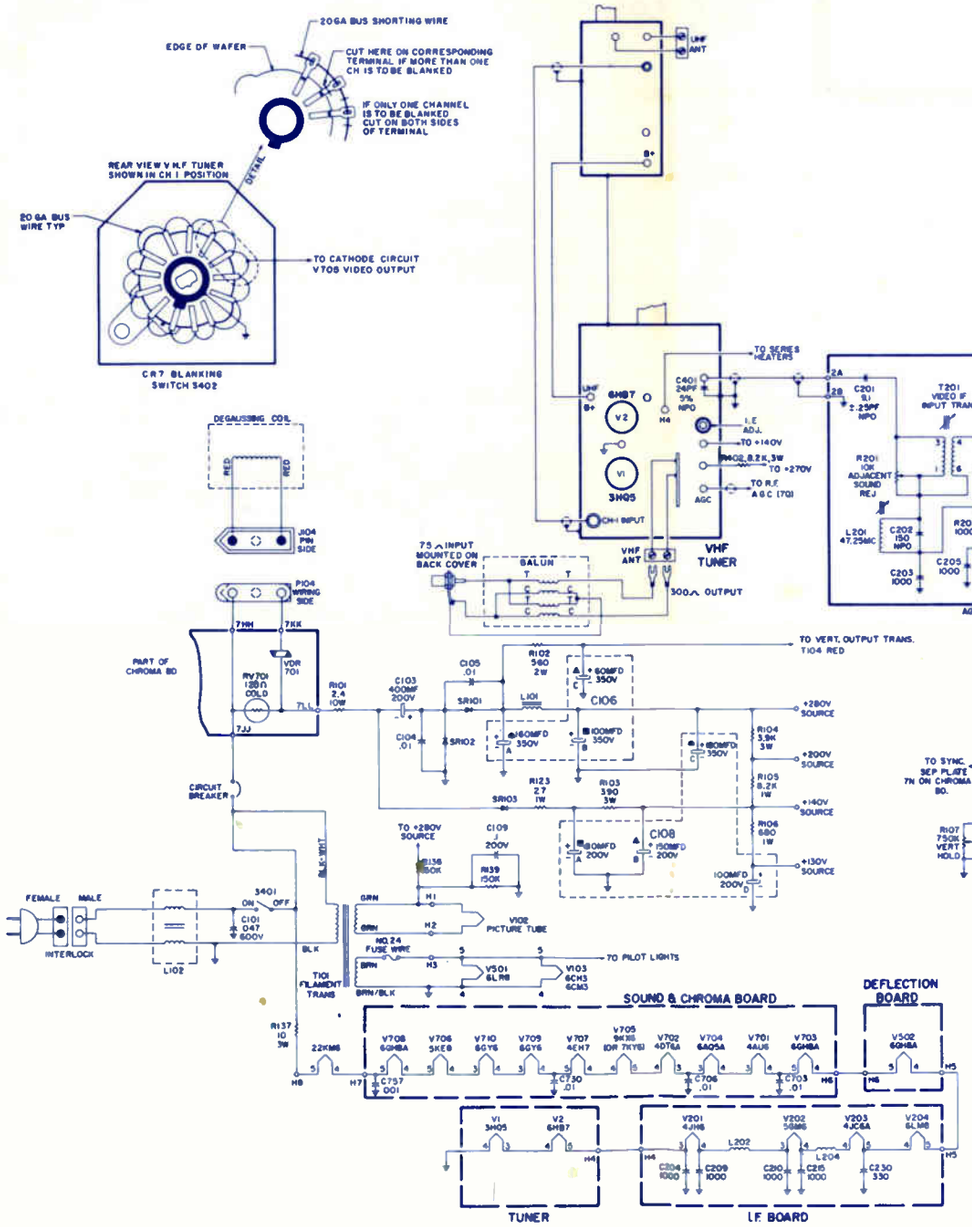
FEBRUARY • 1968



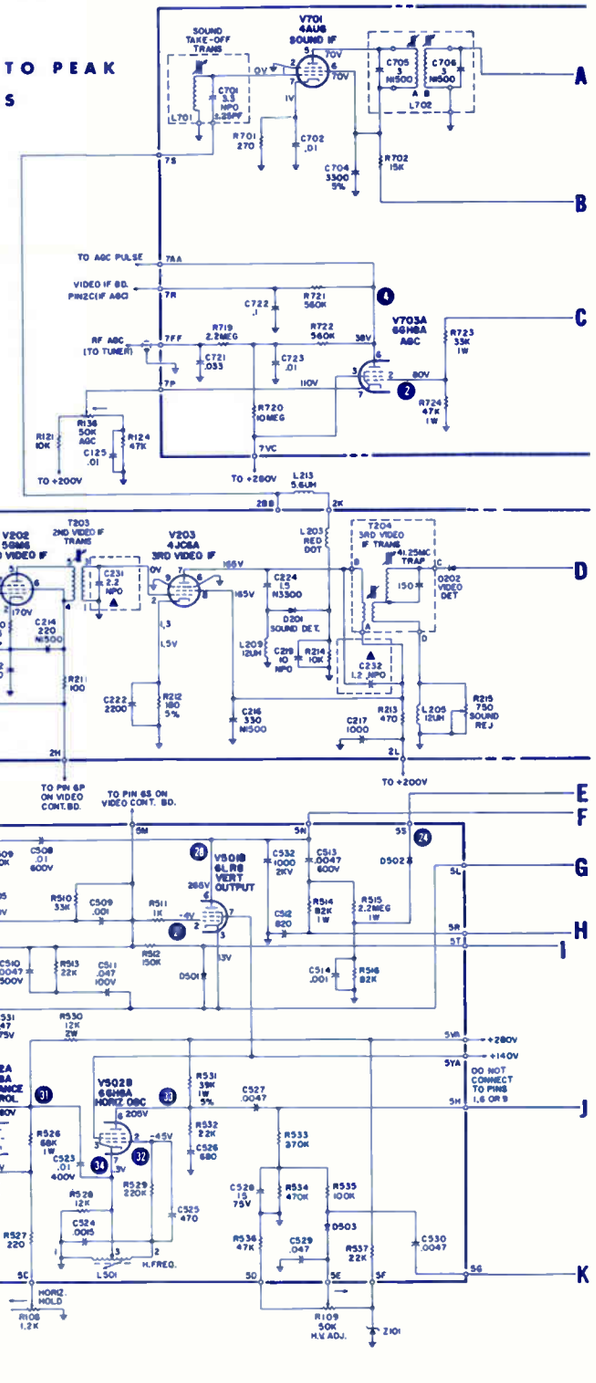




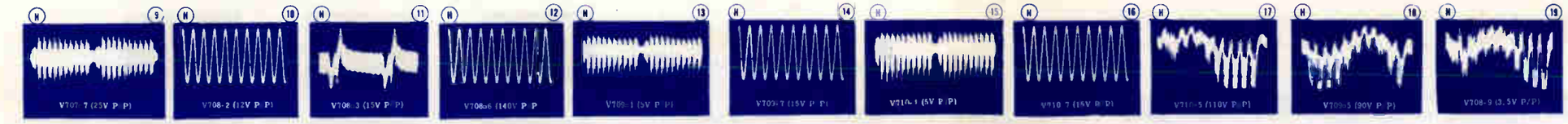
SYMBOL	DESCRIPTION	MAGNAVOX PART NO.
	XFORMERS & COILS	
T101	filament xformer	320339-1
T102	HV xformer	361267-2
T103	focus xformer	361240-2
T104	vert output xformer	320317-3
T105	audio output xformer	320130-4
T201	IF input xformer	360951-1
T202	IF xformer	360951-6
T204	IF xformer & 41.25MHz trap	360953-2
T701	bandpass xformer	361192-1
T702	burst xformer	361296-1
T703	3.58MHz output xformer	361198-1
L101	reactance choke	320124-1
L102	line filter	361250-1
L104	100µh peaking coil	361091-5
L105	5.6µh choke	360676-5
L206	4.5MHz trap	360953-2
L211	tweet choke	360852-7
L214	177MHz tweet choke	360852-5
L501	horiz frequency coil	361269-1
L701	sound take-off coil	360845-2
L702	sound IF coil	360846-3
L703	quad coil	360847-2
L707	150µh peaking coil	360853-5
L713	620µh peaking coil	360853-11
L717	chroma take-off coil	360959-4
L801	r/g master amplitude coil	361092-1
L804	horiz blue tilt coil	361188-1
L805	blue master amplitude coil	361092-5
	degaussing coil (2 used)	361266-3
	deflection yoke	361290-402
	CAPACITORS: 20%, 500v unless noted otherwise	
C106	160/100/60µf, 350v, elect	270071-9
C108	80/150/100µf, 200v, 180µf, 350v, elect	270071-10
C113	68pf, 10% 4kv (N1500) cer	250475-24
C118	130pf, 6kv (N220) cer	250475-11
C120	1kpf, 2kv (N3300) cer	250475-37
C121	33pf, 5% 500v (N750) cer	250470-3305
C401	24pf, 5% (NPO), cer	250508-2405
C705	3pf, 10% (N1500) cer	250529-3099
C711	18pf, 5% (N150) cer	250527-1805
C743	3-12pf, cer trimmer	250371-4
	RESISTORS: 10% ½w unless noted otherwise	
R101	2.4Ω, 10w WW	240082-11
R117	66M (6kv breakdown)	230161-1
R137	10Ω 3w glass	230193-1009
R402	8.2K, 3w glass	230150-340
R606	6.8K 2w glass	230160-72
R617	5.6K, 4w	230150-436
R726	10K, 3w (glass)	230150-342
	CONTROLS	
R107	750K, vert hold	220146-50
R108	1.2K, horiz hold	220146-71
R109	50K, HV adjust	220208-42
R126	10Ω, 2w, vert centering	220181-10
R127	600Ω, sharpness	220146-29
R128	1M, color killer	220208-45
R130	600Ω, contrast	220146-29
R135	200K, crt bias	220208-44
R136	50K, agc adjust	220208-43
R140	3M, tone	220146-26
R201	10K, adj sound rejection	220182-1
R215	750Ω, sound rejection	220166-4
R401	1M, off/on/vol (T924-01)	220135-12
R401	1M, off/on/vol (T924-02)	220126-6
R403	2.5K, color	220232-4
R404	250K, bright	220126-82
R405	2.5K tint	220232-4
R605	6K blue drive	220166-15
R611	1.5M, blue screen	220166-17
R616	5M, height	220166-22
R804	120Ω, master tilt	220167-6
R814	60Ω, r/g master tilt	220167-3
	SEMICONDUCTORS	
CR101	focus rectifier	530132-1
Z101	zener diode	530073-16
D201	video det diode	530065-2
D202	sound det diode	530065-2
D503	horiz regulation diode	530113-1
D701	color killer bias diode	530065-2
	MISCELLANEOUS	
TD101	delay line	360949-5
SG701	spark gap	180832-3
RV701	thermistor	230170-2
VDR701	varistor	230175-2
	circuit breaker	180723-2
	VHF tuner (T924-01)	340131-1
	VHF tuner (T924-02)	340111-1
	UHF tuner	340087-5

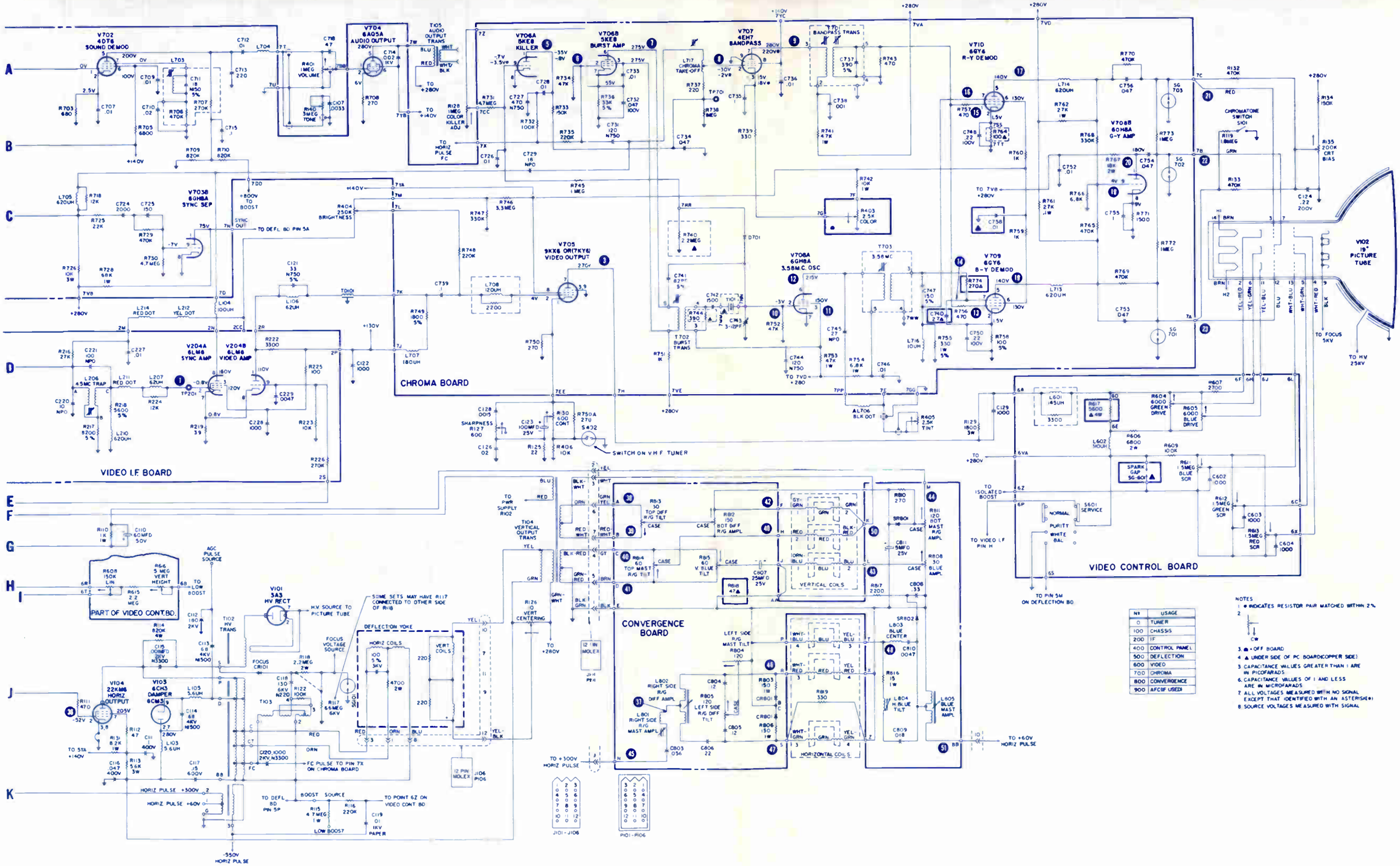


WAVE-FORM & PEAK TO PEAK VOLTAGES



MAGNAVOX
Color TV Chassis T924 Series





No.	USAGE
0	TUNER
100	CHASSIS
200	IF
400	CONTROL PANEL
500	DEFLECTION
600	VIDEO
700	CHROMA
800	CONVERGENCE
900	AFC&F USED

NOTES
1. ● INDICATES RESISTOR PAIR MATCHED WITHIN 2%
2. CW
3. ■ = OFF BOARD
4. ▲ UNDER SIDE OF PC BOARD(COPPER SIDE)
5. CAPACITANCE VALUES GREATER THAN 1 ARE IN PICOFARADS
6. CAPACITANCE VALUES OF 1 AND LESS ARE IN MICROFARADS
7. ALL VOLTAGES MEASURED WITH NO SIGNAL EXCEPT THAT IDENTIFIED WITH AN ASTERISK(*)
8. SOURCE VOLTAGES MEASURED WITH SIGNAL

1136

RCA VICTOR
Color TV Chassis
CTC28 Series

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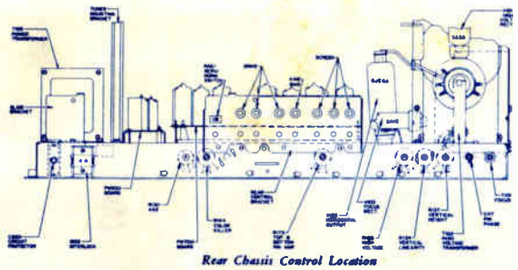
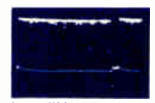
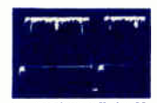
FEBRUARY • 1968



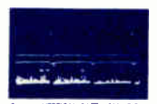
Rear Chassis Control Location



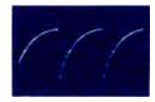
1 VERTICAL RATE 3V P-P
2ND DETECTOR TEST POINT



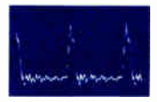
2 HORIZONTAL RATE 3V P-P
2ND DETECTOR TEST POINT



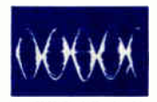
3 VERTICAL RATE 5V P-P
V304B 6LF8-2
2ND VIDEO AMP. GRID



12 HORIZONTAL RATE 200V P-P
V105 6JE6-2, 6
HORIZONTAL OUTPUT GRID



13 HORIZONTAL RATE 250V P-P
T102-U (AFC REFERENCE AND CONVERGENCE PULSE)



14 HORIZONTAL RATE 40V P-P
(117-A (GROUND POINT B178-2)
TOP AND BOT. PIN AMP.

MODEL AND CHASSIS CROSS REFERENCE

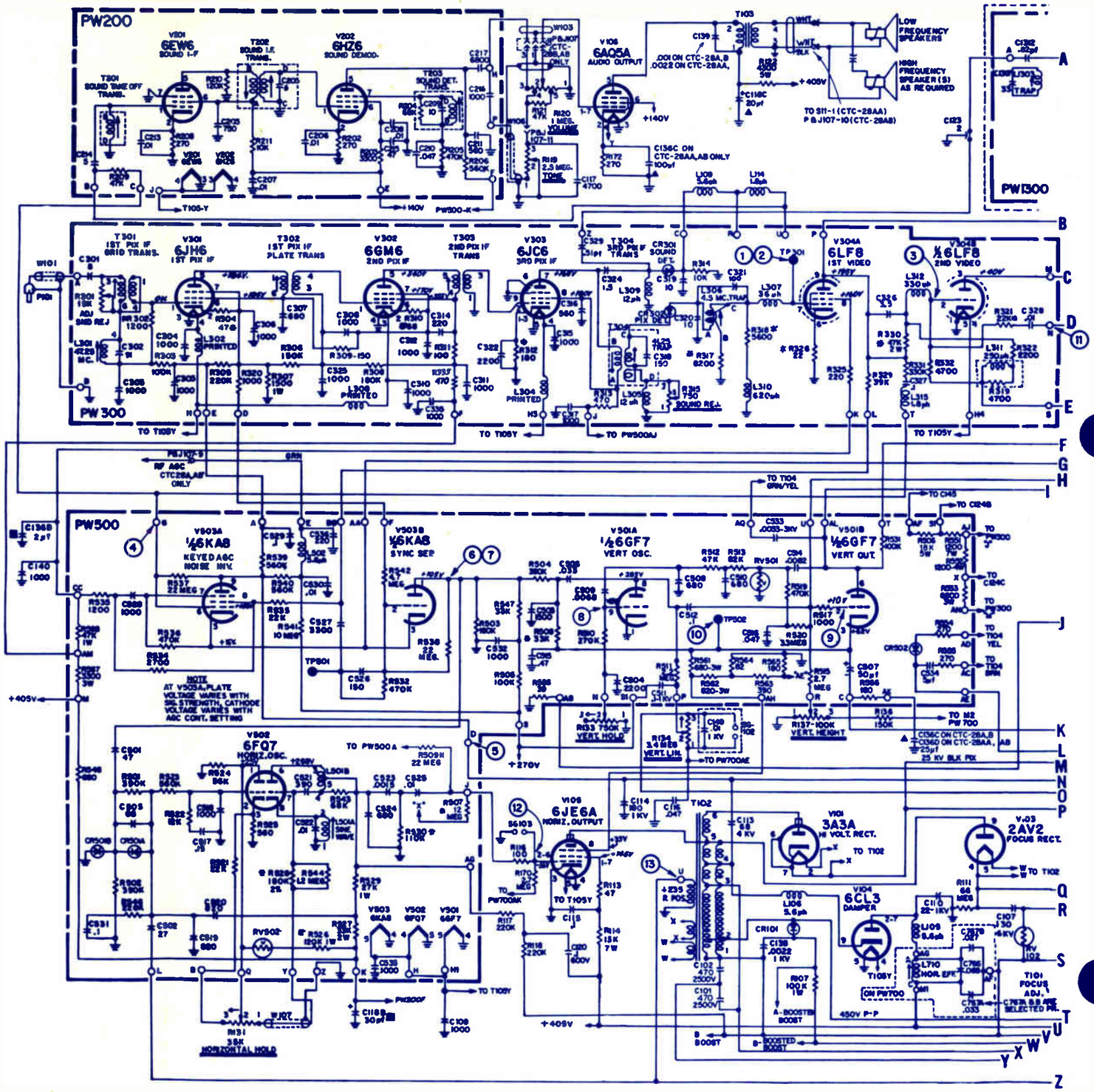
Model	Name	Chassis	TMA	Tuner	Picture Tube	Remote	Speaker
GJ-733M, W	"DRISCOLL"	CTC28A	502A	KRK131B/132JA, KA, LA	25XP22		2-4" x 6"
GJ-737M, W, S	"CHATFORD"	CTC28A	502A	KRK131B/132JA, KA, LA	25XP22		2-4" x 6"
GJ-741W	"TONSBERG"	CTC28A	502A	KRK131B/132JA, KA, LA	25XP22		2-4" x 6"
GJ-741WR	"TONSBERG"	CTC28B	503A	KRK131C/132JA, KA, LA	25XP22	CRK10A CTP12A-C	2-4" x 6"
GJ-745L, N	"HANCOCK"	CTC28A	502A	KRK131B/132JA, KA, LA	25XP22		2-4" x 6"
GJ-745LR, NR	"HANCOCK"	CTC28B	503A	KRK131C/132JA, KA, LA	25XP22	CRK10A CTP12A-C	2-4" x 6"
GJ-749W, F, Y	"DUMAS"	CTC28A	502A	KRK131B/132JA, KA, LA	25XP22		2-4" x 6"
GJ-753S	"LINARES"	CTC28A	502A	KRK131B/132JA, KA, LA	25XP22		2-4" x 6"
GJ-753SR	"LINARES"	CTC28B	503A	KRK131C/132JA, KA, LA	25XP22	CRK10A CTP12A-C	2-4" x 6"
GJ-795WK	"STOCKHOLM"	CTC28A	502A	KRK131B/132JA, KA, LA	25XP22		2-4" x 6"
GJ-795WRK	"STOCKHOLM"	CTC28B	503A	KRK131C/132JA, KA, LA	25XP22	CRK10A CTP12A-C	2-4" x 6"
GJ-797LK, NK	"BENNINGTON"	CTC28A	502A	KRK131B/132JA, KA, LA	25XP22		2-4" x 6"
GJ-797LRK	"BENNINGTON"	CTC28B	503A	KRK131C/132JA, KA, LA	25XP22	CRK10A CTP12A-C	2-4" x 6"
GJ-798FK, SK	"VINCENNES"	CTC28A	502A	KRK131B/132JA, KA, LA	25XP22		2-4" x 6"
GJ-801SK	"GALICIA"	CTC28A	502A	KRK131B/132JA, KA, LA	25XP22		2-4" x 6"

The letter following the third numeral designates the cabinet finish as follows: F—ANTIQUED PROVINCIAL FRUITWOOD, H—HEIRLOOM PINE, L—ANTIQUED COLONIAL MAPLE, M—AUTUMN MAHOGANY, S—ANTIQUED MISSION PECAN, W—NATURAL WALNUT (GJ753W, GJ737W) DANISH WALNUT (GJ741W, GJ795WK) ANTIQUED LIGHT WALNUT (GJ749W), Y—ANTIQUED BRUSHED PARCHMENT WHITE. The letter "K" following the model number indicates a custom model.

SYMBOL DESCRIPTION	RCA PART NO.
C118 — 4 section elect	114001
A — 80µf 450v	
B — 30µf 450v	
C — 20µf 450v	
D — 40µf 150v	
C124 — 4 section elect	112827
A — 80µf 450v	
B — 20µf 250v	
C — 50µf 450v	
D — 50µf 50v	
C136 — 3 section elect	115869
A — 80µf 450v	
B — 25µf 25v	
C — 2µf 350v	
C139 — 1000pf ±10% 3kv cer	120696
C316 — 560pf ±5% 500v cer N1500	109142
C319 — 10pf ±0.5pf 500v cer NPO	
C503 — 68pf ±10% 500v cer NPO	109232
C507 — 50µf 150v elect NP	109227
C521 — 390pf ±5% 1.5kv cer N1500	109806
C524 — 680µf ±5% 500v mica	218468
C533 — 3300pf ±10% 3kv cer	120347
C534 — 5µf 10v elect NP	115868
C709 — 4pf ±0.5pf 500v cer NPO	105247
C714 — 330pf ±5% 500v mica	79191
C723 — 15pf ±10% 500v cer NPO	109316
C724 — 82pf ±10% 500v cer NPO	105246
C728 — 200pf ±5% 500v mica	922153
C740 — 330pf ±5% 500v mica	79191
C759 — 1000pf ±20% 1kv cer	105778
C767A — 0.033µf 600v, 0.027µf 600v paper, matched pair	121576
C767B — 0.033µf 600v, 0.027µf 600v, paper, matched pair	121576
C805 — 0.1µf ±10% 100v mylar	119383
C1311 — 15pf ±5% 500v cer NPO	109316
CB101 — breaker-circuit 1.75a	113950
DIODES	
CR101 — 800 PIV at 2ma	113391
CR201 — 1N3195	113998
CR301 — sound det	112524
CR302 — pix det	112524
CR502 — 1N3194	113998
CR1301 — 1N60	112524
CR1304 — zener	119594
DL101 — line-delay	119593
FW101 — fuse-wire #26	102792
COILS	
L105 — 5.6µh	109171
L107 — filter	112829
L108 — 72µh	77842
L110 — 5.6µh	116643
L114 — 1.8µh	109248
L116 — filter choke	117526
L117 — pin phase	114594
L301 — 47.25MHz trap	115844
L305 — 12µh	105308
L306 — 4.5MHz	105295
L307 — 36µh	101819
L310 — 620µh	113404
L311 — 250µh	100298
L312 — 330µh	113280
L501 — horiz frequency	112866
L701 — chroma take off	119592
L702 — reactance control	112874
L704 — 620µh	109257
L710 — horiz efficiency	114596
L712 — 82µh	117535
L801 — right vert red/grn lines	114597
L802 — right red/green horiz lines	114598
L1301 — 45.75MHz trap	119599
L1305 — disc 45.75MHz	119601
PW500 — circuit-printed deflection (less tubes)	122357
PW700 — circuit-printed chroma (less tubes)	122110
Q1301 — transistor-2473	116080
Q1302 — transistor-3526	119636

RESISTORS: ±10% ½w composition unless otherwise noted

R106 — 1.5M 1w, matched pair	109235
A — 1.5M 1w, matched pair	
B — 1.5M 1w, matched pair	
R111 — 66M, 6kv	114651
R114 — 15K ±5% 7w	121492
R122 — 4.3K, 5w	112852
R124 — 680Ω 10w, WW	114631
R127 — 600Ω 18w, WW	114632
R142 — 10K, 10w, WW	102241
R151 — 39K, 4w	105753
R551 — 1.2K, 7w	109414
R552 — 1.2K, 4w	112849
R553 — 6.8K, 3w	105662
R561 — 680Ω 3w, WW	114628
R562 — 820Ω 3w, WW	120310
R567 — 3.3Ω 3w, WW	114005
R716 — 1M (matched pair)	112863
A — 1M (matched pair)	
B — 1M (matched pair)	
RT201 — thermistor-120Ω cold	107191
RV101 — varistor-175v at 1ma	114707
RV102 — varistor-870v at 1ma	112876
RV201 — varistor-20v at 67ma	116534
RV502 — varistor-110v at 1ma	114862
SG101 — capacitor-spark gap, 10,000pf 1kv	117139
R105 — control-HV adj	112842
R119 — control-tone	122433
R130 — control-AGC	112830
R131 — control-horiz hold	122429
R133 — control-vert hold	122428
R134 — control-vert linearity	114020
R137 — control-vert height	122176
R141 — control-contrast	122427
R143 — control-tint, CTC28A	122431
R143 — control-tint, CTC288	122435
R144 — control-color killer	112841
R145 — control-color, CTC28B	122434
R145 — control-color, CTC28A	122430
R175 — control-top and bottom pin amp	122116
R176 — control-video peaking	122432
R301 — control-sound adj	116457
R315 — control-sound rej	114319
R787 — control-red/blue/grn screen	121574
R788 — control-red/grn kinescope drive	122114
R798 — control-ACC threshold	122768
R801 — control-left blue horiz lines	120949
R804 — control-left vert lines red/grn	109472
R805 — control-left red/grn horiz lines	106320
R808 — control-bottom blue horiz lines	105059
R811 — control-top red/grn vert lines	109472
R812 — control-bottom red/grn horiz lines	114623
R813 — control-top red/grn horiz lines	106320
R814 — control-bottom red/grn vert lines	105059
R1312 — control-ref adj	119611
XFORMERS	
T101 — focus adj	113999
T102 — HV	115876
T103 — audio	119170
T104 — vert output	122118
T105 — power	115838
T107 — top & bottom pin cushion	122119
T108 — side pin cushion	122120
T201 — 1st sound IF	109261
T202 — ratio det (includes C205, R202)	112870
T203 — quad (includes C209, R204)	106383
T301 — 1st pix IF	109252
T302 — 2nd pix IF	113547
T303 — 3rd pix IF	116458
T304 — 41.25MHz trap	112871
T701 — band pass	114003
T702 — burst phase	114004
T703 — 3.58MHz	119633
T705 — video output	122121
Y101 — crystal-3.58MHz	105330
RT101 — thermistor-temperature compensating 5Ω cold (part of yoke)	114742
yoke-deflection	114741
VHF tuner assembly, KRK 131 B, C	
UHF tuner assembly KRK 132 JA, KA, LA	



RCA VICTOR
Color TV Chassis CTC28 Series

4 HORIZONTAL RATE 75 V P-P — PW500 G (6AR6) AGC GRID

5 HORIZONTAL RATE 750 V P-P — PW500 D (6AR8) AGC KEYING PULSE

6 HORIZONTAL RATE 60 V P-P — V700 (6AA11) SYNC SEPARATOR PLATE

7 VERTICAL RATE 100 V P-P — V503B (6AR8) SYNC AMPLIFIER PLATE

8 VERTICAL RATE 100 V P-P — V501A (6GF7) VERTICAL OSCILLATOR GRID

9 VERTICAL RATE 300 V P-P — V501B (6GF7) VERTICAL OUTPUT GRID

10 VERTICAL RATE 10 V P-P — T9502 VERTICAL OUTPUT CATHODE

11 VERTICAL RATE 85 V P-P — PW300 T VERTICAL BLANKING PULSE

15 VERTICAL RATE 40 V P-P — L117 A (GROUND POINT R178-2) TOP AND BOT PIN AMP

16 VERTICAL RATE 60 V P-P — S701 I (SERVICE SWITCH) VIDEO ("Y" SIGNAL)

17 HORIZONTAL RATE 50 V P-P — V707 (6JC6-2 (COLOR) BURST AMPLIFIER GRID

18 HORIZONTAL RATE 3 V P-P — V701A (6GH8A-2 (COLOR) BAND PASS AMPLIFIER

19 HORIZONTAL RATE 90 V P-P — CR703 CR714 JUNCTION PHASE DETECTOR

20 HORIZONTAL RATE 25 V P-P — V704 3, V709 1 (COLOR) DEMODULATOR GRIDS

21 HORIZONTAL RATE 100 V P-P — PW700 3 (COLOR) RED "Y"

22 HORIZONTAL RATE 130 V P-P — PW700 7 (COLOR) BLUE "Y"

23 HORIZONTAL RATE 33 V P-P — PW700 2 (COLOR) GREEN "Y"

24 VERTICAL RATE 10 V P-P — C144 (DISCONNECTED) WITH LR SWEEP INPUT AFT CORRECTION

(CTC28A,AA - OMIT CTC28B,AB-IN)

RESISTANCE VALUES IN OHMS, K=1000

CAPACITANCE VALUES LESS THAN 1 IN MFD. AND ABOVE IN MMFD., UNLESS OTHERWISE INDICATED.

DIRECTION OF ARROWS AT CONTROLS INDICATES CLOCKWISE ROTATION.

VOLTAGES MEASURED WITH "VOLT-OHMYST," WITH NO SIGNAL INPUT, ALL VOLTAGES ±20% WITH 120% AC SUPPLY, UNLESS OTHERWISE INDICATED.

@ INDICATES 5% TOLERANCE.

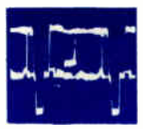
†CG DENOTES SPECIAL RESISTOR.

1137
PHILCO-FORD
TV Chassis18LT43

ELECTRONIC TECHNICIAN / DEALER **TEKFAX**

FEBRUARY • 1968

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



1. 2.5 volts p/p, 15, 750 cps

2. 2.5 volts p/p, 60 cps

3. 115 volts p/p, 15,750 cps

4. 100 volts p/p, 15,750 cps

5. 100 volts p/p 60 cps

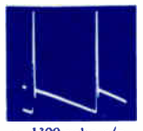
6. 55 volts p/p 60 cps

7. 55 volts p/p, 15,750 cps

8. 50 volts p/p, 60 cps

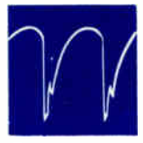
9. 85 volts p/p, 60 cps

10. 50 volts p/p, 60 cps



11. 1300 volts p/p total, 130 volts p/p sawtooth, 60 cps

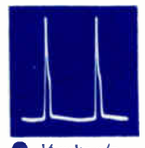
12. 115 volts p/p, 60 cps



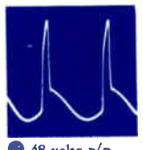
13. 11.5 volts p/p, 15,750 cps

14. 15 volts p/p, 15,750 cps

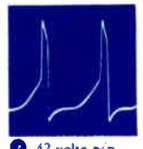
15. 21 volts p/p, 15,750 cps



16. 14 volts p/p, 15,750 cps



17. 48 volts p/p, 15,750 cps



18. 42 volts p/p, 15,750 cps

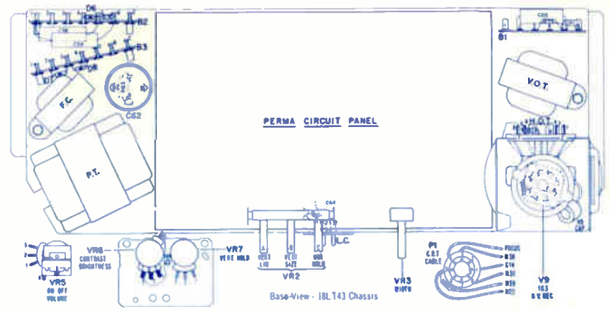
19. 140 volts p/p, 15,750 cps

20. 22 volts p/p, 15,750 cps

21. 12 volts p/p, 15,750 cps

22. 90 volts p/p, 15,750 cps

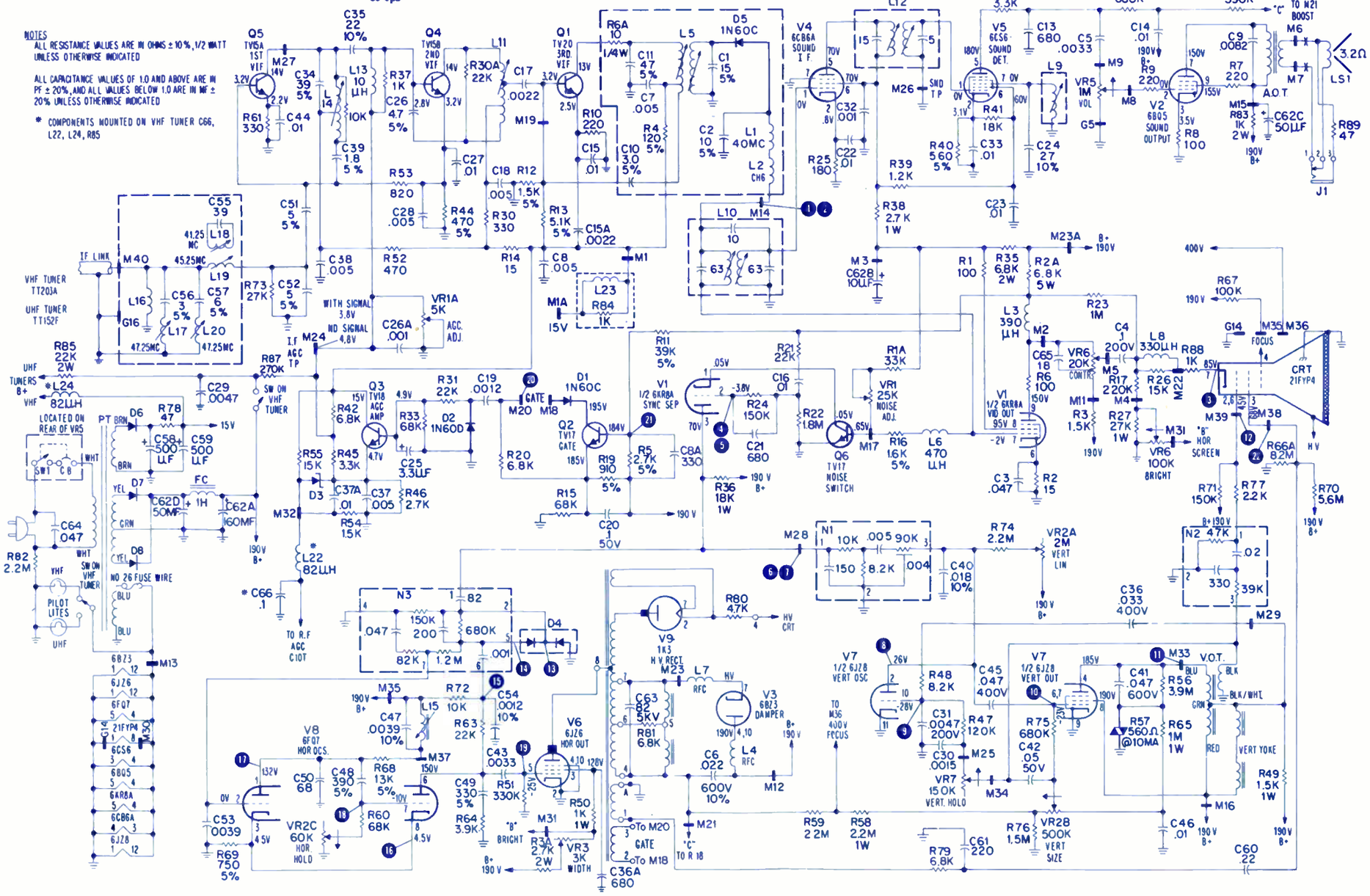
NOTES:
1. ALL VOLTAGES TAKEN UNDER NO SIGNAL CONDITIONS, ANTENNA REMOVED AND TUNER OFF CHANNEL.
2. VOLTAGES MEASURED WITH A V T V M. FROM POINT INDICATED TO CHASSIS GROUND.
3. COIL RESISTANCES READ WITH COIL IN CIRCUIT.
4. BALLOONS SHOWN ON SCHEMATIC INDICATE WAVEFORM TEST POINTS.
5. CONTROL SETTINGS:
   VOLUME - MINIMUM
   CONTRAST - MID RANGE
   BRIGHTNESS - MID RANGE
   ALL OTHER CONTROLS SET FOR NORMAL OPERATION



NOTES
ALL RESISTANCE VALUES ARE IN OHMS ± 10%, 1/2 WATT UNLESS OTHERWISE INDICATED

ALL CAPACITANCE VALUES OF 1.0 AND ABOVE ARE IN PF ± 20%, AND ALL VALUES BELOW 1.0 ARE IN MF ± 20% UNLESS OTHERWISE INDICATED

* COMPONENTS MOUNTED ON VHF TUNER C66, L22, L24, R85



OSCILLOSCOPE WAVEFORMS

These waveforms were taken with the receiver adjusted for an approximate output of 2.5V p/p at the video detector. Voltage readings taken with raster just filling screen and all controls set for normal picture viewing except for photos 1, 2 and 3 where contrast was at maximum. The voltages given are approximate peak-to-peak values. The frequencies shown are those of the waveforms...not the sweep rate of the oscilloscope. All readings taken with Model 1450 B&K Oscilloscope.

SYMBOL	DESCRIPTION	PHILCO-FORD PART NO.
	CAPACITORS	
C58	500/20µf, 15v supp	30-2614-2
C59	500/20µf, 15v supp	30-2614-2
C62	160/10/50/50µf @ 200v filter	30-2616-1
	DIODES	
D1	1N60C, AGC gate	34-8022-6
D3	zener, AGC	34-8057-10
D6	silicon rect +15v	34-8054-7
D7	silicon rect B+	34-8054-11
	COILS	
L1	40MHz det choke	32-4837-1
L2	ch 6 dropout	32-4645-7
L3	390mh plate chunt	32-4762-11
L4	60MHz damper plate	32-4112-62
L5	3rd VIF	32-4884-5
L6	470mh 2nd det	32-4762-22
L7	60MHz damper coth	32-4112-62
L8	330mh video plate series	32-4762-20
L9	quad	32-4876-1
L10	4.5MHz trap & snd take off	32-4688-13
L11	2nd VIF	32-4885-7
L12	SIF interstage	32-4745-12
L13	10µh 2nd VIF base	32-4887-2
L14	1st VIF	32-4885-6
L15	horiz stabilizer	32-4754-3
L16	tuner cplg	32-4652-96
L17	47.25MHz trap	32-4652-78
L18	41.25MHz, trap	32-4652-80
L19	1st IF base pole	32-4652-79
L20	47.25MHz trap	32-4652-78
L22	82mh tuner AGC	32-4762-27
L23	choke + 15v supply	32-4887-2
L24	82mh, tuner + 15v	32-4762-27
	NETWORKS	
N1	vert integrator	30-6030-12
N2	vert retrace	30-6024-9
N3	phase comp	30-6035-2
	TRANSISTORS	
Q1	TV20, 3rd IF	34-6000-72
Q2	TV17, AGC gate	34-6001-63
Q3	TV18, AGC amp	34-6001-64
Q4	TV15B, 2nd IF	34-6000-70
Q5	TV15A, 1st IF	34-6000-69
Q6	TV17, noise switch	34-6001-63
	RESISTORS	
R2A	6.8K 5w video plate	33-1363-82
R57	voristor, vert damp	33-1373-6
S1	on-off pwr (part of VR5) switch	
	XFORMERS	
AOT	audio output	32-10039-1
FC	filter choke	32-10010-9
HOT	horiz output	32-10065-2
PT	power	32-10064-1
VOT	vert output	32-10012-8
	CONTROLS	
VR1	25K, noise adjust	33-5613-9
VR1A	5K, AGC adjust	33-5613-5
VR2	2M vert lin 500K vert size & 60K horiz hold	33-5595-12
VR3	3K, width	33-5609-9
VR5	1M 00v w/cb	33-5619-28
VR6	100K bright; 20K contrast	33-5618-34
VR7	150K, vert hold	33-5619-27
	PERMA CIRCUIT PANELS	
	VIF trap w/comp	38-10113
	MISCELLANEOUS	
	UHF, tuner, TT152G	76-13827-7
	VHF, tuner, TT203A	76-13955-2
	yoke & cable assy	76-12942-8

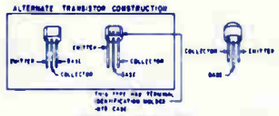
ELECTRONIC TECHNICIAN / DEALER **TEKFAX**

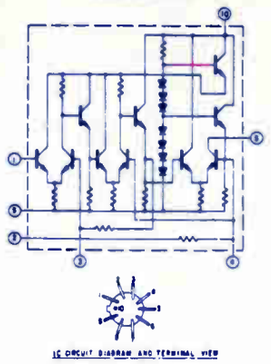
1138

SILVERTONE
TV Chassis
528.71150

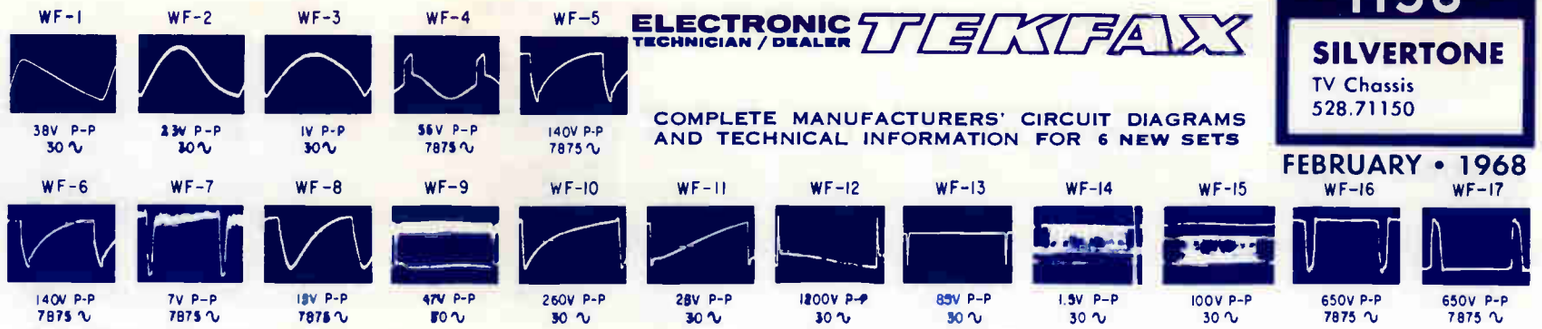
FEBRUARY • 1968

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

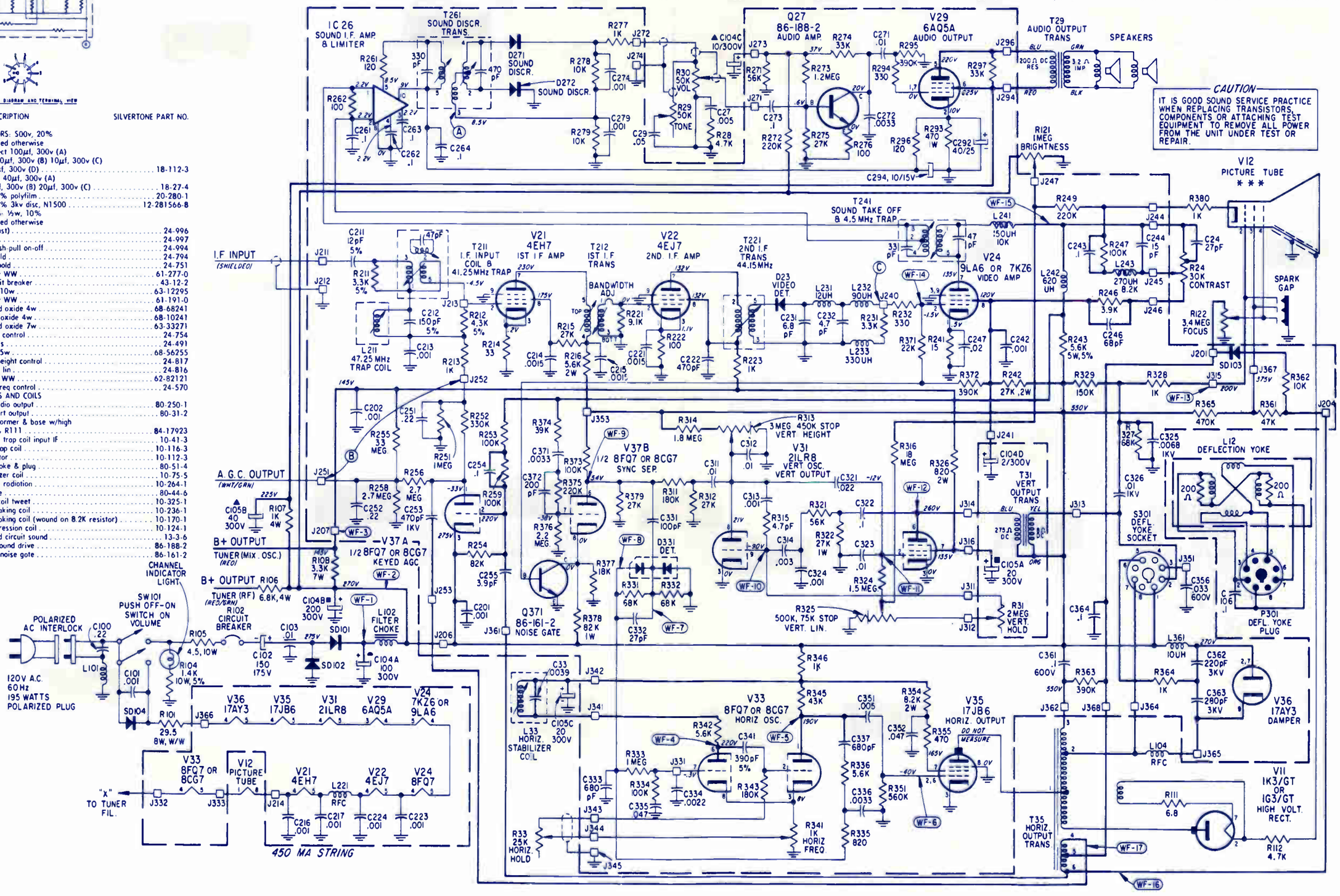




NOTES:
1. RESISTANCE IS SHOWN IN OHMS K 1,000 MEG 1,000,000.
2. ALL RESISTORS 1/2 WATT, UNLESS OTHERWISE NOTED.
3. CAPACITANCE VALUES ARE MFD, UNLESS OTHERWISE NOTED.
4. VOLTAGES READ WITH "VTVM" FROM POINT INDICATED TO CHASSIS GROUND TUNER ON UNUSED CHANNEL, CONTRAST & BRIGHTNESS AT MINIMUM, -4.5 VOLTS BIAS ON AGC LINE ON TEST POINT (B), OTHER CONTROLS AT NORMAL LINE VOLTAGES 120 VOLTS, ANTENNA TERMINALS SHORTED TOGETHER, BUT NOT TO GROUND.
5. ALL WAVEFORMS MEASURED WITH STRONG SIGNAL INPUT AND WITH CONTRAST SET TO GIVE NORMAL PICTURE, AGC LINE OPERATING NORMALLY
6. J1, J2 ETC. INDICATE CONNECTION TERMINALS ON CIRCUIT BOARD.
7. VOLTAGE TOLERANCES ± 20%.



SYMBOL	DESCRIPTION	SILVERTONE PART NO.
	CAPACITORS: 500v, 20% unless noted otherwise	
C104A,B,C,D	— elect 100µf, 300v (A) 200µf, 300v (B) 10µf, 300v (C) 2µf, 300v (D)	18-112-3
C105A,B,C	— elect 40µf, 300v (A) 20µf, 300v (B) 20µf, 300v (C)	18-27-4
C337	— 680pf, 10% polyfilm	20-280-1
C363	— 280pf, 10% 3kv disc, N1500	12-281566-8
	RESISTORS: ½w, 10% unless noted otherwise	
R24	— 30K (contrast)	24-996
R29	— 50K tone	24-997
R30	— 50K vol push-pull on-off	24-994
R31	— 2M vert hold	24-794
R33	— 25K horiz hold	24-751
R101	— 29.5Ω 8w WW	61-277-0
R102	— 1.5a circuit breaker	43-12-2
R104	— 1.2K 5% 10w	63-12295
R105	— 4.5Ω 10w WW	61-191-0
R106	— 6.8K fused oxide 4w	68-68241
R107	— 1K, fused oxide 4w	68-10241
R108	— 3.3K fused oxide 7w	63-33271
R121	— 1M bright control	24-754
R122	— 3.4M focus	24-491
R243	— 5.6K 5% 5w	68-56255
R313	— 3M vert height control	24-817
R325	— 500K vert lin	24-816
R326	— 820Ω 2w WW	62-82121
R341	— 1K horiz freq control	24-570
	XFORMERS AND COILS	
T29	— xformer, audio output	80-250-1
T31	— xformer, vert output	80-31-2
T35	— high volt xformer & base w/high volt leads & R111	84-17923
T211	— 41.25MHz trap coil input IF	10-41-3
T241	— 4.5MHz trap coil	10-116-3
T261	— discriminator	10-112-3
L12	— deflection yoke & plug	80-51-4
L33	— horiz stobilizer coil	10-75-5
L101	— choke, line rodiotion	10-264-1
L102	— filter choke	80-44-6
L231	— RF choke coil tweet	10-325-1
L242	— 620µh peaking coil	10-236-1
L243	— 270µh peaking coil (wound on 8.2K resistor)	10-170-1
L361	— horiz suppression coil	10-124-1
IC-26	— intergroted circuit sound	13-3-6
Q27	— transistor sound drive	86-188-2
Q371	— transistor noise gate	86-161-2



1139

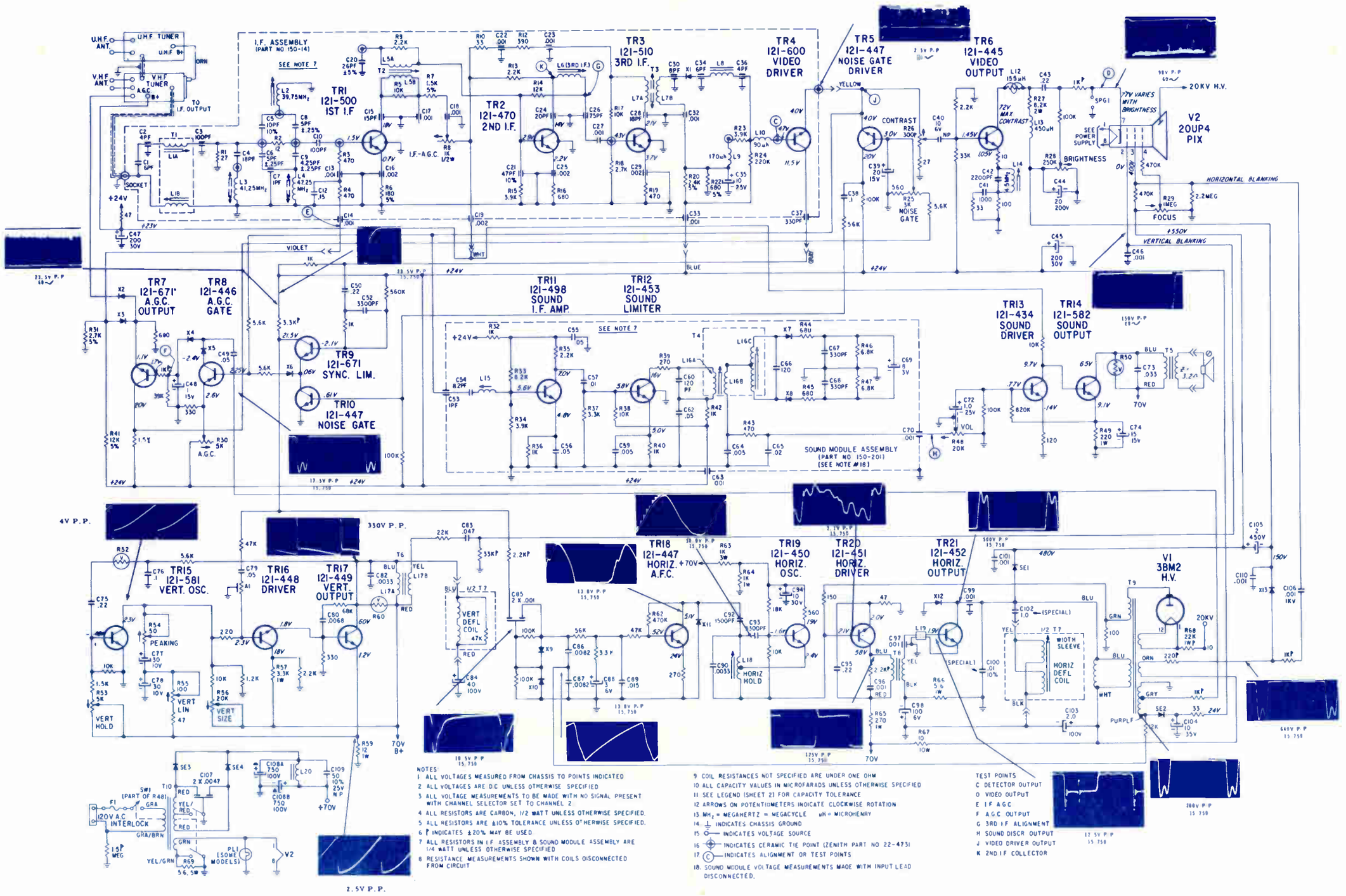
ELECTRONIC TECHNICIAN / DEALER TEKFAX

FEBRUARY • 1968

ZENITH
TV Chassis 1Y21B55

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

SYMBOL	DESCRIPTION	ZENITH PART NO.
C41	1000pf disc 1kv	22-17
C60	120pf mica cap 300v	22-5206
C78	30µf elect cap +20%–10% 10v	22-5417
C85	2 X .001µf dual disc cap 500v	22-21
C98	100µf elect cap 6v	22-5413
C100	.01µf molded cap 10% (special) 600v	22-4772
C101	.001µf disc cap 10% 1kv	22-17
C102	1µf molded cap 10% (special) 200v	22-4771
C107	2 X .0047µf disc cap 500v	22-24
C108A	750µf elect cap 100v	22-5410
C108B	750µf elect cap 100v	
R27	8.2K resistor 2w	63-4984
R50	VDR	63-5440
R52	VDR	63-7085
R60	VDR	63-7086
R67	10Ω resistor 10% 10w	63-7010
R8	1K IF & AGC control	63-7181
R25	3K noise gate control	63-7256
R26	300Ω ±20% contrast control	63-7081
R28	250K bright control	63-5380
R29	1M focus control	63-7078
R30	5K AGC control	63-7082
R48	20K volume control and switch	63-7313
R53	5K vert hold control	63-7083
R54	50Ω peaking control	63-7084
R55	100Ω vert lin control	63-7079
R56	20K vert size control ½w	63-7080
L2	39.75MHz trap coil assembly	20-1475
L3	41.25MHz trap coil assembly	20-1591
L4	47.25MHz trap coil assembly	20-1516
L8	peaking coil	20-2013
L9	series peaking coil	20-2707
L10	det shunt peaking coil	20-2014
L12	155µh series peaking coil	20-2523
L13	450µh shunt peaking coil	20-2025
L14	4.5MHz trap coil	20-1500
L15	4.5MHz input coil (part of T4)	95-2600
L16B	ratio det coil	part of T4
L18	horiz osc coil	S-56875
L19	ferrite sleeve	149-379
L20	filter choke	95-2513
T1	1st IF xformer assembly	20-1459
T2	2nd IF xformer assembly	20-1515
T3	4th IF xformer assembly	20-1460
T4	ratio det coil (part of 150-201)	S-75699
T5	audio output xformer	95-2507
T6	vert output xformer	95-2515
T7	deflection yoke	95-2517
T8	horiz driver xformer	95-2516
T9	horiz sweep xformer	S-75818
T10	power xformer	95-2514
A1	integrator	87-11
F1	fuse 1.2a	136-70
X7	crystal diode	103-90
X9	silicon diode	103-51
X12	diode (damping)	103-111
X13	diode (video)	103-112
SE1	rectifier (focus)	212-80
SE2	rectifier (24v)	212-64
SE3	rectifier (power)	212-71
SPG1	spark gap	52-957



NOTES:
1. ALL VOLTAGES MEASURED FROM CHASSIS TO POINTS INDICATED.
2. ALL VOLTAGES ARE D.C. UNLESS OTHERWISE SPECIFIED.
3. ALL VOLTAGE MEASUREMENTS TO BE MADE WITH NO SIGNAL PRESENT WITH CHANNEL SELECTOR SET TO CHANNEL 2.
4. ALL RESISTORS ARE CARBON, 1/2 WATT UNLESS OTHERWISE SPECIFIED.
5. ALL RESISTORS ARE ±10% TOLERANCE UNLESS OTHERWISE SPECIFIED.
6. ↑ INDICATES ±20% MAY BE USED.
7. ALL RESISTORS IN I.F. ASSEMBLY & SOUND MODULE ASSEMBLY ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED.
8. RESISTANCE MEASUREMENTS SHOWN WITH COILS DISCONNECTED FROM CIRCUIT.
9. COIL RESISTANCES NOT SPECIFIED ARE UNDER ONE OHM.
10. ALL CAPACITY VALUES IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
11. SEE LEGEND (SHEET 2) FOR CAPACITY TOLERANCE.
12. ARROWS ON POTENTIOMETERS INDICATE CLOCKWISE ROTATION.
13. MH = MEGAHERTZ = MEGACYCLE uH = MICROHENRY
14. ⏚ INDICATES CHASSIS GROUND.
15. ○— INDICATES VOLTAGE SOURCE.
16. ⊕ INDICATES CERAMIC TIE POINT (ZENITH PART NO 22-4731)
17. (C)— INDICATES ALIGNMENT OR TEST POINTS.
18. SOUND MODULE VOLTAGE MEASUREMENTS MADE WITH INPUT LEAD DISCONNECTED.

TEST POINTS
C DETECTOR OUTPUT
D VIDEO OUTPUT
E I.F. AGC
F A.G.C. OUTPUT
G 3RD I.F. ALIGNMENT
H SOUND DISCR. OUTPUT
J VIDEO DRIVER OUTPUT
K 2ND I.F. COLLECTOR

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.

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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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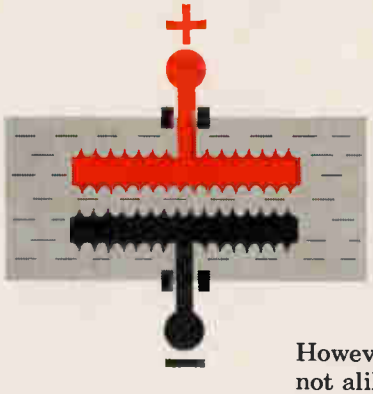
SOUTH-EAST	938 GORDON ST., S. W. Atlanta, Georgia	TEL: 404-758-2232
WEST	SARKES TARZIAN, Inc. TUNER SERVICE DIVISION 10654 MAGNOLIA BLVD., North Hollywood, California	TEL: 213-769-2720

MALLORY **Tips for Technicians**

Why some filter capacitors develop hum... and some don't



Aluminum electrolytic capacitors are widely used as filters in DC Power Supplies. This is because of their large capacitance in relatively small size. All in all, they do an efficient job of reducing ripple (hum) to acceptable levels.

However, all electrolytic capacitors are not alike. This is often why some types seem to allow hum to rise to objectionable levels more quickly than do others. In order to understand why, we must investigate actual construction methods.

As you know, electrolytics are basically made by depositing a film of aluminum oxide on aluminum foil to form the positive anode. The oxide is the dielectric. A semi-liquid electrolyte surrounds the anode and is actually the negative cathode. In order to connect this semi-liquid cathode to a terminal, a second piece of aluminum foil is used. This is often *called* the cathode, but it is not. It is actually only the *cathodic connection*. (The preceding describes a "polarized" electrolytic capacitor.)

When high ripple currents are applied to polarized electrolytics, a thin oxide film forms on the so-called "cathode". It begins to assume the characteristics of a second anode. This in turn, has the same effect as placing two capacitors in series. Consequently, overall capacitance is reduced. Inevitably hum increases.

This action is especially noticeable in electrolytics which use plain foil as the "cathode". This is simply because the oxide builds up over a relatively small area.

Mallory avoids this problem by etching the "cathode" on electrolytics. As a result, oxide build-up is spread over a vastly increased area. Therefore, ripple currents are maintained at very low levels for very long time periods.

Of course etched "cathodes" cost a lot more to make. But you get them from Malloy at *no extra cost.*

Meanwhile, see your local Franchised Mallory Distributor for capacitors, resistors, controls, switches, semiconductors, and batteries. Or write Mallory Distributor Products Company, a division of P. R. Mallory & Co. Inc., Indianapolis, Indiana 46206.

DON'T FORGET TO ASK 'EM *"What else needs fixing?"*

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ELECTRONIC TECHNICIAN / DEALER

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FEBRUARY 1968 • VOL. 87 No. 2

COVER
Servicing transistorized 2-Way radio equipment requires skill and knowledge of test procedures and instruments.

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MAGNAVOX: Color TV Chassis T924 Series
PACKARD BELL: TV Models MSJ-202, MSJ-204
PHILCO-FORD: TV Chassis 18LT43
RCA VICTOR: Color TV Chassis CTC28 Series
SILVERTONE: TV Chassis 528.71150
ZENITH: TV Chassis 1Y21B55

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EDITOR'S MEMO

Current Can Kill!

No technician in his right mind would stand in a pool of water and check voltages on a TV set. But every day we read of people who do almost the same thing. Take the story of the woman who put an electric space-heater on a shelf by the bathtub and while she was bathing, the heater fell into the tub. The result, of course, was fatal. But every day people do things just as brilliant.

As technicians who work with electronic equipment we are expected to have a little more respect and knowledge of the potentials we deal with. Although some technicians never get more than a minor shock, others who have had many may think that they have built up an "immunity."

A few words of wisdom to the "immune" — don't get lax and play games with electricity or the next thing you play will be a harp.

It really takes very little current to be fatal, a lot less than you may think. In fact, the value is in the low milliamperes! If you were to touch a 117-vac, 60Hz line with your hand, you would probably have a hard time letting go of it at less than 10ma. More than that could be fatal!

You probably know that the body has a certain amount of resistance and that the lower the resistance, the higher the current flow becomes.

The average, healthy adult male has a dry body resistance of less than 5K, measured from hand to hand and standing on both feet. Body resistance drops drastically if you are sweating and also depends upon which two points on the body the resistance is measured. No indication of brain power, but, the resistance from ear to ear is less than from hand to hand.

If you touched that 117vac line with your hand, assuming your body resistance is 5K, you would be passing about 23ma. If you were sweating, your resistance woud drop to about 1K and your body would be passing 117ma! That could be a real "ouch."

Figures tell us that thousands of people are killed in home accidents. Some statistics even indicate that hundreds die each year just falling out of bed! In contrast, few men who work in or near hazardous conditions are fatally injured. Electronic and electrical equipment need be no more dangerous than sleeping in bed. But remember that old saying about current flow — it takes the path of least resistance. Don't become a short circuit.

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NOT SATISFIED with your present income? The most practical thing you can do about it is add to your Electronics know-how, pass the FCC exam and get your Government License.

The demand for licensed men is enormous. Today there are over a million licensed broadcast installations and mobile transmitters on the air, and the number is growing constantly. And according to Federal Law, no one is permitted to operate or service such equipment without a Government FCC License or without being under the direct supervision of a licensed operator.

This has resulted in a gold mine of new business for licensed service technicians. A typical mobile radio service contract pays an average of about $100 a month. It's possible for one trained technician to maintain eight to ten such mobile systems. Some men cover as many as fifteen systems, each with perhaps a dozen units.

Opportunities in Plants

And there are other exciting opportunities in the aerospace industry, electronics manufacturing, telephone companies, and plants operated by electronic automation. Inside industrial plants like these, it's the licensed technician who is always considered first for promotion and in-plant training programs. The reason is simple. Passing the Federal Government's FCC exam and getting your License is widely accepted proof that you know the fundamentals of Electronics.

So why doesn't everybody who "tinkers" with electronic components get an FCC License and start cleaning up?

The answer: it's not that simple. The Government's licensing exam is tough. In fact, an average of two out of every three men who take the FCC exam fail.

There is one way, however, of being pretty certain that you will pass the FCC exam. That's to take one of the FCC home study courses offered by the Cleveland Institute of Electronics.

CIE courses are so effective that better than 9 out of every 10 CIE graduates who take the exam pass it. That's why we can afford to back our courses with the iron-clad Warranty shown above: you get your FCC License or your money back.

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Want to know more? Send the coupon below for free copies of our school catalog, "How To Succeed In Electronics," describing opportunities in Electronics, together with our special booklet, "How To Get A Commercial FCC License." If coupon has been removed, just send your name and address to us.

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Matt Stuczynski, Senior Transmitter Operator, Radio Station WBOE: "I give CIE credit for my First Class Commercial FCC License. Even though I had only six weeks of high school algebra, CIE's lessons made Electronics easy. I now have a good job in studio operation, transmitting, proof of performance, equipment servicing...and am on my way up."

Thomas E. Miller, Jr., Engineer, Indiana Bell Telephone Company: "I completed my CIE course and passed my FCC exam while in the Navy. On my discharge, I was swamped with job offers from all over the country. My only problem was to pick the best one, and I did—engineer with Indiana Bell Telephone. CIE made the difference between just a job and a management position."

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LETTERS TO THE EDITOR

German Equipment

I have been a subscriber to ET/D for several years and I could use some help. I wonder if any reader can tell me where I can obtain a schematic for a Kirksaeter, Model RTX400 stereo receiver (solid-state) which was made in West Germany.

YUKIO MOTOIKE

Gardena, Calif.

• *One ET/D reader recently informed us that anyone desiring information on German-made radios, tape recorders, stereos and phonographs can possibly obtain it from the following source: Mr. Kurt Herrmann, German Hi Fi and stereo repairs, 731 E. Houston St., San Antonio, Tex., 78205. — Ed*

Speaker Information

I would like to acquire some plans for a speaker cabinet with provision for a 15in. speaker and a tweeter horn — also, information on the amount of sound absorbing material necessary to install the speaker I have. Can you provide me with the address of the Jensen Co.?

WARREN M. SIEVERIN

Barnes, Kan.

• *Inquiries for Jensen speaker information should be sent to the Jensen Manufacturing Div., The Muter Co., 6601 S. Laramie, Chicago, Ill. 60638. —Ed*

More on Technician Shortage

About the technician shortage. No wonder there's a technician shortage. What technician would work 50 or 60 hours a week for $100 to $120, work on holidays, no fringe benefits, little or no paid vacation (the prevailing conditions in some areas) when good technicians are getting from $3.50 an hour and up in many other areas of electronics — working 40 hours a week with time-and-a-half for overtime, holidays and weekends off (or compensated time), reasonable paid vacation and fringe benefits?

I left (much to my regret) a military career to work as a full-time TV technician. In the military service, no one complained about repair costs, frequency of service or unrealistic trouble symptoms. I've been called a crook on a number of occasions, have been told that I know nothing about electronics, television repair, and on one occasion, a TV owner invited me out of his house when I advised him that his "jerry-rigged" antenna, with bell-wire lead-in, caused his color reception to be poor.

I think this is the life story of many TV technicians. I believe that some of the nation's best electronic troubleshooters will be found in TV repair shops. I also believe that large companies are finding this out and are recruiting these technicians for industrial electronics work. Perhaps the reason some TV technicians (including myself) have not done so well in the TV game is because we are not, by nature, businessmen. We are primarily technical minded and, in most cases, it ends there. We can analyze circuits much better than we can analyze business principles.

What happens when all the "old good technicians" are gone? Let the public "do-it-yourself." Sorry, that's my outlook on the situation.

No complaints on your fine magazine. It has saved my skin many times. Keep up the good work — you're doing fine.

MELVIN L. NETHERY

Midwest City, Okla.

Electronics Directory

I need the name and address of the manufacturers of the Merlin auto radio antennas. Also, I am interested in obtaining a complete electronics directory.

PAUL CAPITOL

Erie, Pa.

• *Perhaps some reader can supply Mr. Capitol with the address of the auto antenna manufacturer. In the June 1967 issue of ET, we printed an Electronic Technician's Directory which lists a great many of the manufacturers and companies involved in the products which ET/D readers sell and service. A more complete listing of electronic manufacturers is published by United Catalog Publishers, Inc., 645 Stewart Ave., Garden City, N. Y., and by Electronic Periodicals, Inc., 33140 Aurora Rd, Cleveland, Ohio 44139. — Ed.*

Needs 'Ansafone' Info

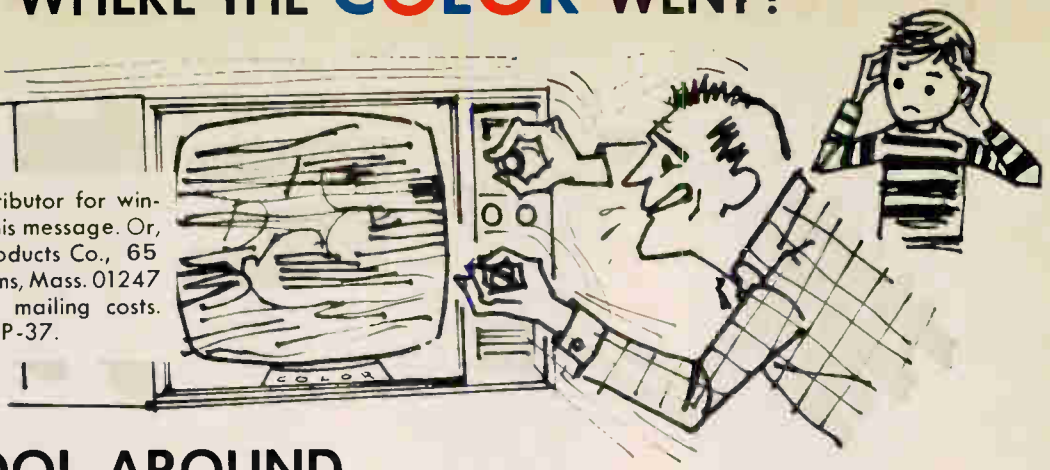
I have read and used ET for several years and have found it interesting and helpful. I have a problem. I need a schematic and parts info on "Ansafone" — a phone answering system built by the Ansafone Corp. I have the model KH85F for repair. I do not have the manufacturer's address. Can any ET/D reader help me?

VERNON HISTBECK

Minneapolis, Minn.

• *Sorry, we are unable to locate the company's address. — Ed*

WONDER WHERE THE COLOR WENT?



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DON'T FOOL AROUND... CALL YOUR NEIGHBORHOOD TV TECHNICIAN

HE'S THE ONE WHO CAN BRING IT BACK ALIVE!

There are many jobs around the house you can tackle yourself. If you're a bit handy, it's no trick to fix a leaky faucet or a broken window.

BUT a color TV set is something else again!

It's the most complicated piece of equipment you've ever owned—bar none. Yes, far more complicated than your old black and white set.

Trying to fix it yourself can be extremely dangerous.

Trying to fix it yourself can also be quite expensive.

So why try?

The independent radio-TV service dealer in your neighborhood can do the job right. As TV sets have grown more complex, he's kept abreast of the changes.

With the introduction of color TV, he's had to learn a lot of new things.

After all, he repairs all kinds of TV sets for a living and quite a few of them are color. In the last two years, almost as many color TV as black and white sets have been sold.

When your color TV starts acting up, you may think it has a new or unusual ailment. But your independent TV service technician won't consider the problem new . . . or unusual. Most likely, he'll know what to do within a few minutes.

Sure . . . he charges for his services. He's a professional.

Because he is, you'll be pleased with the service.

What he charges will be far less than you'd pay in the long run if you entrusted the job to an amateur or attempted to do some tinkering yourself.

THIS MESSAGE WAS PREPARED BY SPRAGUE PRODUCTS COMPANY,
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YOUR INDEPENDENT TV-RADIO SERVICE DEALER

DON'T FORGET TO ASK YOUR CUSTOMERS "WHAT ELSE NEEDS FIXING?"

SS-7117

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Test your MATV profit potential.

The design and installation of 82-channel Master Antenna Television Systems can be one of the most lucrative opportunities open to the modern service dealer. Potential customers include everyone from average homeowners to apartment complexes. However, your choice of equipment often dictates the difference between winning and losing a bid... the difference between trouble-free installations and frustrating callbacks... and the difference between handsome returns and financial headaches. It is your business, but are you making the most profitable choice?

You have an obvious advantage in selling and pricing a system when the entire system, from antennas to amplifiers to cable to tapoffs, was designed and built to function as one integrated unit.

1. Who has the industry's only true 82-channel master antenna system?

In the age of color, the antenna is king. Customers aren't satisfied with anything less than the finest color reception available. Especially when it's available at no extra cost.

2. When you need the highest gain 82-channel color antenna you can get, where do you go?

On-channel amplification is the most economical means of providing both VHF and UHF in small and medium sized systems. When you're going for economy—why not go all the way?

3. Which solid-state color distribution amplifiers provide the most economical ON CHANNEL amplification?

Less loss requires less amplification and lower cost systems—doubly important in 82-channel systems where UHF cable losses can be staggering with ordinary coax.

4. What is the lowest loss RG/59 type coaxial cable designed for 82-channel master antenna systems?

Most 82-channel tapoffs have much higher losses on UHF—where you can least afford it. But wall taps with no additional UHF loss are like money in the bank.

5. Which 82-channel wall tapoffs give you the same low losses on UHF as VHF?

Why pay premium prices for 82-channel splitters, line taps, wall taps, matching transformers, etc.—when one line gives you all 82-channel distribution equipment at no extra cost?

6. Who has the most complete line of 82-channel master antenna distribution system equipment?

Score yourself.

1. Channel Master MATV 2. Color Crossfire 82 3. Color Amps 4. Color Duct 82 5. U-V Wall Tapoffs 6. U-V Distribution Equipment

You guessed it.

CHANNEL MASTER

Master Antenna Television Systems

You score extra MATV profits every time you choose Channel Master. If you aren't picking Channel Master—your profits can be improved. See your Channel Master distributor or write to Channel Master, Ellenville, New York 12428.

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E. F. Johnson Co.

FM Two-Way Radio Model 242-502,503 — Receiver Circuit Description

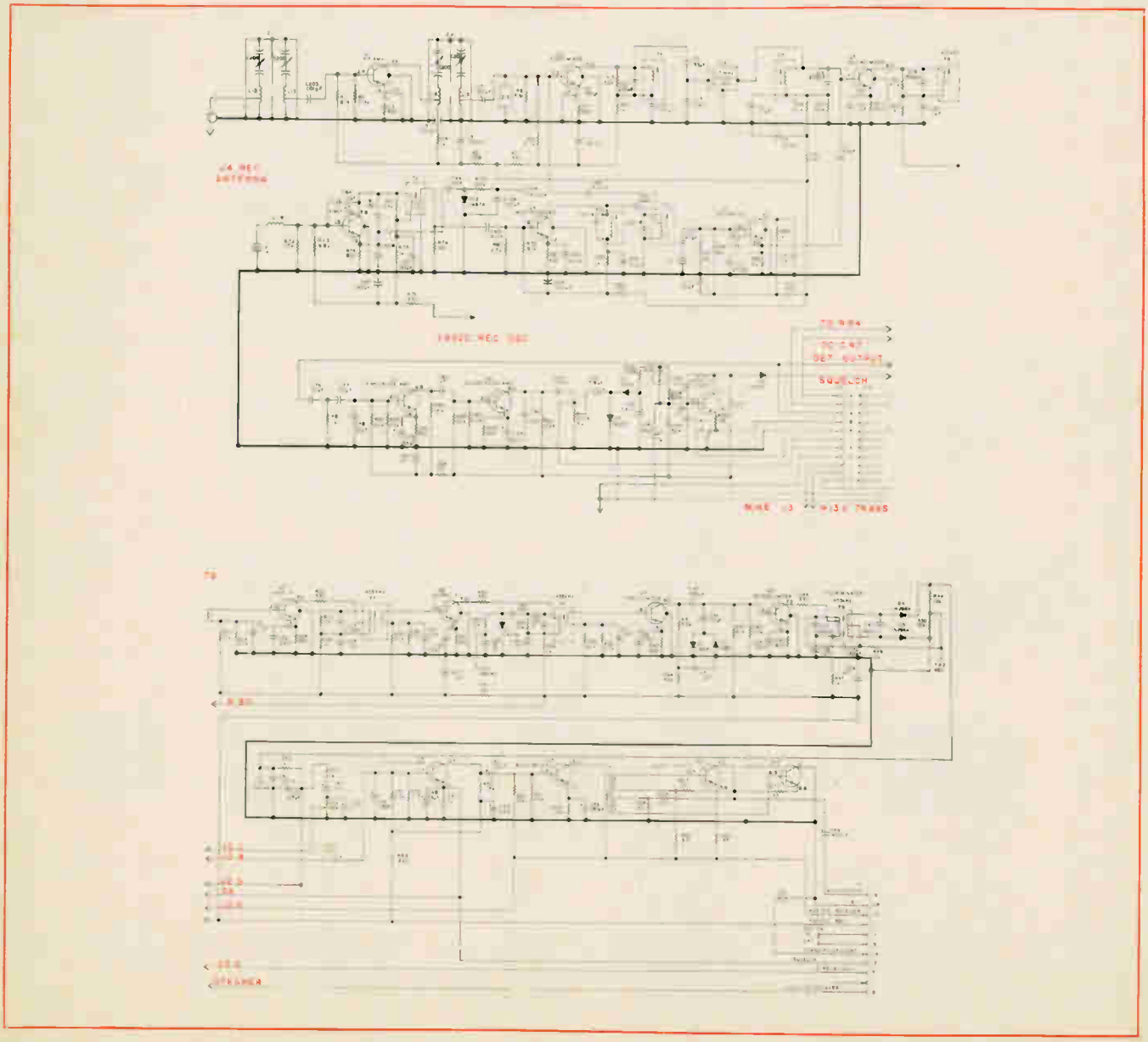
The Johnson FM receiver is a completely solid-state dual-conversion superheterodyne unit. The intermediate frequencies are 10.7MHz and 455kHz. The squelch is noise operated and is immune to impulse type noise.

RF Amplifier

The RF amplifier stage consists of selectivity elements Z1 and Z2 and transistor Q1. The incoming signal from the antenna is coupled through the lowpass network located in the power adpater and through de-energized contacts 4, 8 and 3 of RLY1 in the dc power adpater (contacts 3, 9 and 4 in the ac power adapter) to P4. P4 is connected to J4, the receiver antenna jack located on the back of the transceiver. The signal is coupled from J4 directly to Z1. Z1 is a high Q bandpass filter, commonly called a helical resonator. The signal is coupled through Z1 and C203 to the base of the RF amplifier, Q1. The amplified signal from the collector of Q1 passes through Z2, the second helical resonator and is coupled by C5 to the base of Q2, the first mixer.

1st Oscillator

The 1st oscillator is a series resonant type using a 3rd overtone crystal. The output from the collector of Q3, the 1st oscillator transistor, is coupled by T2, the 1st oscillator transformer, and C63 to the base of the multiplier, Q4. A



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TECHNICAL DIGEST

sample of the 1st oscillator output voltage is coupled by C99 to a rectifier filter network consisting of D12, R110 and C109. The output of this network is the 1st oscillator test voltage, used for peaking the oscillator, and is measured at the yellow test point, TP4.

Multiplier

The multiplier is an amplifier with the output tuned to the 3rd harmonic of the input. Third harmonic tuning is provided by tuned circuits T3 and T16. Using two tuned circuits in the output provides for greater spurious and harmonic rejection. The output, 10.7MHz below the carrier frequency, is tapped off T16 and coupled to the base of the first mixer, Q2, by C68.

1st Mixer

The output of the 1st mixer is tuned to the difference frequency of the RF amplifier and multiplier inputs, or 10.7MHz. T4, the 1st mixer transformer, is tuned to 10.7-MHz and couples the output to the crystal filter, Z4.

2nd Oscillator

The 2nd oscillator operates as a parallel mode colpitts type with an output frequency of 11.155MHz or 455kHz above signal input to the 2nd mixer. The output is taken off the emitter of Q6 and coupled to the base of the 2nd mixer by C17.

2nd Mixer

The inputs to the 2nd mixer are 10.7MHz from the crystal filter, and 11.155MHz from the 2nd oscillator. The output is tuned to the difference frequency, or 455kHz. Transformer T6 provides 2nd mixer tuning and couples the 455kHz signal to the base of the 1st IF amplifier, Q7.

IF Stages

Q7 and Q8 are high gain, 455kHz IF amplifiers. Q9 and Q10 are combination IF amplifiers and limiters. The collector swing of Q9 is reduced by limiting the collector voltage to 4v and thus decreasing the over-all dynamic range of the 1st limiter. Diodes D1 and D2 form a fullwave clipper which aids the limiting action of Q9. The input at the base of Q10, the 2nd limiter, is sufficient to keep that stage in saturation at all times. The output of Q10 is applied to the primary of the discriminator transformer, T9.

Discriminator

The discriminator, consisting of T9, D4, D5 and associated components, detects any unbalance in phase shift appearing across the secondary of T9 causing either D4 or D5 to conduct and develop audio across R49 and R50.

Audio

The audio from the discriminator is applied to a de-emphasis network made up of R52 and C43. Its purpose is to restore the pre-emphasized frequency spectrum to its original form. The de-emphasized audio is applied to the volume control. The audio is taken from the movable contact of the volume control, R54, and coupled to the base of the 1st audio amplifier, Q14, by C47. Audio preamplification is performed by Q14, the 1st audio amplifier, and, Q15, the audio driver. T1, the driver transformer, couples the driver output to a series class B combination consisting of Q16 and Q17. The series class B output stage can deliver approximately 5w of audio to a 3.2Ω PM speaker.

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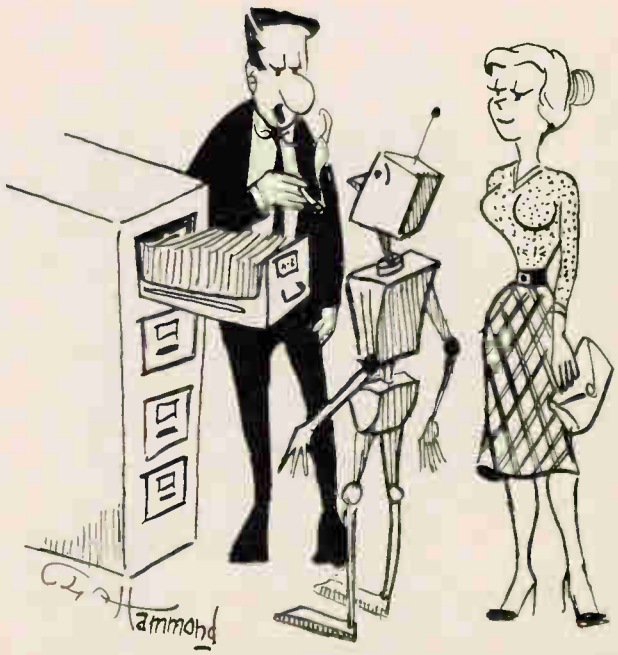
TECHNICAL DIGEST

Noise-Operated Squelch

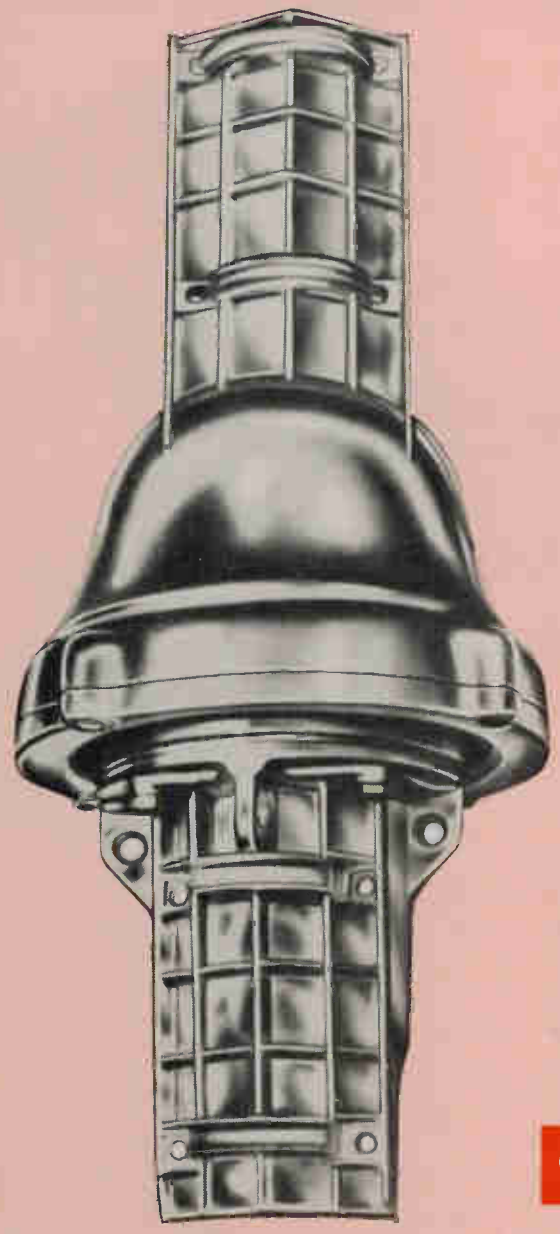
The operation of the squelch depends entirely on the presence or absence of an on frequency RF carrier. With no on frequency signal input to the receiver, noise from the discriminator is coupled from the de-emphasis network, through an audio filter with a sharp rolloff below 3kHz, and to the base of the 1st noise amplifier, Q11. The noise is amplified by Q11, Q12 and applied to the squelch potentiometer, R104, through C85. The noise voltage is then rectified and doubled by diodes D6 and D7. The resulting negative dc output reverse biases Q13, the squelch gate and switches it off. In the off condition the collector potential of the squelch gate rises to approximately 10v. This voltage represents a large forward biasing potential to the anode of D8 and for all practical purposes D8 is a short circuit with respect to the collector of Q13 and the emitter of Q14, the 1st audio amplifier. Approximately −10v drop across D8 is applied to the emitter of Q14, reverse biasing it, switching the stage off.

With the presence of an on frequency carrier, the quieting effect takes place and the input to the noise amplifier becomes reduced to such a low level that it is effectively removed. The noise squelch audio filter prevents the audio from being amplified by the noise amplifiers. Therefore, the output from the rectifier doubler network falls to a level less than is necessary to keep the squelch gate switched off. The squelch gate becomes forward biased and switches on. Its collector voltage drops to approximately 2.5v, causing D8 to switch off. When D8 switches off, the emitter voltage of the 1st audio amplifier, Q14, falls to a level less than is required to keep that stage switched off. Q14 switches on and the audio becomes operative.



"Run along, you've just been replaced."

Never ask a lightweight rotor to do a heavyweight's job.



Selling your customer a lightweight rotor when he has a large antenna array just doesn't make sense. Especially since you can offer him an alternative: the heavy-duty "Bell Series" rotor, from CDE.

Available in both automatic and manual forms, this rotor is designed specifically for large, heavy antenna arrays... designed specifically for unmatched fringe-area reception... designed to give your customers the finest color TV reception possible. In fact, this is the *only* heavy-duty rotor available.

We call it the Bell Series because of its completely weatherproof, die-cast aluminum housing. You'll call it rugged because it has 4 to 5 times the stalling and braking torque of any other rotor! This means *any* antenna will turn, even under the most adverse weather conditions... and that your customers will get terrific color or black and white reception despite high winds or heavy icing. Great FM reception too!

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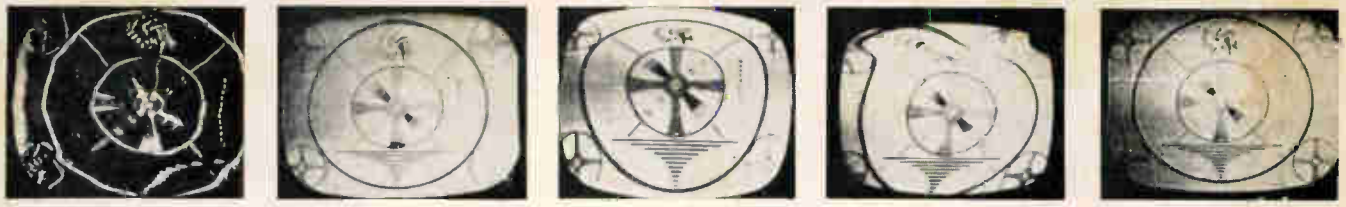

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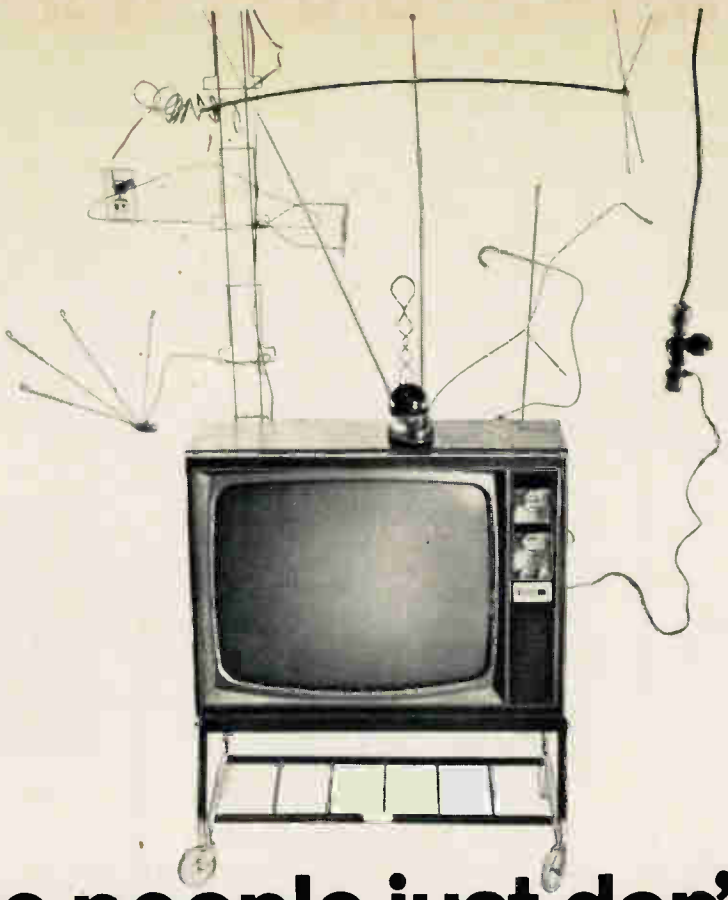

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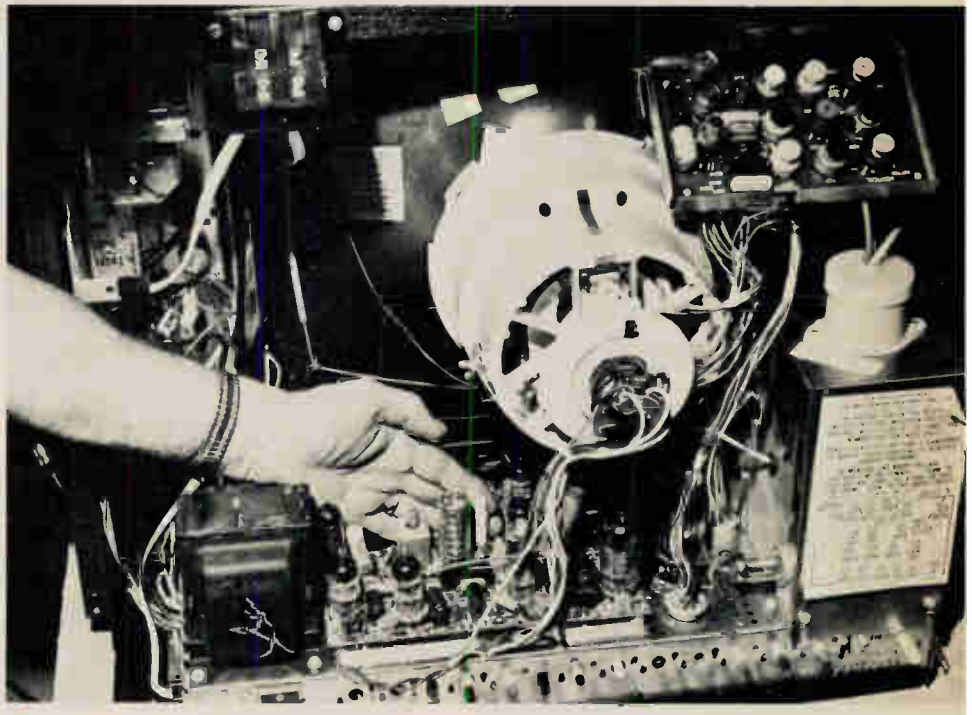
ELECTRONIC TECHNICIAN / DEALER

FEBRUARY 1968

SOLVING DIFFICULT COLOR PROBLEMS

Learn how to 'crack' those 'tough-nuts' and make your work-day more productive and satisfying

Fig. 1 — Isolate the possible defective color stages first on the manufacturer's schematic and then locate the stage or stages on the chassis.



■ You can solve most color TV problems by tube replacements. But you'll run into a few difficult jobs occasionally that refuse to yield to this easy technique. Right here is where the "boy" technicians get separated from the "men" technicians. And you'll be in the grown-up class only if you know what you're doing and use the proper test instruments correctly.

You'll need the following test instruments to handle the tough ones:

1) A Color bar/dot generator.
2) A good, accurate VTVM.
3) A stable broadband scope.
4) A Color tube jig setup.
5) Color TV schematics and full service data.
6) A good dynamic tube tester.

You will also need a few convenient hand tools — including a degaussing coil — most of which you already have in the shop.

Isolating the color stages

First, check or substitute all color-circuit tubes. Then try to isolate the stage or stages in which the symptoms indicate the problem exists. Now use the scope and VTVM to locate the defective component (see Fig. 1).

Does this sound oversimplified? Read on — we'll get into the details immediately.

Some experienced service technicians, for example, go directly to the 3.58MHz oscillator stage in case of no color. When one color is missing, they go to the corres-

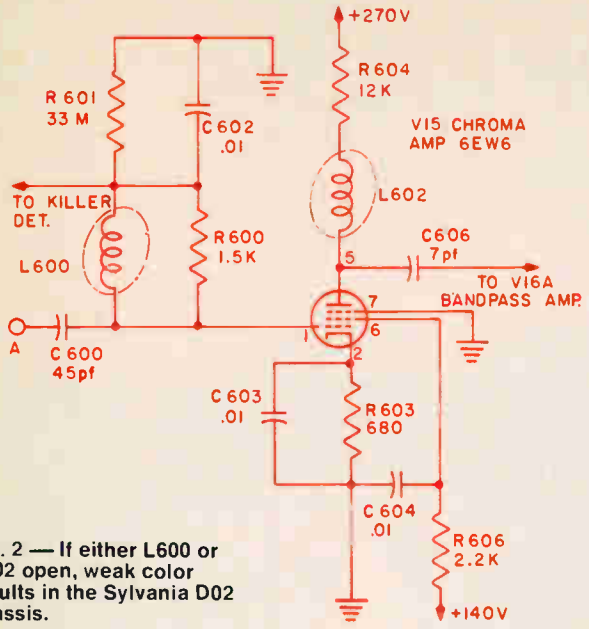


Fig. 2 — If either L600 or L602 open, weak color results in the Sylvania D02 chassis.

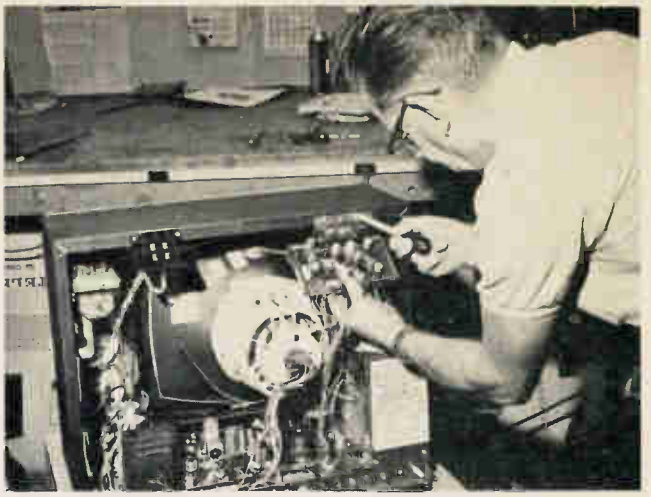


Fig. 3 — After a color receiver is repaired it is wise to make purity and convergence checks before delivering the set. Touch-ups can be made in the home.

ponding stages that amplify the missing color. The cause of two missing colors can usually be located in the demodulator or the R-, B- or G-Y amplifiers. The cause of a changing tint in a B/W screen can be located in the R-, B- and G-Y amplifier stages or the color CRT. And look for a change in the gray scale after the color receiver warms to the normal operating temperature.

To check if the color stages are working, simply flip the SERVICE/NORMAL switch to SERVICE position. Now adjust all SCREEN controls to minimum. Advance one color SCREEN control after the other to see if each shows a horizontal color line on the color CRT. If all colors register, the trouble is ahead of these stages. But it should be mentioned at this point that a bad SCREEN control can sometimes lead you astray. Make certain that all three controls are good.

No Color

The easiest problem to solve is usually "no color." Generally, as previously stated, the problem will be solved most of the time by replacing one or two tubes. First, substitute the 3.58MHz oscillator tube. Then, in turn, substitute the burst and bandpass amplifiers, demodulators, R-, G- and B-Y amplifier tubes. If only one color is missing, go to the tube that provides the missing color. If red is missing, for example, check the "X" demodulator and R-Y amplifier tubes. Likewise, if blue is missing, check the "Z" demodulator and B-Y amplifier tubes. Do not overlook the possibility of a bad gun in the CRT.

In the event two colors are missing, begin at the R-Y, B-Y and G-Y amplifier tubes that provide the two colors. It is unlikely that two separate tubes are at fault. Also check the CRT. You may have one dead color gun and another that's very weak.

Weak Color

When the symptom is weak or intermittent color, the situation can become real tough at times. The cause of very weak color or just not enough color, can originate anywhere from the antenna to the CRT.

In the aforementioned case, begin by assuming: if the B/W picture is good, the color picture should be good. But, first, we check all color tubes on the tube tester. This will help eliminate weak stages. Now, if any shorted tubes show up but replacements do not solve the weak color condition, we then check for overheating or burned plate and screen resistors. Also for open peaking coils or transformers in the plate circuits.

Weak color can likewise be traced to the 3.58MHz oscillator circuit, chroma amplifier, bandpass amplifier, burst amplifier and color-killer stages. One or two weak colors can be traced to the demodulator and R-, G- and R-Y amplifiers. Check and replace the 3.58MHz oscillator crystal if weak color persists.

A tube tester, VTVM and scope are valuable in locating weak color stages. It is usually best to employ the incoming station signal to check for weak color. In case the bar/dot generator is used, keep the generator's output low. You can fail to detect a weak color stage if a very strong color generator signal is used.

A Sylvania D02 chassis had weak color. Although a 6EW6 chroma tube checked out weak, it

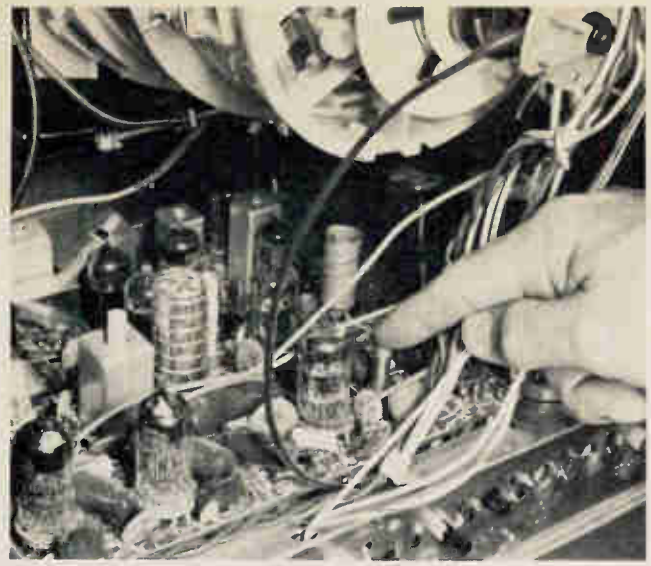


Fig. 4 — By pushing gently on various PC board components, you can frequently locate a poor connection.

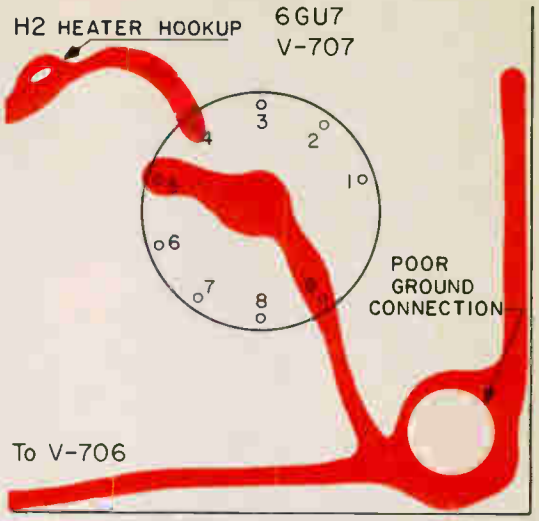


Fig. 5 — A bad heater ground connection caused intermittent color problems in an RCA CTC15A chassis.

and other replacements did not improve the color.

The scope probe was placed on pin 6 of the 3.58MHz 6GH8 oscillator, and the stage was oscillating. To save valuable servicing time, the circuit was "broken in half" by checking the signal on the plates of the "X" and "Y" demodulator tubes. The check showed below-normal color signal amplitude. Next, we progressed to the plate of the bandpass amplifier, 6KT8. Results were the same.

Then the scope probe was applied to pin 5 of the chroma amplifier and a weak, distorted signal appeared. The control grid indicated a good strong color signal. After checking the schematic we concluded that an open L602 or out-of-tolerance R604 could be causing the trouble. But R604 was a 2w resistor.

So a continuity check of L602 showed it was open. At first, if we had followed the clue revealed by the shorted chroma amplifier, we would have saved time. Undoubtedly, the 6EW6 tube drew heavy current and opened L602 (see Fig. 2).

In another Sylvania D02 chassis we found L600 to be open in the grid circuit of the same chroma amplifier — producing the same symptoms — weak color.

It is wise to make quick purity and convergence checks of each color receiver after it is returned to the customer's home (see Fig. 3).

Intermittent Color

Intermittent stages in a B/W chassis are often "tough" to locate. But an intermittent color stage is frequently even more difficult. You'll find it necessary to be extremely careful and patient when working on intermittent color problems. They can originate anywhere in the set from an improper color-killer setting to a cracked PC board.

Try to isolate the intermittent color to one or possibly two stages. Use the VTVM to determine if incorrect voltages or resistances are causing the trouble. A scope is ideal for checking intermittent color stages.

A complete, original manufacturer's schematic and full service information is a "must" when troubleshooting intermittent color circuits. Sometimes, by pushing gently on coils mounted on PC boards, using an insulated rod or your fingers, you can locate bad connections. (see Fig. 4).

Poor Color Picture

This intermittent color problem arose in a CTC15A RCA set and affected both color and B/W pictures. The gray scale of the B/W picture would change into various tints of color. At times, a 10in. reddish color-bar would appear down the center of the TV screen. Sometimes, after operating for four or five hours, the picture would fade and the raster go black.

One thing appeared certain, the trouble had to be in the last video stage, the R-, G-, B-Y amplifiers or in the color CRT. The color CRT checked good but was left connected to the tester for one hour in an effort to insure that a cold/hot intermittent condition did not exist in the CRT. All tubes were checked and a weak 6AW8 video output tube was replaced.

We now assumed the symptom could only be caused by a defective R-, B- or G-Y amplifier stage. And, of course, a weak video amplifier tube could make the raster go dark.

Let's check over the poor color symptoms once again. They were

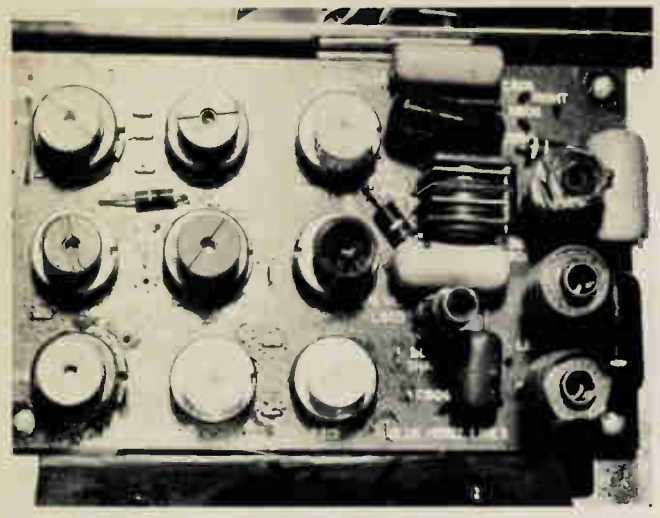


Fig. 6 — If one color suddenly disappears, check the stacked selenium rectifiers on the convergence board of an RCA CTC25XA chassis. Substitute if in doubt.

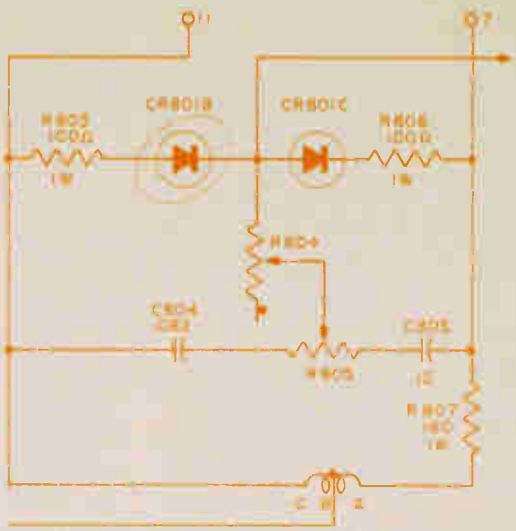


Fig. 7 — Intermittent stacked rectifier CR801B caused trouble in this CTC25XA chassis.

characterized by changes in the B/W picture, misplaced green and reddish color on the CRT screen, fading picture, then a dark raster.

Once again, we now assumed the trouble had to be in the R-, B- or G-Y amplifier stages.

Two new 6GU7 amplifier tubes were substituted. We still had the same trouble after the set operated for several hours in the color CRT mockup test jig. In some of the earlier models, the coupling capacitor between demodulator and amplifiers would become shorted or leaky. So we clipped one end of these but they checked good. All grid and plate voltages checked normal. The chassis was left to cook again on the color mock-up bench.

The chassis worked perfectly for two days and was then returned to its cabinet. Sometimes, an intermittent trouble will only act up when the chassis is enclosed in its own cabinet. This happened to be the situation in this case.

Fifteen minutes before delivery time, the set began to act up. Bingo! The picture narrowed, the raster appeared a sickly greenish-yellow and a wide red strip appeared down the center of the screen. Then the raster went black.

The back cover was carefully removed and the cheater cord was plugged in quickly. This chassis didn't have time to cool off. We saw the trouble directly before us: Both 6GU7 heaters were dark! By pushing around on one of the 6GU7 tubes, both came back to life again. Further checking showed a bad heater ground connection to the R-, B-, G-Y and blanker tubes (see Fig. 5).

Too Much Red

The customer's complaint on this CTC25XA was "too much red." In fact, sometimes there was a red line around the figures — according to the owner. We checked the chassis in the owner's home and everything seemed normal. The B/W and color pictures were both good.

We checked the TINT control with a color bar/dot generator clipped to the VHF antenna terminals. The color bars did vary 30deg and the skin hue was normal. After one hour of checking we returned to the shop.

Within three days we received the same complaint but found the color receiver working normal when we arrived. We coaxed the customer into letting us take the chassis to the shop for closer observation. But he wanted us to wait until after the weekend.

When we brought the chassis in and it was connected to the color-jig, it ran perfectly for five straight days. Poking around on the PC board turned up a fat zero. Actually, we had never seen the symptoms the owner complained about. So the chassis was returned.

When the chassis was replaced in the cabinet, a red ring appeared around every object on the screen. The owner said this was the trouble he had complained about. Then the picture returned to normal. Here we had intermittent convergence trouble.

We had "goofed" on this job in several ways. First, we were looking for excessive red in the picture with possible weak green and blue highlights. Secondly, we did not take the cabinet to the shop and left the defective convergence board attached to it.

Now we removed the convergence board and checked a few

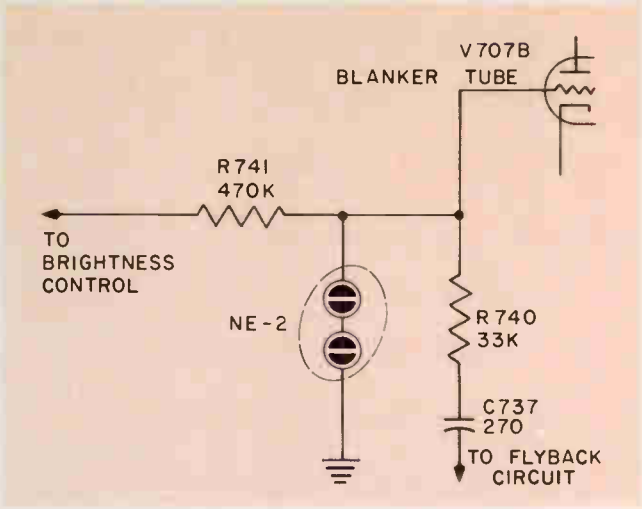


Fig. 8 — Replacing two NE2 lamps improved color-brightness in this RCA CTC10 chassis.

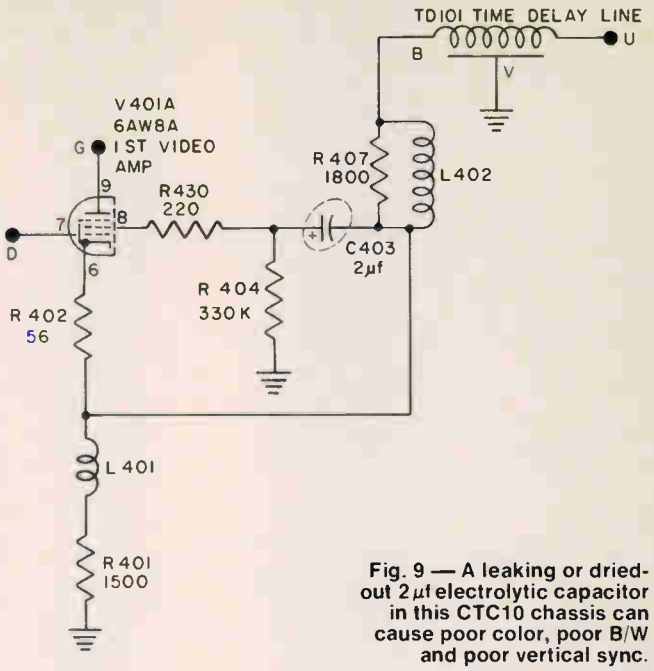


Fig. 9 — A leaking or dried-out 2 μf electrolytic capacitor in this CTC10 chassis can cause poor color, poor B/W and poor vertical sync.

controls. By moving the stacked selenium rectifier on the convergence board, the red color popped out. The resistance of each section of the rectifier was checked with an ohmmeter. Then, by twisting the prongs lightly, we found one section would open (see Fig. 6 and 7). When the rectifier assembly was replaced, the "too much red" problem was solved.

Very Weak Color

The complaint on an RCA CTC-10 chassis was "very faint color." The set had been this way for two entire weeks before the owner brought it in from a deep-fringe area. All tubes were checked. We knew this one had to be in tip-top shape for deep-fringe reception. Both UHF and VHF tuners were cleaned and then the chassis was connected to the color jig.

Replacing the RF tube in the tuner and a 6GM6 in the IF section improved the B/W picture. We still had very little color, plus some vertical roll. The tube tester showed a short in the burst amplifier tube and a weak reactance tube. Both were replaced and this improved the color somewhat. Still, we were a long way from good B/W and color pictures.

We quickly checked our color file on the CTC10 chassis. Sure enough, a couple of modifications had been made to improve both B/W and color reception.

By replacing two small neon lamps, the color brightness was improved (see Fig. 8). Also, the vertical sync and B/W picture were greatly improved by replacing a 2μf electrolytic capacitor in the video circuit (see Fig. 9). To go a step further, the color picture was improved and became more stable when the 3.58MHz crystal was substituted. We had checked the oscillator grid with a VTVM and found it to be −3v. And after replacing the crystal, it measured −7v.

Two Colors Missing

The complaint was "poor color" on this Admiral LK5591 model. When the receiver was first switched on, the picture appeared green and the raster was slow in filling out. A possibility of two separate troubles existed: poor color and insufficient width. We also learned that the owner had "fiddled" with the color knobs at the rear.

The insufficient width problem was solved by replacing the horizontal output tube. Now to tackle the color problem. Adjusting the FIDELITY control made the picture go from green to greenish-blue.

By changing the 3.58MHz oscillator tube, the color picture was restored. At least we had some red in the picture. The color picture was additionally improved by setting up the B/W scale and touching up the convergence.

But three days later we were called back for the same trouble. Again we had no red and very little blue color. The color demodulator tube involved was substituted with little result. Then, by checking the SCREEN controls, we had no red and very little blue. The horizontal line was green as grass.

We concluded that the trouble was intermittent and now had broken down altogether. The trouble was definitely in the color demodulator stage or screen circuits of the CRT. To make certain, the color CRT was checked first. We didn't have to go further. The green gun checked perfect, the blue gun was very weak and the red gun barely moved the meter needle. ■

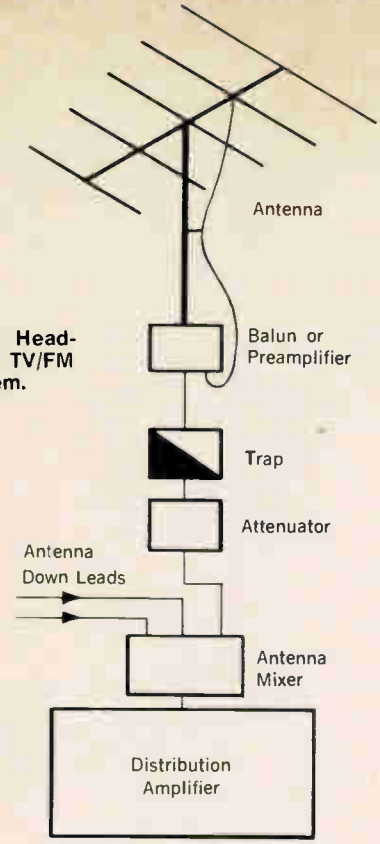


Fig. 1 — Head-end of TV/FM MATV system.

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Selling and Installing MATV Systems

Here's another 'boat' you'll regret missing if you don't start up the gang-plank now

■ The idea of master antenna TV systems (MATV) for improved TV and FM radio reception is not new. But, because many of the 60-million homes in the nation which have TVs and FM radios are fast graduating into the 2- and 3-set category, a strong demand for the systems has developed in recent times.

Some 15 years ago, MATV systems started to become popular in apartment houses, motels, hospitals, hotels and schools. Now their popularity has spread to the home and the demand is rapidly increasing. The system is sometimes called the "wall-to-wall" antenna concept.

Even in those homes having one or two portable-type sets mounted on wheels, the MATV concept has caught on. When this home is wired for a MATV system — having three or four outlets in as many rooms — the one or two sets become more versatile, practical and useful. Good reception can be quickly obtained in any room that has a power and antenna outlet.

The demand for better color TV reception has also spurred the MATV concept forward. And, finally, let us not forget the influence which the expanding UHF and FM/stereo sectors are now exerting on MATV. Most MATV systems for homes are designed to cover VHF, UHF and, of course, FM radio. And service-dealers who do not take advantage of this great potential are truly missing the "sky-boat."

Getting Started

It is unlikely that a significant number of your customers will come into your shop tomorrow morning and start demanding MATV systems for their homes. You'll have to sell them. But, before you can sell 'em, you'll have to know precisely what you're selling and why. You might begin by informing yourself of some pertinent facts about the business:

For over twenty years, for example, you might start by informing yourself, (and tell your customers later when you are properly prepared), that the TV set has to a great extent dominated living room arrangements in many homes. In most cases, the TV set is located near a window and ac outlet — making it necessary to arrange all other furniture so that TV may be viewed with reasonable comfort. Unsightly cords, lumps under the rugs and coils of wire hanging behind the set not only compromise set performance but ruin room decor. But it is easy to eliminate these inconveniences in both old and newly constructed homes by installing MATV systems. You're not convinced?

From the viewpoint of convenience and flexible room arrangements, it makes good sense to have several TV outlets in the living room of the modern home. Increased use of portable TV also creates the need for at least one TV outlet in every room where it is to be used. Add to this the FM receivers, and we have another argument for home type TV signal distribution systems. But why stop here.

With the number of two-, three- and four-set homes increasing, you either install additional unsightly antennas on the roof or use inefficient signal-depleting couplers. But, for top-performance (at the same time eliminating signal-sapping coils of wire hanging behind the set, lead-in running under

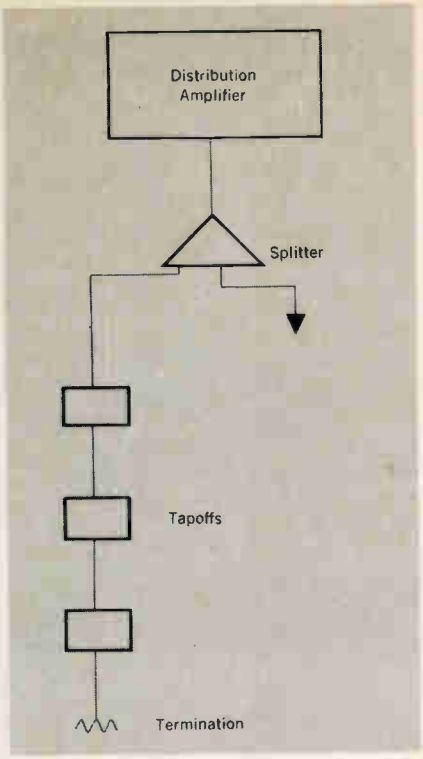


CHART I

DB TO VOLTAGE TIMES CONVERSION CHART

DB	Voltage Times	DB	Voltage Times	DB	Voltage Times
1 DB	1.12X	16 DB	6.3X	31 DB	35X
2 DB	1.25X	17 DB	7X	32 DB	40X
3 DB	1.4X	18 DB	8X	33 DB	45X
4 DB	1.6X	19 DB	9X	34 DB	50X
5 DB	1.8X	20 DB	10X	35 DB	56X
6 DB	2X	21 DB	11X	36 DB	63X
7 DB	2.25X	22 DB	12.5X	37 DB	71X
8 DB	2.5X	23 DB	14X	38 DB	80X
9 DB	2.75X	24 DB	16X	39 DB	90X
10 DB	3.16X	25 DB	18X	40 DB	100X
11 DB	3.55X	26 DB	20X	43 DB	140X
12 DB	4X	27 DB	22.5X	46 DB	200X
13 DB	4.5X	28 DB	25X	50 DB	300X
14 DB	5X	29 DB	28X	56 DB	600X
15 DB	5.6X	30 DB	32X	60 DB	1000X

Fig. 2 — (Left) TV/FM MATV Distribution system.

the rug or mashed under a metal storm sash), you will have to give your customers MATV systems. Many of your customers will never know what really satisfactory TV reception is until you give them a signal distribution system with outlets.

In addition to following common-sense conclusions that lead to selling yourself and your customers on a better "TV-future," you'll have to learn how to design and install various types of MATV systems to fit a wide variety of customer needs.

You'll have to learn all about signal preamplifiers, amplifiers, baluns, matching transformers, line splitters and many other specialized components. You'll find yourself paying more attention to antenna capabilities, signal gain, system noise figure, amplifier response and impedance match. But we'll give you the complete story in this article series, plus additional important information in the antenna article series, "Antennas — Sans 'Bafflegab' and 'Bushwa,'" which began in the September, 1967 issue.

The MATV System

You'll learn first that an MATV system has two main sections: the headend (see Fig. 1) and the distribution system (see Fig. 2). The headend normally consists of the antenna and preamplifier (whenever required). Additionally, the headend may include mixing networks, traps, filters and other components — depending on specific considerations which will be detailed in forthcoming articles.

You should not jump to the conclusion that selling and designing MATV systems is difficult. In fact, all the arguments for them are essentially "pat" and create a soft-sell situation as far as most TV/FM users are concerned. And selecting the components for any given system is very simple.

We select the individual components for the distribution system first. We then select the headend components. Additionally, instead of trying to work with signal strength, gain and loss in microvolts, we apply decibels (db) which reduces the process to simple arithmetic addition and subtraction.

For example, we begin by establishing a reference level of 0db (or 1000μv) to which all plus or minus db are referenced to. (This is established across a 75Ω impedance.) We don't actually need this much voltage to operate most modern TV sets, but it is established this high to provide an adequate margin of signal under all conditions.

Now, with a signal level of 0db at the input of an amplifier having a 20db gain, for example, all we need to do first is add up all the various system losses (cable, splitter, insertion, isolation, etc.) and subtract them from the amplifier gain. This provides us with the amount of signal, in db, available at the amplifier output. If we want to know how much voltage this amounts to, we simply multiply db by its voltage/times factor. We don't even have to figure this out, all we need to do is refer to Chart I as shown above.

Suppose, for example, we have a 0db input signal to a certain amplifier which has a 20db gain. The total system loss is 12db. By deducting 12db from 20db we come up with 8db. The voltage/times factor

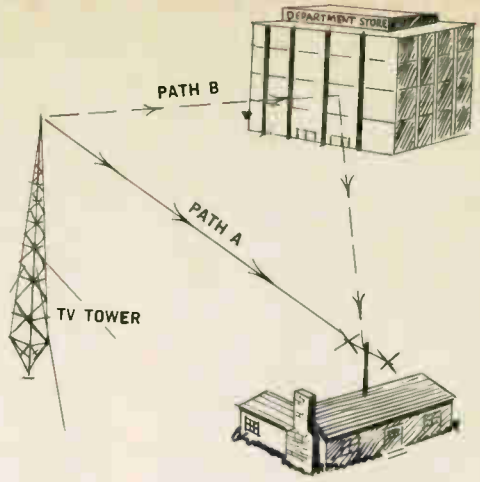


Fig. 3 — High buildings, hills, smokestacks, etc. can sometimes become a problem and requires selection of antennas having sharp frontal lobes — high front-to-back signal ratios.

CHART II

RG 59/U	2.7	3.5	4.1	5.8	8.9	9.8	11.0	12.2
RG 59/U FOAM	2.1	2.7	3.1	4.2	6.0	6.7	7.3	7.9
RG 11/U	1.4	1.7	2.2	3.2	4.9	5.4	6.1	6.3
RG 11/U FOAM	1.1	1.4	1.6	2.3	3.7	4.0	4.4	4.9
*300 CHAR. RIBBON	.75	1.1	1.7	1.8	2.9	3.3	4.2	4.5

* ATTENUATION IS MUCH HIGHER WHEN WET.

for 8db, as shown in the chart, is 2.5. Now 2.5 times 1000μv is 2500μv. We shouldn't have any trouble working 2 TV sets and a couple of FM receivers from a system of this type.

After the distribution system is all down on paper, we then select the antenna and preamp (if a preamp is necessary) to provide a 0db (or 1000μv) signal at the distribution amplifier input.

Of course, it is not quite as simple as we have made it sound. If you want to sell and install MATV systems successfully, you'll need to spend a modest amount of time studying, doing research and learning more about the essential details involved in selecting proper head-end components, including antennas and distribution system components.

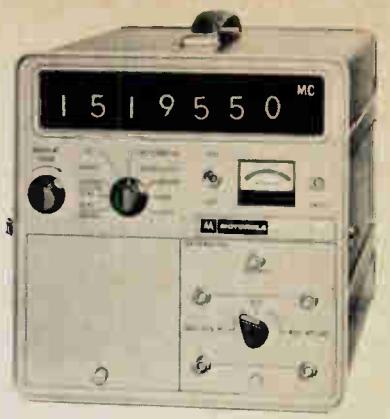
Some details in the area of overall planning, for example, will include a determination of the direction and the number of channels your customer desires (or can be received from a practical viewpoint). The best type of antenna or antennas necessary to provide acceptable reception on these channels must be determined. You will have to decide if a rotator is necessary or not. All of these considerations become more critical in fringe- and deep-fringe areas. And the matter of antenna mast or towers, their location, type and height becomes a fundamental consideration.

You may be confronted with the problem of ghosts, if high buildings or hills, smokestacks, etc. are located to the right or left of the reception location. You may also find yourself faced with a co-channel or adjacent channel interference problem or both. And in certain areas you may run into intermodulation distortion, caused by two frequencies mixing together to produce a third. This can happen, for example, when a very strong FM signal on or near 100MHz mixes with 77MHz (channel 5), causing interference on 177MHz (channel 7).

To provide the kind of reception the public demands today, especially on color TV, the MATV system must be designed to equalize signal levels on VHF, UHF and also FM stations. This is not exactly an easy job. But it can be accomplished by proper choice of antennas, and the proper use of attenuators or preamplifiers prior to the distribution system input. Here we generally find it more economical to attentuate the stronger signals down to the weakest signal levels by using variable attenuators — if the weakest station or stations provide at least 0db at the amplifier input.

You will also find it necessary to give more careful consideration to selecting antenna lead-in and cable used in the distribution system. Newly designed, lower-loss cable has come on the market in recent times and by careful selection of lead-in and cable you can frequently "juggle" and "trade-off" one component for another — arriving at an overall optimized system to fit any particular situation or need. Some cable characteristics are shown in Chart II, but the latest "brand-named" products available are not included.

Forthcoming articles will go into greater detail regarding the business and technical factors briefly outlined here. ■



Motorola's model S-1075 digital frequency meter.

MAKING A GO AT 2-WAY RADIO

Know the specialized test instruments needed and procedures required to check and maintain this equipment

Part Two of an In-Depth Series

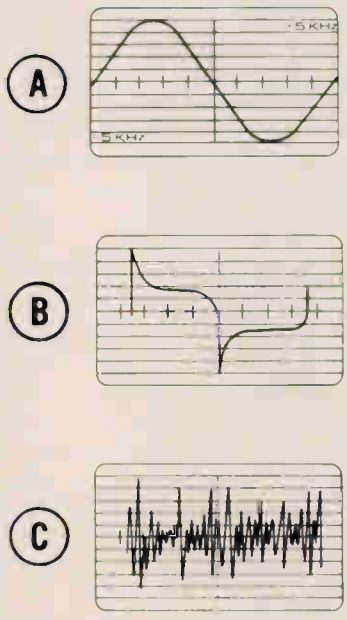


Fig. 1 (A) — Exact 5kHz deviation. (B) — Spikes caused by limiting problems. (C) — Typical voice pattern. All as seen on Gertsch visual deviation monitor.

■ The introductory article of this series (ELECTRONIC TECHNICIAN/DEALER, January 1968), gave you a brief, general outline of the essential business and technical factors involved in establishing and conducting a successul two-way radio communications equipment sales and service business. One important point mentioned was the specialized test instruments needed.

Keeping in mind the preventive-maintenance concept also stressed in that article, let's take a closer look at some of the test instruments needed and checking procedures necessary to maintain FM two-way equipment properly.

Deviation and 'Netting' Checks

If you give your two-way customers the kind of service required to keep their equipment operating at top efficiency and, which is also important, the kind of service which will keep your business prospering, two important periodic equipment checks are necessary: These are FM deviation and "netting" checks. And, once again, specialized

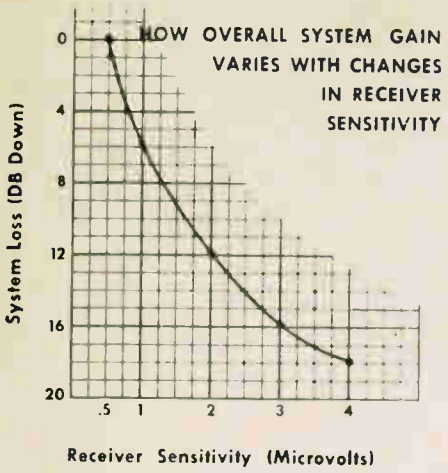


Fig. 2 — Receiver sensitivity/gain chart.

Gertsch monitor, model DM4.

Gertsch frequency/deviation meter and signal generator, model FM9E.

test instruments are needed to perform this work rapidly and accurately.

Because audio recovery at the FM two-way receiver is directly proportional to transmitter deviation — up to the limits prescribed by present-day business, industrial, etc., FM systems — it is necessary to adjust the deviation control of narrow-band FM (NBFM) transmitters to within prescribed limits (±5kHz). This can be done in a number of ways, but an accurate combination frequency/deviation meter can provide the means for doing the job easily and rapidly. Additionally, with the aid of a scope, the audio output quality of a transmitter can be easily checked (see Fig. 1A, 1B and 1C). The scope can be either an accurately calibrated general-usage type or it can be a modern, solid-state type specially designed and calibrated for two-way work. The latter instrument is usually called a "visual deviation monitor."

The frequency meter, whether a single instrument or in a combination frequency/deviation or other meter combination, can be obtained in either a standard dial-reading type or one having a digital readout which displays frequencies in MHz, kHz and Hz.

All instruments mentioned here come with operators' manuals which contain complete and detailed instructions.

It should be mentioned at this point that the transmitter's center frequency should be measured prior to making deviation checks. And, since the center frequency tolerance of NBFM transmitters (operating above 50MHz) is ±0.0005 percent, the frequency meter must be accurate to within half this figure, or 0.00025 percent. But the tolerances of high-grade frequency meters used in two-way work today are thoroughly adequate for adjusting the center frequency to within these prescribed limits. The accuracy of high-grade deviation meters is within 3 percent or better.

It should also be noted here that many present-day two-way communications transmitters have designed-in automatic deviation limiting circuits (ADL) which clip audio that would normally cause over-modulation.

The "netting" process involves tuning all transmitters of a base-station/mobile network to the exact frequency or frequencies to which they are assigned. Then all receivers of the network are tuned to the frequency or frequencies of the transmitters they expect to receive.

One good method for netting a base/mobile system is to first set the base-station transmitter to its exact assigned frequency with an accurate frequency standard and then tune its receiver to the exact frequency assigned to the mobile transmitters. The base-station transmitter and receiver are then used as standards for adjusting both the mobile transmitters and receivers.

Specifically, this is done as follows: When the base-station transmitter and receiver are properly tuned, the base-station transmitter is put on the air in a normal manner and its carrier is used to tune each of the mobile receivers. Using a portable test set connected to a mobile receiver's metering socket, each mobile receiver oscillator is tuned in turn to discriminator zero. In a similar manner, each mobile transmitter is put on the air and tuned to give a zero discriminator reading at the base-station receiver.

Lampkin crystal calibrator atop the 105B frequency meter.

Lampkin type 205A FM modulation meter.

It should also be mentioned here that each mobile receiver and transmitter is rechecked periodically with an accurate frequency meter to insure on-frequency operation and efficient transmission and reception for each unit in the network — likewise, with the transmitter and receiver at the base station.

Receiver Sensitivity and Noise

Two other important preventive maintenance checks are necessary before efficient operation of a two-way communications system can be assured: This means checking receivers periodically for sensitivity and ambient noise. Special test instruments are also required to perform this work.

As we already know, receiver sensitivity is normally expressed in terms of the amount of signal strength required to produce 20db of noise quieting. And since all high-grade receivers have a guaranteed sensitivity specification, the idea is to keep the receiver's sensitivity at this level.

The curve in Fig. 2 shows how gain varies with changes in receiver sensitivity. The figure 0.5μv is used as a reference point and is plotted at the zero db level for convenience.

From the viewpoint of over-all system performance, the receiver's sensitivity is closely associated with the ambient noise level.

Ambient noise is measured in terms of microvolts of noise — the same as received signals are measured in microvolts of strength. For efficient communications, signals at the receiver must be greater than the ambient noise. Where the ambient noise level overrides the signal level, the signals will not be readable regardless of the receiver's sensitivity.

Note that ambient noise and signal level will vary from point to point throughout the operating area of a system. Thus, it becomes necessary to check ambient noise levels at various points within the system's operating area. Generally, noise will be considerably lower in rural areas than in heavily populated industrial areas.

To check receiver sensitivity, an accurate signal generator and good ac voltmeter, calibrated in db, are needed. The signal generator must have a calibrated output control that indicates signal strength for each control setting. The technique requires an unmodulated signal which is injected into the receiver and increased gradually until a drop of 20db occurs in the speaker noise level.

For example, if the receiver's sensitivity is specified as 1μv, then a 1 μv injected signal should reduce receiver noise 20db. These checks should be made periodically and recorded in the station's log book or service record book.

Problems of ambient noise and receiver sensitivity will be discussed in more detail in a forthcoming article of this series.

A number of other important checks, requiring specialized instruments and test accessories, are also necessary to properly maintain various types of two-way communications equipment. These include wattmeters to check transmitter power output, dummy antennas, specialized test-sets which save time in making transmitter and receiver checks and other specialized test instruments. Some of these instruments and their practical uses will be mentioned in a forthcoming article of this series. ■

Heathkit Model IM12 harmonic distortion meter.

Hewlett-Packard Model 403A ac transistor voltmeter.

Motorola Model S1053C solid state AC voltmeter.

TEKLAB REPORT

Part Four of a Test

Using Audio Test

Understand how distortion analyzers work —

■ Part three of this series (ET August 1967), covered the sine/squarewave generator, combined with a scope, for faster and more efficient servicing.

We'll now put a typical harmonic distortion analyzer and ac voltmeter to work to detect distortion in modern audio amplifiers — "listening tests" for distortion are not accurate enough.

A harmonic distortion meter is used primarily in conjunction with an audio frequency sinewave generator to determine the distortion characteristics of audio amplifiers and components used in audio amplifiers.

A harmonic distortion analyzer tells us how much distortion has been added by an audio amplifier. The instrument simply "subtracts" the amplifier's original input signal from its output signal. The difference is harmonic distortion and is generated by the amplifier.

Harmonics

If you listen to a 440Hz sinewave generated by an audio oscillator and fed through an amplifier and speaker, you can identify the tone as "A" above middle "C" — if you have an ear for music. Then if you strike "A" above middle "C" on a piano, there should be a resemblance between the notes. You will observe that the frequency, or pitch, of each note is identical. But the sound quality, or what musicians call "timbre," is quite different. Practically all musical instruments cover the 440Hz range but each note "sounds" different. This audio difference between musical instrument notes arises because of the difference in "harmonic content" of the notes produced by each instrument.

Harmonics are classified by their relationship to the fundamental tone. A second harmonic has twice the frequency of the fundamental, a third is three times, etc.

Before we begin to use a distortion analyzer, it may prove helpful to understand the fundamental-suppression circuit used in a typical instrument.

The Fundamental-Suppression Circuit

The fundamental-suppression circuit described here is contained in a Heath Model IM12 distortion analyzer. The circuit consists of a triode voltage amplifier (½ 12AX7) driving a phase splitter which uses a triode-connected pentode (12BY7). The phase splitter feeds the Wien bridge null network (shown in Fig. 1) to suppress the fundamental test frequency. The signal voltages that do not cancel in the null network are directly coupled to a triode (½ 12AX7) connected as a cathode-follower.

The Wien bridge requires two signal voltages of opposite phase at a 2:1 voltage ratio to produce a null. The plate and cathode signal voltages of the phase splitter are opposite in phase. The voltages are approximately 2:1 because of plate- and cathode-load values.

The frequency determining elements of the Wien bridge are the resistance-capacity series arm and the resistance-capacity parallel arm.

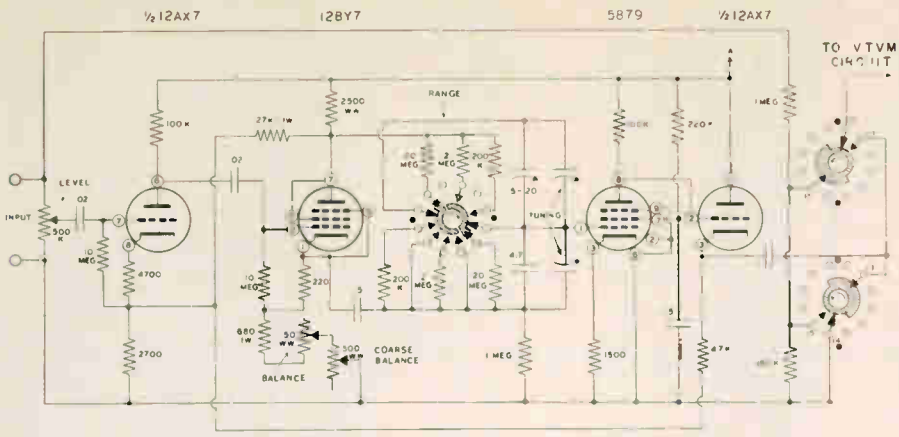


Fig. 1 — Schematic of the Heath IM12 harmonic distortion meter shows the Wien bridge circuit which cancels out the fundamental frequency.

Instrument Series

and Alignment Instruments

your ears are not good enough for checking amplifier distortion

The resistances are equal, as are the capacitances. Minor tolerance variations within the precision resistors and tracking variations of the two-gang tuning capacitor are compensated by the BALANCE control which varies the 2:1 voltage ratio a small amount.

The natural response of a Wien bridge null network is too broad for a distortion analyzer, at twice the null frequency (where the second harmonic appears) the response is still considerably attenuated. Using negative feedback around the bridge, from the (½ 12AX7) cathode-follower to the input (½ 12AX7) cathode, the bridge response is altered to a sharp notch at the null frequency with nearly flat response above twice the null frequency and below half the null frequency.

The RANGE switch selects the resistance values in the Wien bridge frequency determining arms. The two intermediate switch positions open one arm and short out the other arm. This permits the 12BY7 tube to function as a cathode-follower only and drive the 5879 tube grid directly. Then this section acts as a normal amplifier having the same gain and frequency response but without the Wien bridge null in the response characteristic.

In operation, the whole input signal is fed through this section to the voltmeter circuit. The operating level of this section is adjusted with the INPUT LEVEL control to give a full scale meter reading.

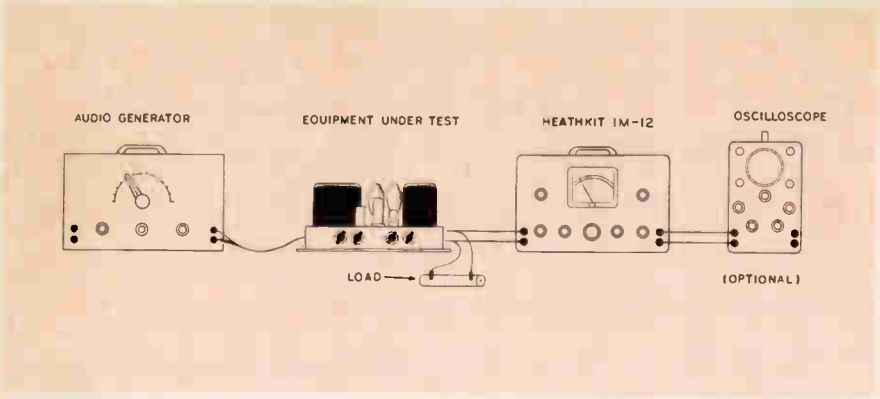
When the Wien bridge is switched into the circuit and adjusted to eliminate the fundamental, the remaining voltage is read on the meter as distortion in percentage of full scale.

The physical construction of the Wien bridge, such as the "hot" tuning capacitor frame and the high impedance above-chassis ground level (20M on the 20-200Hz range), tends to make the instrument subject to hum pickup. This inherent sensitivity is substantially reduced by the feedback loop around the bridge. But during operation at or near line frequency, the null network opens the feedback loop and the hum reduction is thus ineffective. Therefore, by shielding the tuning capacitor, shielding the range switch, insulating the capacitor shaft and by using balanced filament wiring and a wired ground circuit, the residual hum level is reduced.

Rules for Distortion Checks

There are certain rules you should follow when making harmonic distortion checks: You do not need a dummy load when checking the Hi-Fi preamp. You can feed its output directly into the distortion meter. A power amplifier must have a correct "dummy" load across its output to get a reading of any significance. A resistor rated at least twice the amplifier's maximum output power will be needed.

It is a good idea to check the audio signal generator for distortion — the generator can be checked by feeding its output directly into the distortion analyzer.



A typical setup of test instruments and amplifier for harmonic distortion measurements.

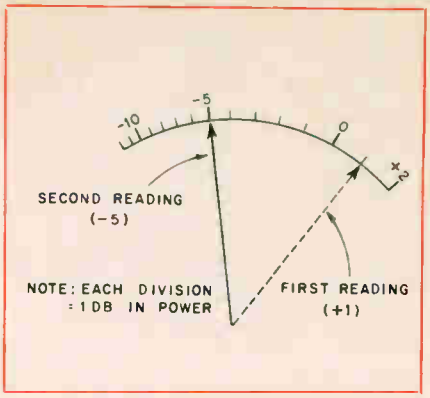


Fig. 2 — Reading the ac VTVM db scale.

The distortion meter reads everything coming through the amplifier except the fundamental frequency which is nulled out by the Wien bridge and may interpret hum as harmonic distortion. It is a good idea to check the amplifier's noise level against manufacturer's specs before checking an amplifier.

Distortion will build up gradually as the output power of an amplifier is increased — up to a point where the waveform clips and you will notice a sudden increase in distortion to the 5 or 10 percent range or more. So when clipping appears at the tops and bottoms of the sine-waves, you are at about 1 percent distortion. Now let's take a look at our ac voltmeter.

The AC Voltmeter

The ac voltmeter, when used properly, can be a valuable test instrument in servicing audio equipment. The instrument can be used for a variety of purposes, including amplifier frequency response checks, signal tracing, power level measurements, gain measurements, amplifier-balancing applications and general audio voltage measurements.

We use this instrument because of its high input impedance. In simple terms, it doesn't load the circuit being checked. If we use an ordinary voltmeter on an AVC circuit, we would use a low scale of about 2 or 3v. A 1k ohms/volt meter on this low scale, may have a total resistance of only 2 or 3K — enough to short circuit the signal. Using an ac voltmeter we would do the job very nicely with its input impedance of about 11M or more.

When using the ac voltmeter for audio equipment, we will be reading the db/scale in a number of applications. Most of us know what db (decibel) means but some are not too sure. In the beginning db was a means of expressing the relationship between human hearing and audio strength. Since the human ear does not respond to audio in direct proportion to its strength, a unit of measurement corresponding to the ear's volume nonlinearity was adopted called the bel, and is used most frequently in one-tenth units — or deci-bel. The human ear responds to a logarithmic increase or decrease rather than in a linear manner and this is what db expresses.

The difference in output capabilities of a 50w and a 25w amplifier is only 3db louder, not "twice as loud" as some may think.

Reading the Decibel Scale

When making a frequency response check on an amplifier at the reference frequency, the output level of the amplifier causes the meter to indicate "+1" on the db scale (as shown in Fig. 2). The frequency of the amplifier's input signal is then varied, resulting in a second reading of "−5" on the scale. Since the meter pointer has deflected 6db in a negative direction (from +1 to −5), the power level variation would be expressed as −6db.

If it becomes necessary to set the RANGE switch to another range while making db measurements, then the reading on each range must be algebraically added to the figure shown on the selected range switch position. This permits a db reading from one range switch position to another.

If in the aforementioned example the first reading of "+1" is taken with the RANGE switch in the "10db" position and for the second reading of "−5", it is necessary to switch to the "0 db" position. Then the power level variation in db is determined as follows:

First reading (+1) + (+10) = +11

Second reading (−5) + (0) = −5

From +11 to −5 indicates a −16-db power level variation.

Measuring Amplifier Frequency Response

The ac VTVM referred to in the

Eico Model 261 ac volt/watt meter.

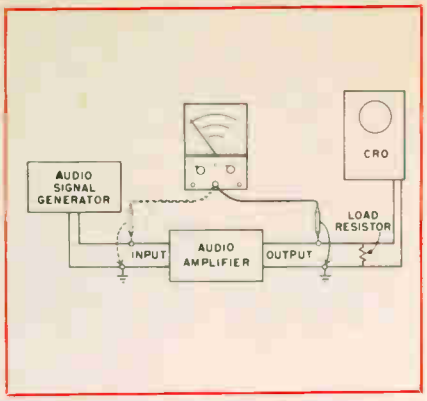


Fig. 3 — Test setup for frequency response measurements.

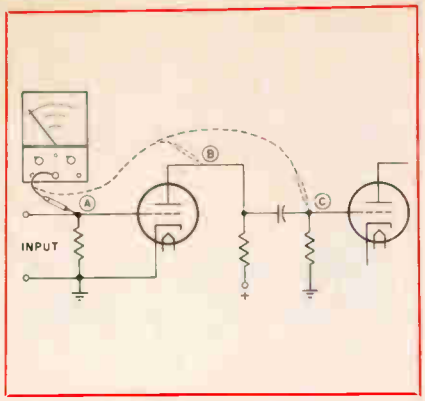


Fig. 4—Making voltage gain measurements in an audio amplifier.

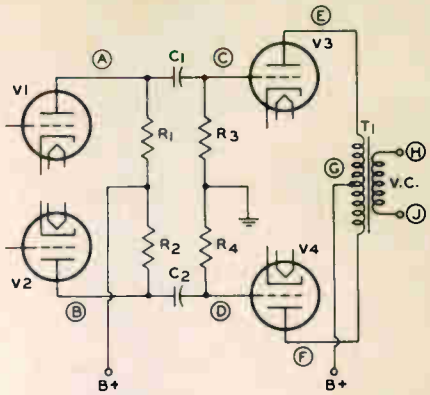


Fig. 5 — Test points in an audio amplifier circuit.

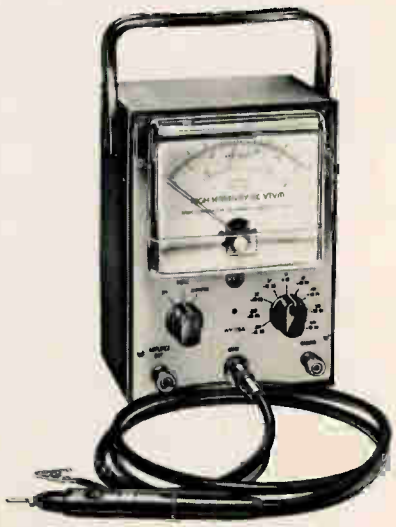
setup (Fig. 3) is an RCA type WV76A. An audio-frequency generator is also needed to supply the input signal.

Three response checks at different power levels are recommended to obtain an accurate picture of response. The amplifiers should be checked at a low audible level, a moderate listening level and at the maximum power level.

1. Connect the equipment (as shown in Fig. 3). The ac VTVM should be connected to the input of the amplifier each time the input frequency is changed. If necessary, adjust the output control of the audio generator to provide a constant input amplitude for all frequencies.

The resistive load connected across the amplifier should be a noninductive type and capable of dissipating the total power output of the amplifier.

RCA Model WV76A ac VTVM.



The Scope (shown in Fig. 3) is not necessary for the frequency response check but it may reveal distortion in the output waveform.

2. Set the FUNCTION switch of the ac VTVM to METER and the slide switch on the probe to DIRECT. Set the RANGE switch to a position which will include the expected value of the voltage to be measured.

3. Set the amplifier VOLUME control to the position which provides the output level at which the check is to be made. If the amplifier has TONE controls, set them to the FLAT position so they have a minimum effect on the amplifier frequency.

4. Adjust the generator to the desired reference frequency. The usual reference frequency is 1kHz.

5. Adjust the generator output control so the ac VTVM pointer indicates the desired reference level. Check the voltage at the input of the amplifier. It is important that the input signal voltage does not vary as the frequency is changed in the following steps. If it does, reset the generator's OUTPUT control so the original input signal voltage is maintained.

6. Tune the audio generator to the lowest frequency to be measured. Record the db meter reading (number of db above or below the reference power level).

7. Tune the generator up to the next frequency to be measured. Below 200Hz, take a reading every 10 or 20Hz. The interval can be increased to 1kHz when the readings begin to level off.

8. Repeat steps 3 through 7 for each power output level at which the frequency response check is to be made.

Gain Measurements

Voltage gain measurements of amplifier stages can be made by measuring the input and output voltages of the stage and dividing the input voltage into the output voltage. The quotient is the gain figure.

With a conventional amplifier arrangement as shown in Fig. 4, the input voltage is measured from point "A" to ground. The gain of the tube is determined by measuring the voltage from point "B" to ground and dividing this reading by the input voltage. The entire stage gain must include whatever loss results in the coupling circuit. Consequently, the output voltage must be measured at the grid of the next stage, point "C," to get proper voltage gain measurement.

AC-Balancing Adjustments

The dynamic balance of push-pull amplifier circuits can be checked by setting up the ac VTVM for voltage measurements and checking the signal levels at various points throughout the amplifier. A typical amplifier circuit which uses a push-pull driver and push-pull output stage is shown in Fig. 5. If the circuit is properly balanced, the signals as measured from point 'C" and point "D" to ground should be equal. Similar balance checks can be made from points "A," "B," "E" and "F." ■

The Nineteenth Article in a Continuing Series

Semiconductors from

Knowing basic photofet and light-emitting diode principles

■ The previous article described the operation of front-wall and back-wall photovoltaic cells (solar cells), photoconductors (photoresistors) and phototransistors. There are still two other photosensitive semiconductors that electronic technicians must prepare to encounter — the photofet and photomos.

Photofet Transistors

The basic structure of a junction field-effect transistor (FET) was illustrated in Fig. 1 of the December 1966 article. Virtually no electrons can flow from the channel (P-type material) to the gate (N-type material) in this transistor when the N-type material is at a more positive potential than the P-type material. Under these conditions, the junction of P- and N-type material acts like the junction of a reverse-biased diode and resists current flow. The greater the reverse bias, the greater the junction's effective size and the smaller the remaining area in the P-type material for source-to-drain channel current. The reverse-biased junction has reduced the source-to-drain current.

The photofet (Fig. 1) operates on a similar principle. A thin slice of P-type silicon material (the substrate that will act as the gate) is secured to a metal surface. A film of N-type material is deposited on the substrate. This film functions as the photofet channel, and source and drain leads are secured to it.

When the substrate of P-type material is made more negative than the film of N-type material, the junction separating these two types of material is reverse biased and resists the flow of electrons. The greater the applied reverse bias, the greater the effective size of the junction, and the thinner the conductive portion of the film between source and drain. The reverse biased junction has reduced the source-to-drain current.

When exposed to light, the photofet's junction of P- and N-type material functions like the photodiode junction described with Fig. 9 in last month's article. When light strikes the photofet junction, electrons in the P-type material pass through the reverse biased junction into the N-type material. Light has the effect of reducing the reverse bias junction resistance, increasing the source-to-drain current.

A basic photofet circuit is shown in Fig. 2. The gate biasing voltage (V_{GG}) is adjusted so that the drain-to-source current (I_D) is reduced to nearly zero when the photofet is not exposed to light.

When exposed to light, the photofet's gate current increases in proportion to the intensity of the incident light. This additional current is labeled λi_G. The resulting change in the voltage drop across the gate resistor (R_G) can be determined by the equation $\lambda v_G = \lambda i_G R_G$. Since the potential of the voltage source (V_{GG}) remains virtually constant, the change in the gate-to-source voltage is equal to the change in the voltage drop across the gate resistor.

The greater the intensity of the incident light, the greater the resulting voltage drop across the gate resistor, the smaller the gate-to-source voltage (gate reverse bias) and the greater the resulting drain-to-source current. The smaller the intensity of the incident light, the greater the resulting drain-to-source current (I_D). Changes in the intensity of the incident light result in corresponding changes in the gate-to-source current, the drain-to-source current and the resulting voltage drop across the load resistor (R_L).

Neglecting limitations resulting from noise factors, the greater the value of a photofet's gate resistors (R_G), the greater the photofet's sensitivity. The December 1966 article explained that FETs are high-impedance devices because of their very small drain current. Measurements indicate that for one photofet the drain current (I_D) varied from 20na (20×10^{-9}a) per foot candle when this resistance (R_G) is zero to 20ma (20×10^{-3}a) per foot candle when this resistance (R_G) is 500M. Increasing the gate resistance 500M increased the sensitivity 10^6 times.

Photofets have a greater light sensitivity than any of the photosensitive semiconductors described last month. Their frequency response, although high, is not quite as high as some photodiodes. Their noise level, however, is generally better than that of a diode and transistor or diode and FET combination. They reportedly are at least ten times as sensitive as a phototransistor with four times the gain bandwidth product. In TEKLAB tests we obtained an adequate frequency re-

A to Z

will prepare you to understand new test instruments and consumer products

sponse from a modulated light source undetected by the phototransistors checked.

Photomos Transistors

Photomos transistors (photosensitive MOS transistors) are still in the experimental stage. At last report, experimental models failed to have a desirable low-noise factor or sufficient stability. Future photomos transistors will probably resemble the MOS transistors illustrated in Fig. 1 and 5 of the January 1967 article. The insulation and gate electrode could be made transparent to permit the impact of incident light on the semiconductor material beneath their surface. This would change the effective channel thickness and resulting resistance between source and drain.

Light-Emitting Diodes

There are two basic methods of generating visible light: incandescence and luminescence. Incandescent light is generally produced by electrically heating tungsten lamp filaments or other material to a high temperature. The higher the temperature, the greater the light output.

Luminescence is light radiation that results from exciting atoms with an external source of energy. When atoms in a gas are excited by an electrical discharge, the gas appears to glow (luminesce). The fluorescent coatings on the face of a CRT glow as a result of electrons striking it. Atoms in fluorescent coatings, used in fluorescent lamps, are excited when absorbing ultraviolet light produced by an electrical discharge through mercury vapor. Most of the energy the excited coating releases when returning to normal is in the form of visible light.

At normal temperatures all atoms contain electrons. When energy is applied to an atom from an outside source (such as electrons bombarding the fluorescent surface of a CRT), some of these electrons absorb the energy and are excited into a "higher energy level." As the electrons return to normal, they release the energy that they have absorbed. This energy may be released in the form of ultraviolet light, visible light, heat (infrared), microwaves, lower-frequency forms of radiation or a combination of these forms. The only requirement is that the energy released must equal the energy absorbed. The higher the frequency emitted,

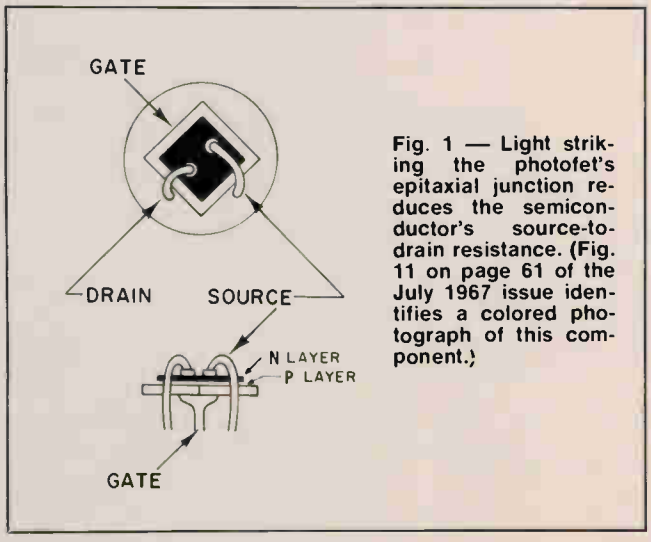


Fig. 1 — Light striking the photofet's epitaxial junction reduces the semiconductor's source-to-drain resistance. (Fig. 11 on page 61 of the July 1967 issue identifies a colored photograph of this component.)

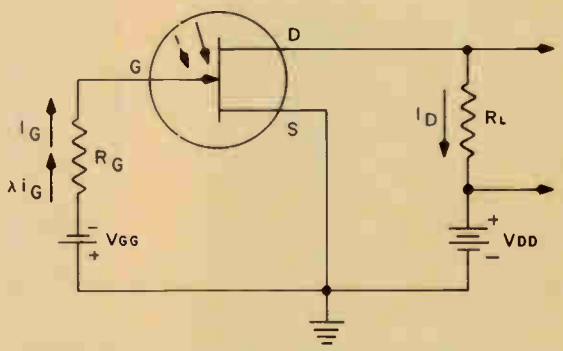


Fig. 2 — The photofet gate is reverse biased for minimum drain-to-source current when not exposed to light.

the greater the energy released. The stronger the signal emitted, the greater the number of atoms releasing energy.

The form of energy released by an excited atom (ultraviolet light, visible light, etc.) depends on the type of atom excited (boron, gallium, indium), its temperature and the way electrons in one atom are bonded to those in another atom. Tests have shown that the electron stresses in some diode junctions are such that the diode will emit visible or infrared light when their atoms are exposed to an electrical current. (In this manner some diodes also emit microwaves, but applications of those diodes will not be described this month.)

In some of the more efficient diodes the radiant energy produced is greater than the applied electrical energy. The atoms absorb both thermal and electrical energy as they are excited, emitting radiation when returning to their more stable energy level. Bismuth-telluride (BiTe) semiconductors are currently on the market for refrigeration purposes. At 80°F the junctions in one battery of 32 thermocouple diodes are reportedly cooled to 25°F by 12.5a of current at 3.4v applied potential. Specifications for that cooling system indicate that it can remove 35Btu of heat each hour.

Most light-emitting diodes now on the market are made of gallium-arsenide (GaAs) semiconductors. The semiconductor chip in one such diode measures 50mil by 50mil by 3mil (1 mil = 10^{-3}in.) and consists of N-type material, chemically treated so that the bottom surface is changed to P-type material. A metal electrode is connected to the bottom P-type material and strands of wire are connected to the top surface. When the diode is forward biased, light must pass around the strands of wire at the top surface.

A more convenient light-emitting diode design is shown in Fig. 3. There only the central portion of the bottom surface is changed to P-type material. Both P- and N-type material are present in the bottom surface where the electrodes can be attached without obscuring the light produced.

A large portion of the light generated at the diode junction is lost by internal reflection (Fig. 3). Gallium arsenide has an index of refraction 3.6 times that of air. This means that when light strikes the top surface of the semiconductor material at an angle that is greater than 16deg from the normal (the normal is an imaginary line perpendicular to the crystal's surface), the light is internally reflected. The reflected light is absorbed by the crystal and lost.

By shaping the top surface into a hemisphere, the amount of reflected light is reduced (Fig. 4) and the diode becomes 10 times as efficient as before with the flat top surface (Fig. 3). The standard diameter for these hemispherical crystals ranges between 36 and 72-

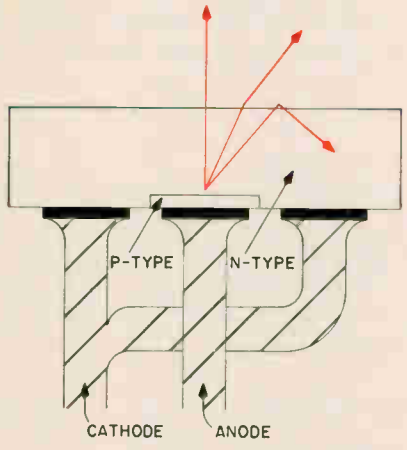


Fig. 3 — By forming both P- and N-type material at the bottom surface, electrodes can be attached without obscuring the light produced. Light striking the top semiconductor surface at an angle that is greater than 16deg from the normal is internally reflected and lost.

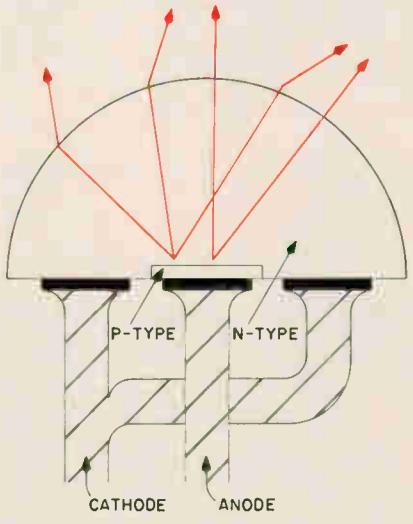


Fig. 4 — The light-emitting diode becomes 10 times as efficient when the top surface is shaped into a hemisphere to reduce internal reflections at the top surface.

mil with junctions between 10 and 20mil. Although the cathode is shown as two connected leads, the semiconductor's hemispherical shape permits the use of a metal ring around the hemisphere's perimeter as an electrode connected to a single cathode lead. A light-emitting diode made with a hemispherical semiconductor is shown in Fig. 5.

Despite the fact that some diodes consume heat when radiating energy, the presence of heat can temporarily or even permanently reduce the number of atoms having the required electron stresses for producing light. Heat can reduce the efficiency of a light-emitting diode. The graph in Fig. 6 shows the relationship between the case temperature of a typical light-emitting diode (like the one shown in Fig. 5) and the relative intensity of the light it produces, when the bias current is kept constant. This graph indicates that when the diode is operating at 120°F, the light it produces is only 80 percent as intense as the light it produces at 75°F. If it were practical to cool the diode to about −70°F, the light produced would be twice as intense as that produced at 75°F.

The applied forward bias voltage is, of course, a major factor for determining the relative intensity of the light produced. A typical relationship between bias voltage, relative light intensity and diode current at 77°F is indicated by the graph in Fig. 7. This graph indicates that when the forward bias is 1.7v, the light-emitting diode conducts 760ma. When the forward bias is 1.5v, the diode conducts 400ma and the light produced is half as intense as that produced with a 1.7v bias. When the forward bias is 1.4v, the diode conducts 220ma and the light produced has only a fourth of the intensity of that produced with a 1.7v bias.

Readings from this curve (Fig. 7) indicate a relatively large current change for a small voltage change. In many cases a 0.25v increase in bias potential, above some low-intensity light-producing voltage, will result in a current increase exceeding the diode's maximum current rating. A slight change in diode junction resistance, as a result of temperature changes, may also result in a damaging current even if the bias voltage did not increase. For this reason, light-emitting diode circuits must be designed for current stability to protect the diode.

The frequency response of light-emitting diodes is very high. In one test a large number of voice channels and a single TV signal with 1MHz bandwidth, were transmitted several miles with light emitted from a gallium arsenide diode.

Lenses and fiber optics can be used in conjunction with photosensitive and photoemissive semiconductors in new electronic test instruments and consumer products. The next article will tell how these optics are used with semiconductors. ■

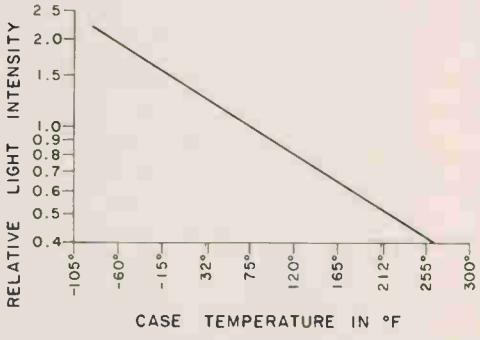


Fig. 6 — A typical relationship between the case temperature and relative light intensity in a light-emitting diode with constant-current forward bias.

Fig. 5 — This light-emitting diode contains a hemispherically shaped gallium-arsenide semiconductor. Courtesy of Texas Instruments.

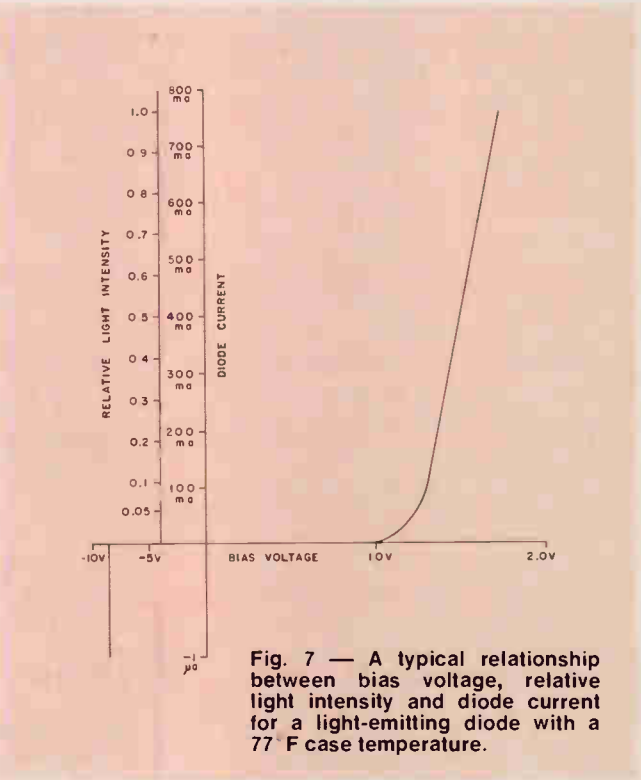


Fig. 7 — A typical relationship between bias voltage, relative light intensity and diode current for a light-emitting diode with a 77°F case temperature.

21 YEARS OF

Proper location essential to

Every service-dealer wants to make his business a success. That statement is true of any businessman. Here's a short article about a man who made a successful business starting as a one-man repair shop. It isn't a do-it-yourself kit for self-made millionaires, but it might give you a few ideas on how to get started.

■ Mel Cohen, owner of Mel's TV and Audio, Duluth, Minn., opened the door of his first shop 21 years ago. He knew where he wanted to go (if you're taking notes, that's step number one), and set himself immediate, reachable goals. Mel Cohen started business in 1946 as a one-man service shop repairing radios and phonographs, and grossed $8000 a year. Now his goals have paid off with a large new building in an ideal location, 30 competent employees and an annual gross business of close to a million dollars! Sound easy?

"But," Mel Cohen admits, "we didn't do it all overnight. Our new 9000 sq ft building, in one of the best locations in town, has been achieved only after years of planning, and made possible by the reputation we have been able to build and maintain. We have been able to give people what they want, what they need and what they expect — quality merchandise and excellent service." The building has two floors, both at street level, because the building is on the side of a hill. The main floor faces on Superior St. The lower level service and warehouse area faces on Jefferson St. in the rear.

Mr. Cohen changed the name of the company from Mel's TV to Mel's TV and Audio upon moving into their new facility because they now sell and service a larger portion of the audio field and specialize in commercial audio system installations. The new location of Mel's TV and Audio is the sixth and largest since its birth. Each location has provided better customer service and increased sales. Mr. Cohen concedes that, along with the addition of new facilities, his employees have played a major role in the success of his business — and their efforts are rewarded. He has initiated a company retirement plan keyed to each individual's salary.

"We put this retirement plan into effect," says Mr. Cohen, "to keep the capable employees we have, and to give those who stay with us until retirement something worthwhile to look forward to."

Mel Cohen admits that stable, experienced employees are hard to find, but they are essential to every good business. And he makes it a point to see that they are happy and stay on the job by treating them fairly. As he points out, "I enjoy my work and we do a good business, but I also know I couldn't have done it alone."

Honesty the Rule

"Honesty is the rule rather than the exception when dealing with a customer," smiles Richard Moe, sales manager of Mel's TV and Audio. People like to come to our store because we give them honest answers to their questions. And they know that we guarantee service and satisfaction for what we sell."

About 50 percent of the business at Mel's TV and Audio comes from customers who bring in their friends, and from customers who have been happy with past service. The new store, which has seven large, pleasant, well-decorated showrooms on the first floor, provides the customer with a relaxing, unhurried atmosphere. Each of the showrooms is arranged so that the customer can get a good look at the merchandise, and also see or hear it in operation. There are seven sales people on the showroom floor, including the office girls, to provide prompt, efficient service. The salespeople do not try to sell something they can't give accurate information on. Any customer who comes in desiring technical information on a specific item such as a color TV or tape recorder is directed to a salesman who understands the product and can give honest, concise answers.

"We do not use 'high pressure' sales techniques here," asserts Dick

CONTINUOUS GROWTH

customer sales and service business

Moe. "We don't have to. We offer quality products and back every sale with a good healthy service policy — and our customers know it!"

Reputation Pays Off

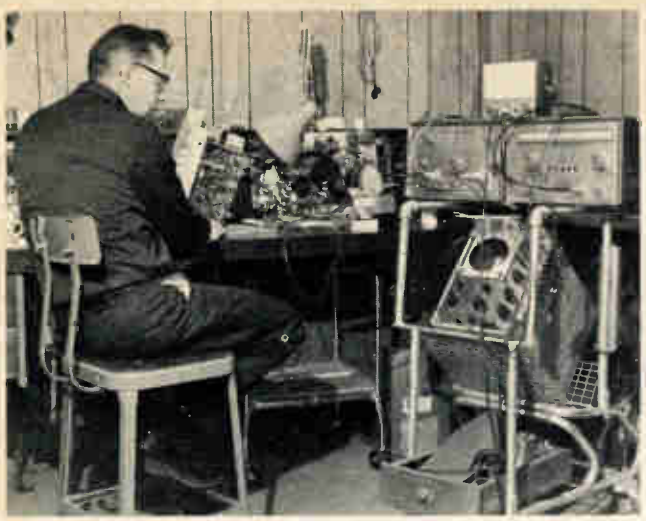
Mel's TV and Audio has been in business for 21 years and has built a reputable business based on its ability to satisfy. Reputation alone counts for about half of the business; the other half comes from local advertising. About 3 percent of the store's annual gross income is spent in newspaper advertising, with a small portion going toward seasonal advertising on TV. Almost all of the advertising is done on a co-op plan with the various manufacturers. To back this up, Mel's stocks approximately $200,000 in TV, stereo, phonographs and component parts to provide immediate delivery to the customer. Some of this inventory is in the store's showrooms and basement warehouse, some in a nearby warehouse.

Location, too, is a big factor in any business. The new store's location is ideally suited to convenient customer shopping. It is situated on a main street with ample parking, adjacent to a thriving shopping center. The front is well lighted and impressively displayed to entice even the most discriminate buyer. All of these factors have brought Mel's to the position it now enjoys, but as Mr. Cohen indicates, "Yes, we have a good business. We have it because we work at satisfying our customers, and that kind of a reputation is our best advertisment."

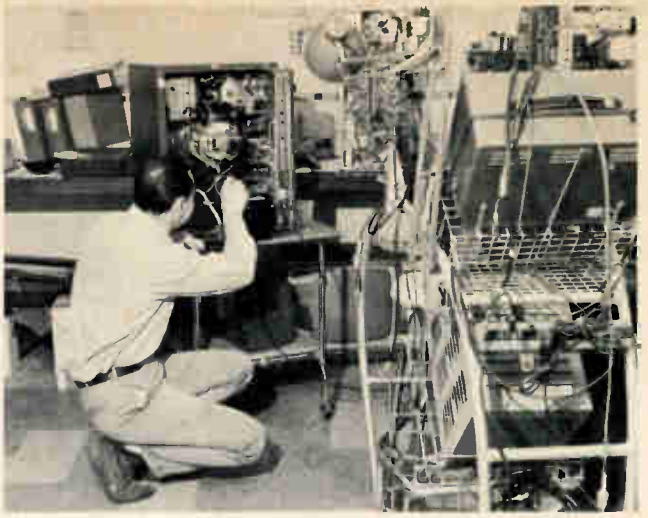
Customer sales counter and front store display area.

Salesman demonstrates color TV set in one of the TV showrooms.

Customer service counter at entrance to service department.



Technician repairs stereo equipment in one of the four "service rooms."



Checking voltages on color TV set with test instruments mounted on special moveable carts built by technicians.

Individual 'Service Rooms'

The service department, managed by Mr. William (Bill) Trudeau, is located below the main floor and takes up about half of the 4500 sq ft of basement area. At the entrance to the service area is the service counter where a smiling young lady courteously writes up orders from customers bringing in merchandise for repair. At the same time she handles the more than 80 telephone service calls received each day. To the left and down the side of the service area are four individual "service rooms," each manned by a technician who specializes in certain equipment. The largest of these rooms accommodates two men who specialize in color TV service.

The rooms are divided by concrete block walls with glass fronts and a door. "They are all nearly soundproof," explains Bill Trudeau. "One of the TV repair rooms is also lined with copper screen to prevent RF interference from adjoining rooms. Even the ac power line is filtered before it reaches the service rooms to reduce any interference which might be on the line. We have about $10,000 invested in shop equipment and our four trucks have an additional $3000 in equipment. Because of the amount of service work we do, we stock approximately 15,000 kinds of tubes and 200 antennas from 3ft masts to 100ft towers."

Our ET/D reporter asked Mr. Trudeau what advantage individual service rooms had over the normal bench setup. "Our efficiency just about doubled," he claimed, "because we no longer have four or five men interfering with each other as far as noise goes. It's difficult for a man to be aligning a TV set next to another man checking a stereo. Eliminating this interference did wonders for our service efficiency.

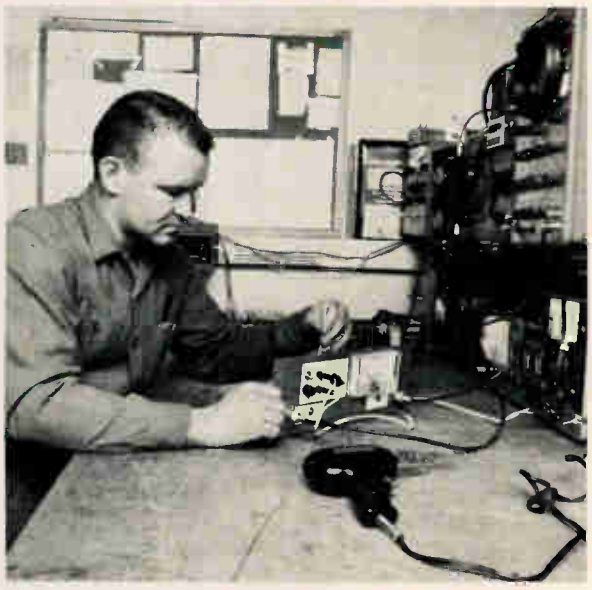
"With all the fields of experience our men command," states Mr. Trudeau, "we can generally handle almost any problem we encounter." Mr. Trudeau has been with Mel's for eight years, and schedules all of the service and installation work for the shop. His department consists of 12 full-time technicians, two part-time technicians, an office girl, parts man, two delivery men and seven trucks. Five of the technicians work in the shop service room, while four of the men work from trucks specially equipped for home service calls. Two men on one truck handle TV antenna installation. That leaves two men and one larger truck for deliveries.

ET/D asked Mr. Trudeau if there was usually enough work to keep all the people in his department busy. He smiled and said, "Well, we receive an average of 80 service calls a day and normally we can accommodate half of these. Somehow we manage to keep up with it. As for our TV service work, much of that is done on a contract basis, and it's great for the customer — and for us. It does several things, but mainly it lets us provide better service for the customer — better service because we are the only ones who work on the set and therefore we know what has been done to it. We keep it in top shape. The customer with a service contract will call us when something starts to go wrong, so we generally get to repair it before it gets too far gone. Also, the customer doesn't have to worry about repair costs. This is what makes him call us when trouble first starts. Then, too, since there is no bill at the end of a repair job, it makes it easy for the technician, in the case of an older set, to make a low-pressure pitch on a new set.

"When we sell a new TV set, the customer automatically gets a guarantee on the labor for 90 days. The customer then has the option of purchasing a one- or two-year service contract at the end of the first 90 days. Usually, we sell a year's contract with a new color set. Our office girl mails out expiration notices to the customer and follows up with a phone call to let the customer know that his contract is due to expire." As Mr. Trudau puts it, "We do a lot of service contract work because it benefits the customer by providing him with prompt, painless, efficient service. We can do this because we know what the set requires and we keep a record of its ills — much like a doctor with his patients." ■

THE SMALL BUSINESS ENTREPRENEUR STILL LIVES

There's always room for small, innovating business pioneers — even in a world of ever-fattening corporate giants



Keith Anderson checks out one of his translators.

■ Mergers in various areas of the electronics field are taking place at a constantly accelerating rate. More corporations get fatter while more little ones disappear. But small businesses continue to spring up like mushrooms in shady woods.

Look at Keith Anderson Co., for example, which is located in a former church building next to an almost abandoned highway near the nubin-sized town of Black Hawk, S. D.

An unusual factory is housed in this unlikely structure: Anderson Co. manufactures TV translator equipment that brings TV programs to remote and isolated communities.

Anderson's factory is small, about 50 x 25ft. His production force consists of two technicians. His product is small too — a metal box filled with electronic components measures only about 15 x 6 x 9in.

Despite the small factory size, however, the firm claims more solid-state translators in service around the world than all other U. S. brands combined.

Most of Anderson's translators are coupled with thermoelectric generators to provide optimum trouble-free service. The translator units are fully solid-state and carry a five-year warranty — and Anderson states that each component used has a life expectancy of more than 10 years.

Improved Translators

Anderson's TV translator installation at Escalante, Utah, is an example of how a TV booster system can be improved. Originally, the firm installed three tube-type translators at Escalante 10 years ago. They brought in signals from Salt Lake City stations and an educational channel. These stations were rebroadcast over a 200 square-mile area. But problems developed.

Occasionally, tubes had to be replaced in the translators. Much more aggravating was power-source failure — a Diesel engine kept breaking down. And maintenance technicians had to make the trek up the 10,000ft mountain on snowshoes to refuel and repair the Diesel.

But in 1964 a trouble-free system was installed which is still operating. This was Anderson's solid-state translator, coupled with a thermoelectric generator supplied by the 3M Co. This generator requires only a small amount of fuel and attention. Maintenance now involves a trip up the mountain only once a year to deliver a small amount of propane gas.

Mr. Anderson has more than 200 translators operating and says, "we know from 15 years' experience that most breakdowns result from power failure."

This can occur, he explains, even when the translator stations are located near established electric lines. Storms, sleet, wind and lightning can rip down lines and poles — creating ever-present hazards. Mr. Anderson is proud of the exclusive circuit he has designed to prevent lightning damage to the equipment.

The Idea and Its Growth

Mr. Anderson's interest in electronics goes back more than 15 years. He first began experimenting with TV while attending the State University of South Dakota at Brookings. He broadened his knowledge in both theory and practice while attending California Polytech. He was selling his tube-type translators abroad, shortly after graduation, while waiting for FCC approval to use them in the United States. Similarly, his solid-state versions were being installed with foreign government approval for several years before the FCC approved installations in the United States.

Haiti received the first of his solid-state translators and then several were installed in Australia. The Australian government was helpful by checking the equipment and subsequently supplying valuable suggestions for improvement.

Other Anderson translators are operating in Canada, Mexico, Brazil, the Philippine Islands and Puerto Rico.

"We put the first unit in Alaska at the time it was becoming a state," Mr. Anderson recalls. His equipment now operates in 35 of the 50 states. National Parks also are good customers. Translators have been installed at Yellowstone, Yosemite, Bryce Canyon and Glacier national parks.

Mr. Anderson speculates that the market for translator service is only about 10 percent saturated. Only two other companies are manufacturing this equipment.

"We will keep our production limited so we can maintain the highest quality and assure our customers of custom built translators — each unit specifically designed and constructed for a particular locality and use," he explains.

Equipment Package and Cost

The entire package which enables a community or an area to receive TV programs (or to improve reception quality) is relatively simple. It includes one receiving antenna, another for transmitting, a translator and the power source.

Methods of financing translator systems are varied. Mr. Anderson explains that some areas have set up tax districts with a fee on each TV set in the district. Some voluntary clubs have been formed with regular dues to pay for the installation and maintenance. Some private individuals have interested their neighbors in translator projects for their mutual enjoyment and thus the initial cost is contributed. Subsequent requests for maintenance costs are met in the same casual manner.

Prices for installation vary considerably, depending on location. The cost of an Anderson translator model T99, a basic 1-w unit, is $1000. Cost of the antennas range from $100 to more than $500 each. The power source can be a thermoelectric generator, batteries or a conventional AC power source.

"The smallest 3M thermoelectric generator, model 505, is entirely adequate for our model T99 translator," Mr. Anderson says.

But Mr. Anderson builds more powerful translators. He also adds amplifiers where necessary to meet extremely adverse situations. His efforts are not limited to TV boosting for the shadow areas, however. Essentially the same units can be adapted to bring better FM radio reception to the hinterlands.

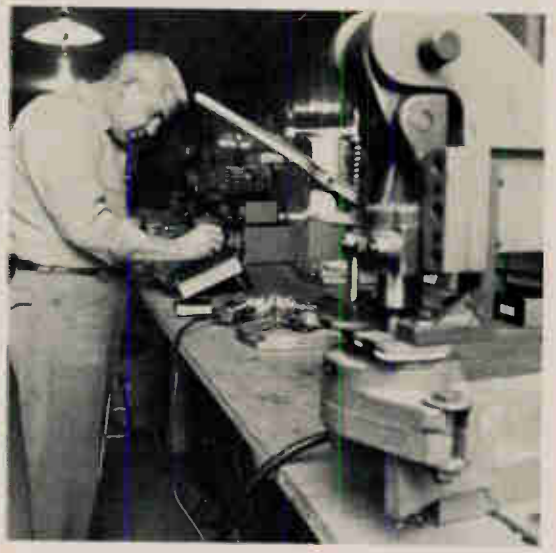
"The tremendous interest in FM/stereo should bring a demand for translators in future years — once the stereo fans are alerted to the possibilities," Mr. Anderson says.

Anderson's business has grown by word of mouth, he points out. "We've been too darn busy to even put a sign on the building," Mr. Anderson smiles.

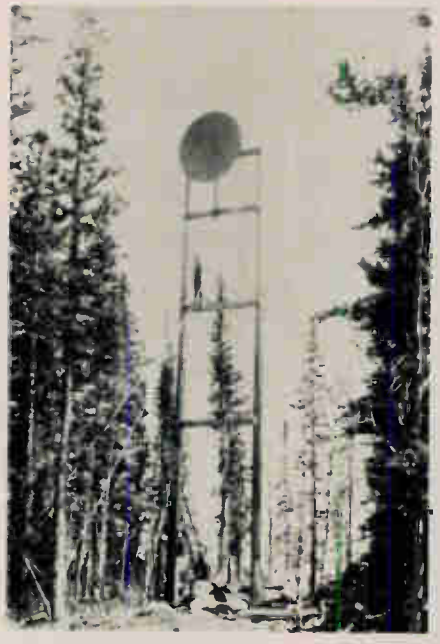
When he does get that sign erected, it will simply say, "Keith Anderson Co.," which is the name used on his products marketed in this country. Another name, Western Telonics, is used on his units produced for installation in foreign countries. ■

A general view of Anderson's assembly line.

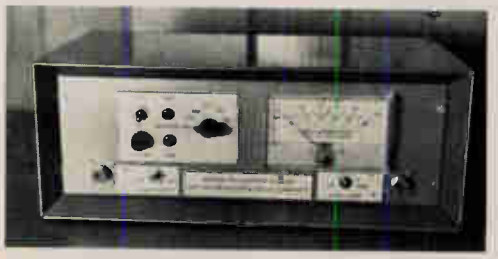
Technician, James Kinney, performs work at the plant's small metal stamping machine.



Robert Hutches, Anderson technician, soldering base plate of model T99 translator.



A 90ft tower carries a 10ft dia parabolic antenna which is used at Escalante, Utah, to bring in educational TV programs. The mast is constructed from two trees. Several TV translators are attached near the tower.



An Anderson TV translator, model T99. All photos here courtesy the 3M Co.

DEALER SHOWCASE

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

CB Base Station Console 700

A console has been designed for transforming small solid-state CB transceivers into base stations. The console will reportedly hold both a CB transceiver and a selective call

system. Specifications indicate that it contains a sloping panel cabinet, panel mounted ac and dc fuses, control switches, power supply, speaker, electric clock, microphone jack and microphone. Price without transceiver or selective call, $89. Polytronics.

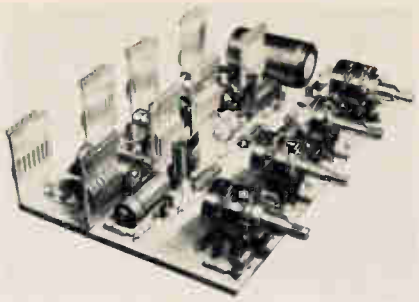
Color TV Set 701

Announced is a color TV set with Spanish-styled cabinet that is reportedly at the top of the manufacturer's

console color TV line. Specifications indicate that the set has a 48 3/16-in. pecan veneer cabinet with casters, 295 sq in. of viewing area and two 6-in. oval speakers. A remote control is designed to perform on/off, volume, channel select, mute, brightness and tint-control functions. Price $925. Philco-Ford.

Stereo Amplifier Assembly 702

Announced is a stereo amplifier designed as a printed circuit assembly which includes volume, balance, bass and treble controls. Specifications indicate that when operating with a 25vdc regulated power supply the



amplifier has an 8 Ω load impedance, 500K typical input impedance, 0.5v typical input sensitivity, 10w power output at 1kHz and 8Ω, 35ma idle current, 560ma maximum current at 10w and 30Hz to 40 kHz frequency response at −3db with 8 Ω load and 1w output. The tone controls reportedly have the following range: Treble: +3db to −14db at 10kHz. Bass: +10db to −10db at 100 Hz. Amperex.

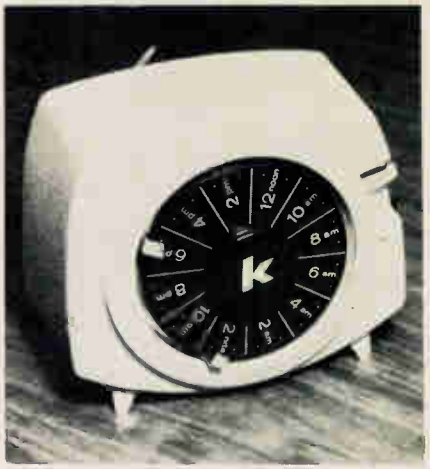
Home Music System 703

An FM/phonograph stereo music system with tape "cassette" recorder/playback cartridge is announced. It is designed to permit stereo and monophonic recording on tape cassettes from phonograph records, FM radio or external sources. The cassette push-button operation reportedly in-

cludes automatic lifting and ejecting of the cartridge. Specifications indicate that the system has 30w IHF output power with an 8 Ω load, less than 1 % harmonic distortion, better than 5 μs squarewave rise time 2.9v usable FM sensitivity, better than 40db image rejection and 30db multiplex separation. The speaker systems are reportedly air-loaded, containing an 8-in. woofer and a 3-in. tweeter. List price $479. Harman-Kardon.

General-Purpose Timer 704

Announced is an electro-mechanical timer designed to handle up to 185w loads. The timer reportedly turns



lights and appliances on or off at preset times. Specifications indicate that the on interval can be made to vary from 15min to 23hr 45min. The timer is enclosed in a 5 x 4 x 2½ in. case with a 6ft line cord. Price $8.77. Allied.

Business-Band Transceiver 705

A solid-state business-band 2-way radio has been designed to provide 5w of power input. The transceiver reportedly features an illuminated channel selector, transmit indicator, auxiliary speaker jack, single-knob tuning, modulation indicator, zener-diode protection and 100% modula-

tion. Specifications indicate that it measures 5¾ x 6¼ x 1⅞ in. and weighs 3½ lb. Courier.

RF Converter 706

Announced is a converter that can reportedly be plugged into a standard auto radio antenna input, permitting reception on the 150 to 164MHz

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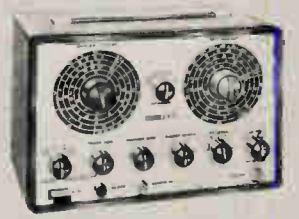

Model 369 Sweep and Post-Injection Marker Generator. For easiest, fastest visual alignment of color B & W TV and FM RF and IF circuits. Five sweep ranges from 3-220 Mc/S. Four marker ranges from 2-225 Mc/S. Crystal marker oscillator. Post injection of markers. **Kit $89.95. Wired $139.95**

Model 460 Wideband Direct-Coupled 5" Oscilloscope. DC-4.5mc for color and B&W TV service and lab use. Push-pull DC vertical amp., bal. or unbal. input. Automatic sync limiter and amp. **$109.95 kit, $149.95 wired.**

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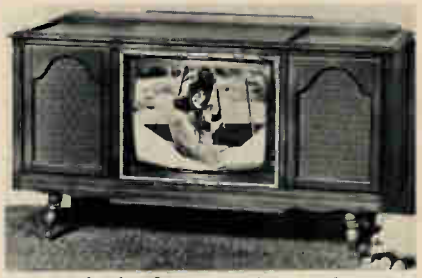
band, with both crystal controlled and tunable provisions selectable. Specifications indicate that a three-gang tuning capacitor eliminates broad tuned circuits, resulting in better sensitivity, image rejection and signal-to-noise ratio. The converter is designed to operate from a 9v battery and measures 2½ x 3½ x 4¼ in. Price $32.95 less crystal. Tompkins.

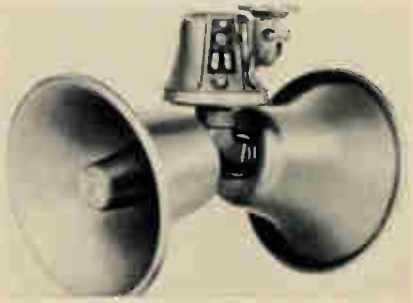
Color TV Sets 707

Announced is a color TV set that reportedly includes a 20-in. diagonally measured, viewable screen; 51-in. early American, maple-veneer cabinet; four speakers, external speaker terminals; four-speed record changer with 45rpm adapter; solid-state AM/FM radio and solid-state dual channel amplifiers. Admiral.



Horn Speakers 708

A twin horn speaker assembly reportedly has an acoustic coupler which makes possible a 121db audio level on each horn with a 100deg corresponding dispersion. A built-in transformer is designed to match either 70v or 25v lines. Weight 9 lb. Price $72. Atlas.



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Color TV Sets 709

Announced is a color TV set that reportedly features a 295-sq-in. viewable screen and a contemporary

breakfront credenza style cabinet with a roller-grain finished walnut veneers and select solids. Sylvania.

Cassette Tape Recorder 710

A solid-state, portable, cassette tape recorder reportedly uses five push buttons for record, forward,

stop, rewind and fast-forward controls. Specifications indicate that it contains seven transistors and a 3-in. speaker. Price $69.95. Admiral.

FM Stereo Tuner 711

Announced is a solid state FM stereo tuner that reportedly contains an integrated circuit IF strip that is equivalent to 20 transistors for improved selectivity and capture ratio. Specifications indicate that it has 2.2-

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μV usable sensitivity. 80db cross modulation. 42db selectivity. 36db stereo separation and 2.5db capture ratio. Price $199.95. Scott.

Headphones 712

Announced is a pair of headphones that reportedly use a dynamic woofer and a ceramic tweeter interconnected

by a full crossover network, resulting in an 18Hz to 22kHz frequency response. Specifications indicate that this woofer tweeter combination is coaxially mounted in unbreakable ear cups and that an ear seal is provided by removable vinyl cushions filled with urethane foam. Net price $50. Superex.

Quartz Lamp 713

Announced is a series of portable lamps that reportedly contain a 75w iodine quartz bulb designed to provide about 2000 hr of clear, bright light without blackening. Specifications indicate that the lamps are equipped with a balanced 45-in. spring-action arm that fastens to a desk or table surface with a double-bolt clamp or with screws. List price $35.95. Acme.

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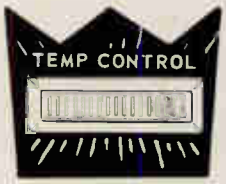

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ADMIRAL

Color TV Remote Control 11A9N/ S376AN — Circuit Description and Operation

The 11A9N color TV remote unit consists of two chassis. The first is a 3A9N preamp the second is the 8A9N relay control chassis. A S376 AN hand-held electronic transmitter (actuator) generates any one of seven available frequencies in the 17 to 22kHz range when a push button is depressed. Each push button applies power to the electronic oscillator and selects a proper frequency determining trimmer capacitor. These constant-carrier signals are doubled in the output transducer (M2), thus radiating ultrasonic signals ranging from 35kHz to 44kHz.

Radiated ultrasonic signals from the transmitter are received and reconverted to electrical signals by a microphone located in the front grill of the TV receiver. Because the microphone is dc biased, it has high sensitivity and linear operation. Two preamp stages are provided in the 3A9N with an emitter-follower output. Because horizontal frequency harmonics fall in the range of the remote frequencies, extensive shielding, mounting the premaplifier chassis integral with the microphone and "floating" the preamplifier are necessary. Bandpass selection is determined by the resistor-capacitor values and by the microphone. Since the remote signals are unmodulated, AGC is unnecessary. Variable emitter degeneration is provided, however, in the 2nd preamp stage. This allows gain adjustment when triggering is encountered from ultrasonic sources outside the system such as coins, keys, etc.

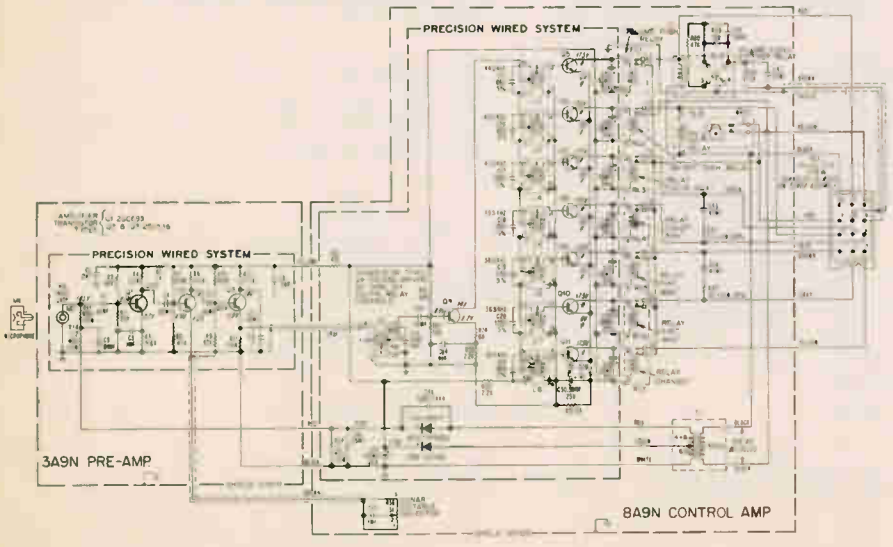
Amplified signals from the preamp are fed to the 8A9N chassis. Input transformer L1 improves the skirt selectivity of the bandpass and equalizes the gain (or tilt) across the spectrum. Its collector load consists of seven sampling windings of the input transformers and a noise rejection resistor, R25.

The seven sampling windings are parts of seven sharply tuned input transformers. When an ultrasonic electrical signal of the same frequency as one of the transformers, for example L4, is fed into the driver stage, Q4, a large signal will be developed across that transformer.

When a signal from the transformer is fed into the base of the keyer stage, Q7, base rectification will occur. This results in pulsating collector current which is filtered by the collector bypass electrolytic, C25. The dc current then trips the relay, RL3, completing the circuit to operate the color intensity control motor clockwise. The collector of the stage is protected from back-EMF transients by its collector capacitor, C25. Additional protection from adjacent channel triggering is provided by the common emitter circuit. When a transistor (Q7) conducts, the emitter current produces a voltage drop across the common-emitter resistance, R26 and R27. This increases the reverse bias on the other transistors.

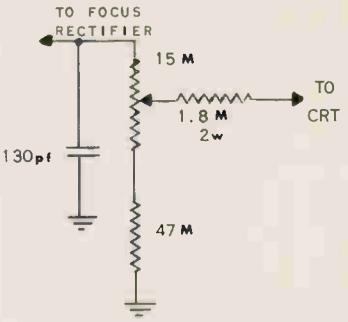
A sealed transformer on the relay control chassis provides a source for the two power supplies. A 210v supply biases the microphone. The low voltage supply provides 17.5v to the relay control chassis and preamp.

Three types of devices are used to perform the actual functions. A four stepper relay, RL9, provides four loudness positions. A bistable stepper relay, RL8, provides the on/off function. The stepper coil has two copper alloy washers for delay to prevent erratic triggering. A two-pole motor and transmission assembly using an armature thrust-clutch drives the channel selector. Two capacitor-assisted reversible ac motors drive color and tint controls through directional clutches and transmissions. Manual control of the stepper and on/off relays are provided by push-button switches on the volume control.

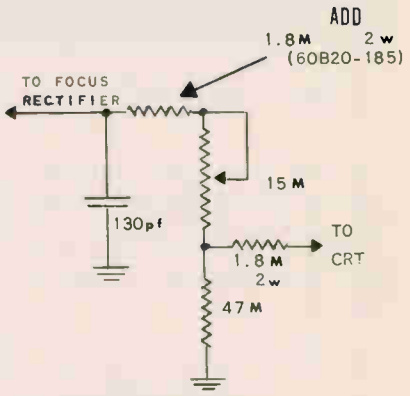


Color TV Chassis H10/H12 Series — Focus Control Modification

The focus control, in present production of H10 and H12 series color chassis, is wired as a rheostat instead



EARLY PRODUCTION



CURRENT PRODUCTION

of a potentiometer. A 1.8M resistor has also been added. This change has been made to improve reliability. It is suggested that you make this modification whenever you replace the focus control in a G11, G13 H10 or H12 chassis. If the set does not have

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FINCO MODEL #65-4 Antenna Amplifier $47.95 list VHF-TV Two-transistor Antenna Amplifier for 75 OHM Downlead, and power supply with built-in single or dual 300 ohm outputs. Provides 12 dB gain in the low band and 14 dB gain in the high band.

FINCO MODEL #65-1 Distribution Amplifier $29.95 list 2-tube 4-output VHF-TV or FM Distribution Amplifier for 300 OHM Operation, providing 8 dB gain at each 300 ohm output to feed home or commercial systems.

FINCO MODEL #65-5 Distribution Amplifier $44.95 list VHF-TV 75 OHM Single Outlet Distribution Amplified for deluxe home or commercial use to feed multiple sets through line tap offs or splitters. Delivers 17 dB Low Band and 14 dB High Band.

FINCO MODEL #65-2 Distribution Amplifier $39.95 list 2-tube 4-output VHF-TV or FM Distribution Amplifier for 75 OHM CO-AX Operation, providing 6 dB gain at each 75 ohm output to feed deluxe home or commercial systems.

FINCO MODEL #65-6 Amplifiers $79.95 list. VHF-TV Antenna Mounted two-transistor preamplifier with 75 OHM two-tube Single Output Distribution Post-amplifier up to 30 dB gain for improved reception. Used in home or commercial installations to feed multiple sets.

FINCO MODEL #65-3 Antenna Amplifier $44.95 list New VHF-TV Antenna Amplifier and Power Supply with built in single or dual outputs to improve reception of weak signals in fringe areas Provides 12 dB gain in the low band and 14 dB gain in the high band.

FINCO MODEL #65-7 FM Signal Amplifier $24.95 list. One-transistor Indoor Behind-the-set FM amplifier with a passive filter input circuit to reject signals outside the FM band which cause interference. Delivers 20 dB Gain.

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adequate focus range after modification, try a lower value resistor (1M for instance) but keep the value as high as possible.

The 75C108-1, -2, -3 are electrically interchangeable, differing only mechanically. All three can be used for replacement. The -1 does not have a shaft, -2 -3 both have shafts but have slightly different terminal lug arrangements.

RCA VICTOR

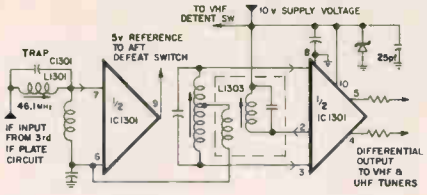
Color TV Chassis CTC30 — Description of the Integrated AFT Circuit

The AFT feature was first introduced in RCA Victor color television instruments June 1966, in the CTC21 color chassis. This is said to be the industry's first transistorized color television AFT system and continues in the 1968 CTC28 and CTC35 color chassis.

The CTC30 chassis will employ the integrated circuit AFT system. This system displays operational and reliability characteristics that in many categories surpasses comparable characteristics displayed by the transistorized AFT system.

The integrated circuit (IC) employed in this AFT discriminator/amplifier system is a type TA5274, labeled IC1301 in the circuit diagram. The functions performed by the IC and its associated outboarded components are: buffer amplification (IF), detection, differential dc amplification and dc voltage regulation.

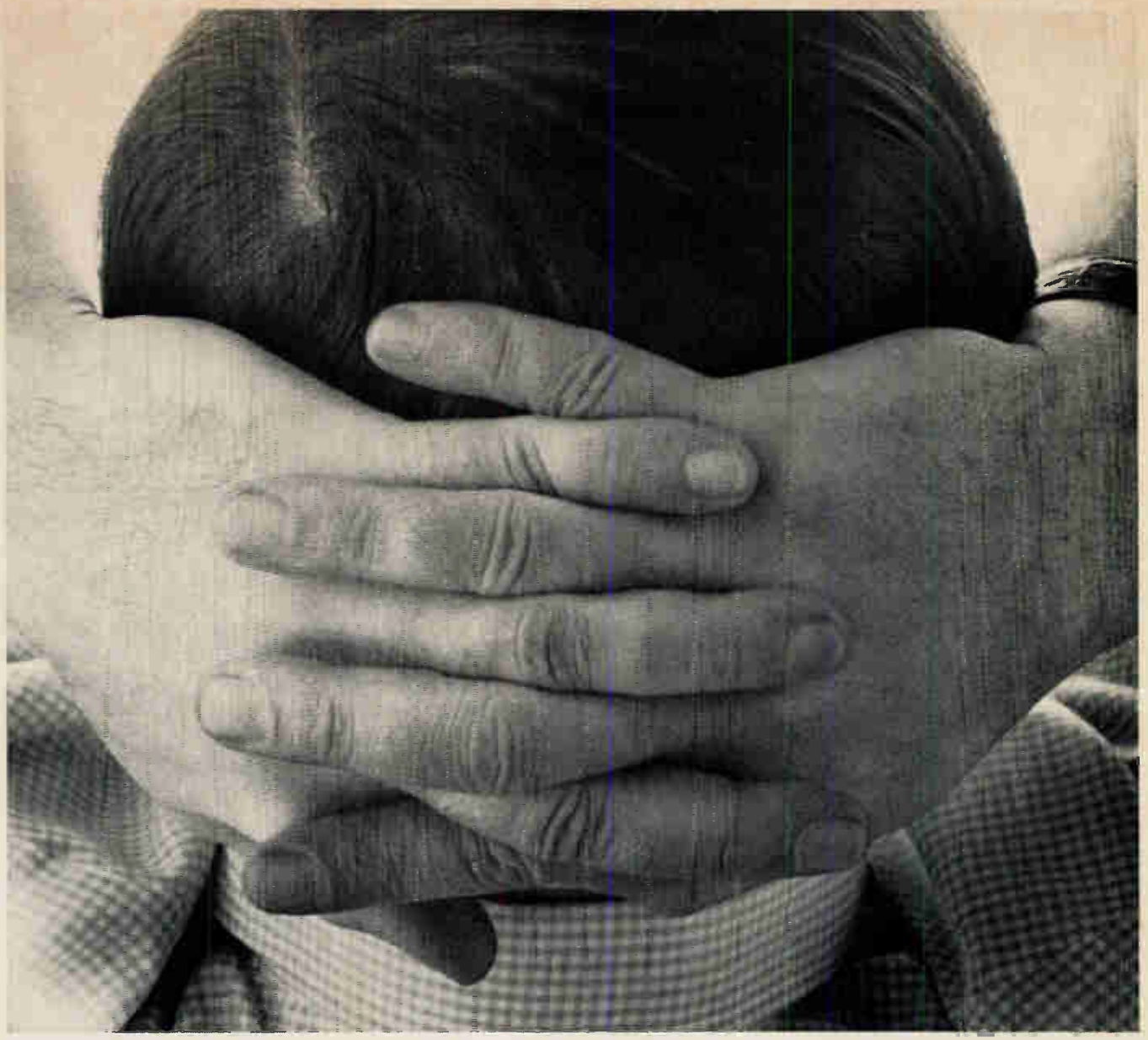
The discriminator/amplifier functions in this manner:



A sample of the picture IF output is applied to the AFT system through a 1.5pf capacitor located in the plate circuit of the 3rd video IF amplifier. This incoming picture IF energy is applied to a tuned input circuit consisting of L1301 and C1301. These components act both as an adjacent channel sound trap and an IF frequency peaking circuit — the correct trap frequency is automatically attained when the input tuned circuit is peaked at 46.1MHz.

The signal is then fed into the buffer amplifier section of the IC, the output of which appears across the discriminator transformer primary (also peaked to 46.1MHz). The discriminator transformer secondary is tuned to 45.75MHz. This secondary feeds the integrated circuit discriminator diodes. The output of the discriminator diodes is applied to an amplifier which delivers a differential voltage output. This differential output is composed of two voltages — one appearing at each of the IC output terminals. The difference between these voltages (or differential), represents the amount and direction of deviation of the incoming IF frequency (from 45.75-MHz). If the incoming IF frequency is exactly 45.75MHz, each discriminator output terminal voltage is 5.5v, the difference between them is therefore 0 volts. As the incoming IF frequency deviates from 45.75MHz, one output terminal voltage increases and the other output terminal voltage decreases an equal amount. The voltage at each terminal will either increase or decrease depending on the direction the incoming IF frequency deviates from 45.75MHz. The system is capable of producing a ±9v differential within its pull-in range. This voltage represents a potential frequency correction for a frequency error of approximately two times the output of the single-ended transistorized system; the final VHF frequency error attained by the system is reduced by 50%. Also, because of this increased output, the pull-in range over which total frequency correction may occur is increased. The manner of obtaining oscillator frequency control by using a "variable capacitance" transistor in the VHF tuner and a varicap diode in the UHF tuner remains unchanged. Also, the manner in which AFT defeat action is accomplished is very similar to that employed by last year's CTC21. Some electrical differences exist, however.

VHF AFT defeat action can be and is electrically accomplished by shorting together the AFT differential amplifier outputs. UHF defeat is slightly different, however. The UHF varicap AFT action requires only one of the differential amplifier outputs. It would appear then, that UHF AFT defeat action would also occur if the AFT differential amplifier outputs were shorted. But, because of the relatively high impedance outputs, some partial UHF AFT action is present when these outputs are shorted. Even though the difference between the outputs is zero, the common above-ground voltage is not constant with fine tuning error.



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COLORFAX

In this particular system, an approximate 5v reference voltage is generated within the integrated circuit for use in achieving total UHF AFT defeat action. This defeat action is electrically accomplished by shorting to this 5v reference, the correction voltage applied to the UHF tuner.

The automatic switching action which accomplished UHF and VHF defeat is identical to that employed by the CTC21. A switch, working in conjunction with the spring-loaded VHF fine tuning mechanism, provides the discriminator/amplifier output shorting action. When the fine tuning knob is depressed, the AFT is defeated; when the fine tuning knob is released, AFT operation is re-established. A similar switching action occurs with the UHF fine tuning mechanism, shorting the AFT amplifier output to the separate 5v reference.

The CTC30, like the CTC21, provides a customer permanent AFT defeat switch, mounted on the front control panel. The CTC30 control panel AFT defeat switch operates by shorting both AFT discriminator/amplifier outputs to the separate 5v reference.

Because of the possibility of AFT adjacent channel sound "lock-out" during VHF channel change, it is necessary to disable the AFT system during this time. This is achieved by momentarily shorting to ground (whenever VHF channel change takes place) the power supply voltage applied to the AFT discriminator/amplifier. The shorting action occurs between detent positions by allowing the grounded VHF detent spring (located on the front of the VHF tuner) to contact a small insulated terminal tied to the AFT power supply lead. This shorting action, in conjunction with a 25pf capacitor located on the AFT discriminator subchassis, provides the required AFT disable time necessary to achieve immunity from AFT "lock out." A 10 Ω resistor is placed in series with the AFT power supply lead to the shorting terminal. This resistor eliminates contact "pitting" caused by instantaneous shorting currents.

RCA VICTOR

Color Chassis — Checking the VDR

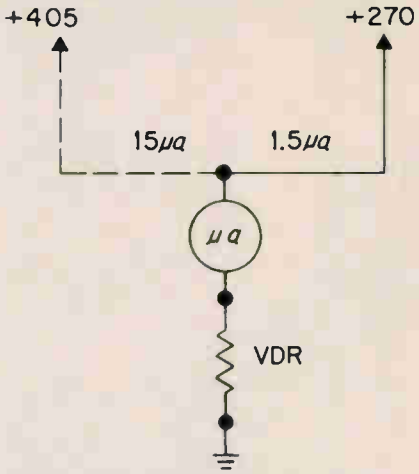
The vertical output circuit of the color chassis employs a voltage dependent resistor (VDR). This special component regulates the bias on the vertical output tube, permitting the vertical picture size to remain constant when wide variations occur in line voltage.

The VDR is generally trouble-free. There could be instances, however, where the service technician might wish to check its operation.

An open-circuited VDR will cause vertical overscan and some loss of vertical hold because of an excessive feedback pulse from the output section.

A shorted VDR will cause a loss of vertical deflection because of an absence of feedback from the output stage to the oscillator section.

One quick check of a VDR is to substitute a new part. Another method of checking a VDR is to substitute a 1M resistor — if the VDR is defective, this resistor will allow the circuit to operate. However, vertical size will be excessive and no voltage regulation would be realized. A simple out-of-circuit test is shown in the illustration. This test is performed by measuring the current through the VDR when two different positive voltages are applied. A voltage difference of approximately 1.5 to 1 results in a 10 to 1 current change. Notice that the voltages used in the test setup are readily available from the operating television chassis and the test actually demonstrates the characteristics of the VDR. Remember the VDR is a reliable device and seldom become defective.



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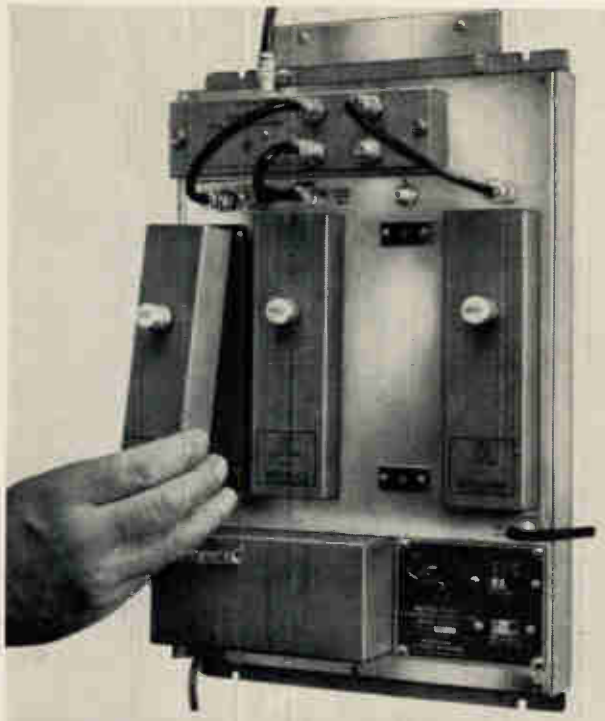
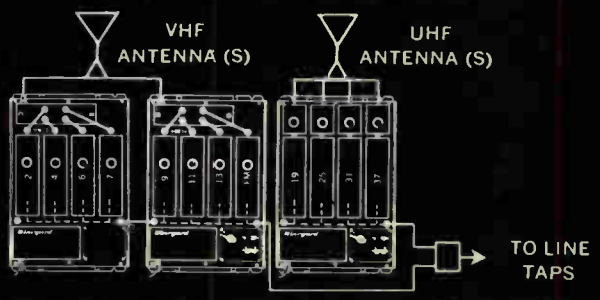


82-Channel Ultra-Plex System
using lo band plug-in VHF amplifier ...hi band plug-in VHF amplifier... and broad band UHF amplifier.

82-Channel Ultra-Plex System
using single channel plug-in amplifiers.



Winegard Ultra-Plex is a unique 82-channel, modular plug-in distribution system with all components matched to work together perfectly. The system never becomes obsolete, because you can add new UHF or VHF channels quickly, easily and inexpensively whenever needed.

Now you can have complete signal control of each channel!
■ Amplifies! ■ Equalizes!
■ and Feeds any number of channels to any number of tv sets —with a minimum of labor and equipment—and at a cost that's actually lower than most "VHF ONLY" systems!

For use in homes, as well as in the largest apartment buildings, hotels & motels, hospitals, etc.

Sensational Winegard **Ultra-Plex** is the best thing to ever happen to MATV system installers. Because **Ultra-Plex** gives the installer unprecedented flexibility regardless of system size. Because **Ultra-Plex** covers the full range of UHF, VHF and FM frequencies.

And because **Ultra-Plex** is super compact...installs easier than old fashioned equipment...costs less...and operates inexpensively with little or no maintenance.

Plenty of other reasons, too. **Ultra-Plex** incorporates your choice of either single channel or broad band solid state amplifiers that plug into the modular power panel. **Ultra-Plex** is totally designed with all the components needed to solve every conceivable distribution system problem. And **Ultra-Plex** equipment is manufactured to the highest commercial standards of quality—second to none.

If you are now installing MATV systems, you'll want to know more about profitable Winegard **Ultra-Plex.** Or if you've wanted to get into the booming MATV business, but thought it too complicated, let us show you exactly how easy and profitable it is. Write for Fact Finder #246 today. It gives you all the facts on MATV systems in general, and **Ultra-Plex** in particular.

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NEW PRODUCTS

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

Transistor Analyzer 714

Announced is an in/out-circuit transistor analyzer designed for in-circuit dynamic ac gain testing and out-of-circuit Beta measurements on 0 to 250 and 0 to 500 scales. Speci-

fications indicate that under test conditions the instrument supplies 6v of collector voltage and an average of 2ma collector current. Transistor leakage (I_{cbo}) is reportedly measured directly in μa. The instrument's all steel case measures 10 ½ x 7 x 4 in. Lectrotech.

Tie Cutter 715

Announced is a hand-held tool designed to provide the electronic technician with a means of cutting

electronic cable lacing and spot-ties. It reportedly eliminates the use of knives and scissors or other unguarded cutters. Macdonald.

Replacement Antennas 716

Announced is a line of 5/8 wavelength and collinear-type antennas reportedly designed to fit the ¼ wavelength mounts on Motorola TAE and TAD equipment. Specifications indi-

cate that these longer antennas give 3db greater gain than the ¼ wavelength whip antenna at 150MHz and that they give 5db omnidirectional gain at 450MHz. According to the manufacturer, these antennas come complete with base, O ring, Allen wrench and silver-plated stainless-steel whip. Larsen.

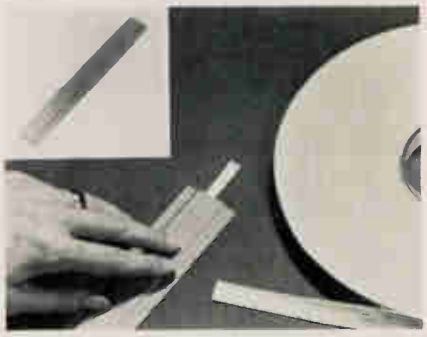
Audio Generator 717

Announced is a transistorized instrument designed to provide a tunable sine or square wave audio-frequency signal. The instrument's frequency range reportedly extends from 20Hz to 200kHz. Specifications indicate that six transistors and two diodes are used to produce a stable signal with amplitude variations of less than ±1.5db and a total sine wave harmonic distortion of less than 0.25. The 3-lb instrument in enclosed in a 7¾ x 5⅜ x 4 ¾ in. cabinet and reportedly features a single scale dial,

switch selection of sine wave or square wave output and range of output level, and an attached shielded output cable. Price $95. RCA.

Rigid Cable Cover 718

A rigid cable cover for telephone, intercom and other low-voltage wire installations is announced. It is manufactured in 4ft lengths that are ⅛ in. high and 1 ½ in. wide. Specifications indicate that foam adhesive, applied

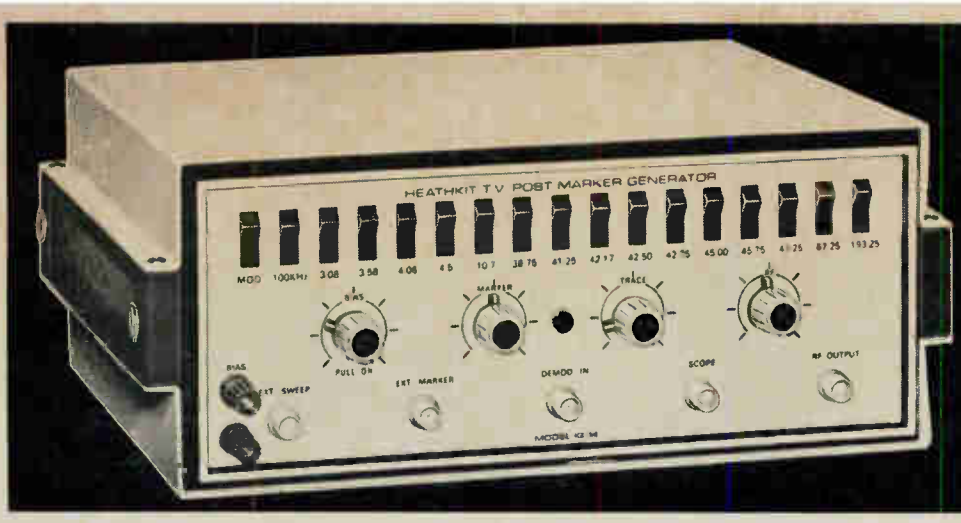


to the edges along the length of the duct, adheres to nearly any clean, relatively smooth surface and eliminates need for drilling holes or using mechanical fasteners. 3M.

Aerosol Varnish 719

Announced is an aerosol varnish that reportedly has demonstrated excellent fungus-resistant qualities as well as an insulating effect at least

10 times that of an untreated surface. Specifications indicate that its dialetric strength is 750v per mil. The varnish has been blended to give a smooth, transparent coating that will not crack, splinter or remain tacky. Industrial Supply.



new HEATHKIT® solid-state crystal-controlled POST-MARKER GENERATOR only $99.95

the most important instrument you can own for Color TV and FM alignment now costs a lot less...the Heathkit IG-14

• 15 crystal-controlled marker frequencies • Switch-select picture and sound IF frequencies, color bandpass and trap frequencies, 6 dB points, plus FM IF center frequency and 100 kHz points • Use up to six markers simultaneously for faster TV alignment • Birdie-type markers • Trace and Marker amplifiers and size controls • 400 Hz modulator • Variable bias supply • All solid-state, 22 transistors, 4 diodes • Circuit boards

Fast, Accurate Color Alignment. Speed and accuracy are important in today's service work . . . important to your customers, important to your profits. Speed and accuracy are what the new Heathkit IG-14 gives you . . . plus features usually costing five to ten times as much.

Just Push A Button. That's all it takes to set a frequency . . . no dial to twiddle, no searching, no resetting problems. Fifteen switch selected crystal-controlled markers. Nothing could be easier or more accurate. The IG-14 has input and output connections so that it can be used with any sweep generator and scope. Also an external marker input. BNC connectors are used throughout.

No Trace Distortion. One of the big values to using a post marker generator like the IG-14 is that markers are injected after the sweep signal passes through the set being tested, thereby eliminating the 'scope trace distortion usually found when injection or absorption type marker generators are used.

Crystal-Controlled Markers For Any TV Alignment Task. Four marker frequencies are provided for setting color bandpass, one marker for TV sound, eight at the IF frequencies between 39.75 and 47.25 MHz, and markers for channel 4 and channel 10 picture and sound carriers for checking tuner RF response. With the ability to use up to six markers at once, such as picture and color carriers at 6 dB points, corner marker and trap frequencies, alignment is fast and precise. Trap alignment is just a matter of selecting the appropriate trap frequency, applying the 400 Hz modulation, and tuning the trap for minimum audio on a scope or meter.

Easy FM IF and Discriminator Alignment. The IG-14 provides *visible* markers at the 10.7 MHz center frequency plus 100 kHz markers on each side . . . visible because they are applied to the trace after detection and so are not attenuated by the discriminator. Use of harmonics, fully explained in the manual, provide tracking markers as well.

Trace and Marker Amplitude Controls . . . on the front panel permit using a regular service type 'scope instead of a wide-band, ultra-sensitive model . . . and stage by stage alignment is easier.

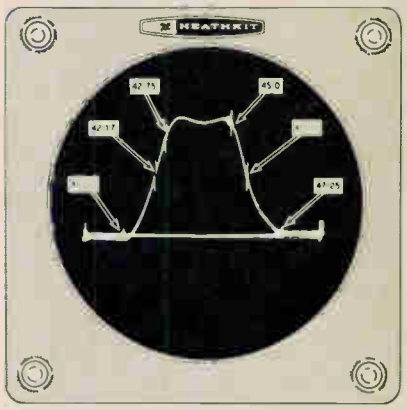
Variable Bias Supply . . . 0 to 15 VDC @ 10 milliamps is isolated from chassis so you can use positive or negative bias.

New Look . . . Circuit Board Construction. Handsome low profile, "stackable" cabinets in the new look of Heath instruments . . . finished in beige and black. Easy-to-build layout with two circuit boards.

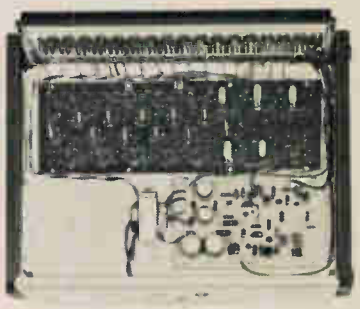
Save Hundreds of Dollars. Until now, an instrument with these features cost much more. Order the IG-14 now . . . it's the best investment in alignment facilities you can make.

Kit IG-14, 8 lbs., no money dn., $10 mo. **$99.95**

IG-14 SPECIFICATIONS—Crystal Marker Frequencies: 3.08, 3.58, 4.08, 4.5, and 10.7 MHz @ .01%; 39.750 41.250, 42.170, 42.500, 42.750, 45.000, 45.750, 47.250, 67.250, and 193.250 MHz @ .005%. **FM Bandwidth Marker:** 100 kHz. **Modulation:** 400 Hz. **Input Impedance:** External sweep, 75 ohm; External marker, 75 ohm, Demodulation input, 220K ohm. **Output Impedance:** RF output, 75 ohm; Scope output, 22K ohm. **Bias Output Voltage:** Variable from 0 to 15 VDC @ 10 MA. Isolated from chassis for either negative or positive bias **Type of Marker:** "Birdie." **Controls:** Bias voltage with AC on/off; Trace size; Marker amplitude; RF output; Modulation on/off; Markers, individual switches for each frequency. **Semiconductors:** Transistors: (16) 2N3692; (6) 2N3395; (3) Silicon diodes; (1) Zener diode, 13.6-V. **Power requirements:** 105-125 volts, 50/60 Hz AC @ 7.5 watts. **Net weight:** 8 lbs.



SIX MARKERS SIMULTANEOUSLY. The scope trace above shows how six markers can appear at the same time. Note the trap markers, 6 dB points, and picture and sound carriers . . . all on one trace with the IG-14.



EASY TO BUILD. Note how everything except the front panel switches and controls mount on two circuit boards . . . even the crystals.

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NEW PRODUCTS

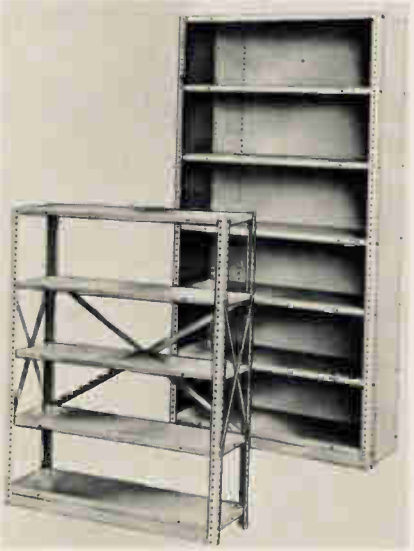
Solder Sucker 720

A tool, designed to remove excess solder from circuit boards, plated-through holes or terminals, reportedly

consists of a miniature 18w 6v soldering iron, an attached suction bulb and a reservoir for the removed solder. Specifications indicate that the solder reservoir is made of easily cleaned stainless steel, and that the suction tip is chrome plated so that solder will not adhere. Oryx.

Storage Shelving 721

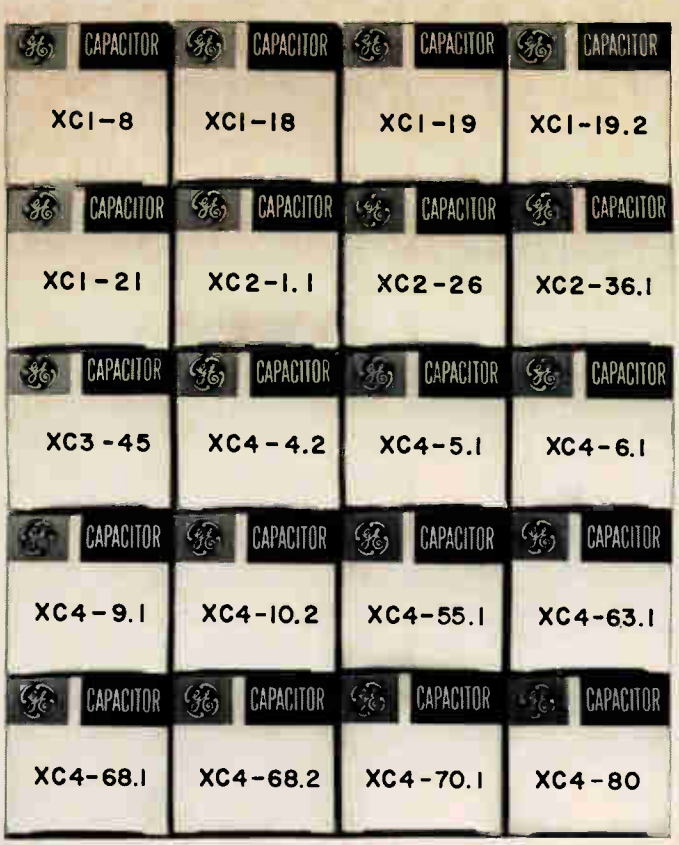
Announced are shelving packages in 48, 72, 84 and 96in. heights by 30, 36, 42 and 48in. widths and in 9, 12, 15, 18 and 24in. depths. Specifications indicate that each size is produc-



ed in open or closed (with end and back panels) style. Corner posts reportedly are 14-gage steel, with 18-gage steel shelving. Midland.

VOM 722

Announced is a VOM with a 0 to 10, 50, 250, 500, 1000vdc; 0 to 100 a. 2.5ma, 100ma dc current; 0 to 10, 50, 250, 500vac; and R x 1, R x 10, R x 100 0 to 10K scales controlled with one knob. Specifications indicate that



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Stock only 20 General Electric Service-Designed replacement capacitors and meet over 70% of your replacement needs.

Use General Electric extended-range replacement capacitors. Just 20 General Electric Service-Designed replacement units will meet over 70% of all TV can style needs!

"Extended-range" means that fewer General Electric types are needed to meet your requirements. Every GE aluminum capacitor meets not just one, but a range of capacitance and voltage requirements. And, to make selection easier, the application range of every General Electric capacitor is shown clearly on the unit, and on the carton.

You can quickly see, for example, that the GE capacitor rated 50-60 mfd up to 450 VDC will replace any unit between 50 and 60 mfd at any voltage up to 450 VDC. You save time and money in making replacements because General Electric capacitors are Service-Designed with you in mind!

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Application ranges for 20 General Electric capacitors that meet over 70% of your replacement needs.

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XC1-8
60 to 80MF up to 450V.

XC1-18
100 to 150MF up to 350V.

XC1-19
88 to 160MF up to 250V.

XC1-19.2
100 to 160MF up to 250V.

XC1-21
110 to 200MF up to 300V.

XC2-1.1
60 to 80MF up to 450V.
1 to 2MF up to 350V.

XC2-26
30 to 40MF up to 500V.
35 to 45MF up to 500V.

XC2-36.1
60 to 80MF up to 475V.
90 to 160MF up to 250V.

XC3-45
40 to 60MF up to 350V.
40 to 60MF up to 350V.
50 to 80MF up to 350V.

XC4-4.2
75 to 100MF up to 475V.
3 to 4MF up to 475V.
3 to 4MF up to 475V.
90 to 200MF up to 25V.

XC4-5.1
60 to 80MF up to 475V.
2 to 4MF up to 450V.
2 to 4MF up to 450V.
2 to 4MF up to 450V.

XC4-6.1
60 to 80MF up to 475V.
2 to 4MF up to 450V.
2 to 4MF up to 450V.
90 to 200MF up to 25V.

XC4-9.1
35 to 50MF up to 475V.
30 to 40MF up to 475V.
2 to 4MF up to 150V.
20 to 40MF up to 25V.

XC4-10.2
1 to 2MF up to 350V.
10 to 25MF up to 25V.
45 to 80MF up to 250V.
50 to 100MF up to 25V.

XC4-55.1
30 to 40MF up to 450V.
15 to 20MF up to 450V.
15 to 20MF up to 450V.
60 to 80MF up to 450V.

XC4-63.1
20 to 30MF up to 450V.
15 to 20MF up to 450V.
90 to 160MF up to 250V.
20 to 40MF up to 150V.

XC4-68.1
10 to 20MF up to 250V.
25 to 50MF up to 50V.
40 to 50MF up to 450V.
60 to 80MF up to 450V.

XC4-68.2
15 to 20MF up to 450V.
90 to 160MF up to 250V.
20 to 50MF up to 75V.
20 to 50MF up to 50V.

XC4-70.1
15 to 20MF up to 450V.
60 to 100MF up to 350V.
50 to 100MF up to 50V.
80 to 150MF up to 350V.

XC4-80
30 to 40MF up to 450V.
30 to 40MF up to 450V.
30 to 40MF up to 450V.
30 to 40MF up to 450V.

NEW PRODUCTS

the instrument has a 10/vdc sensitivity and a 5/vac sensitivy. The instrument reportedly has a magnetic cover for securing it to any iron-based metal surface. The manufacturer indicates that the instrument comes with a fully illuminated dial, and an optional probe is also illuminated. Dealer net price $21.95, illuminated probe $2.69 extra. Components Specialities.

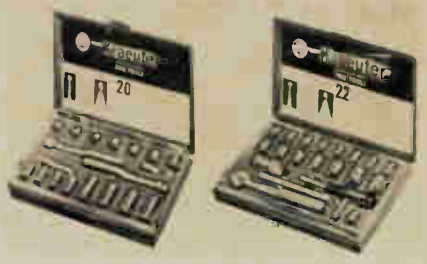
Cable Stripper 723

A cable stripping tool has been designed to remove the plastic protective jacket from nonlead telephone cables

without damaging the underlying shielding or insulation. This tool reportedly can be used to remove neoprene, polyethylene or PVC jackets. The cable strippers are made in two sizes: one for cables with 5/16- to 3/14-in.-od jackets and another for cables with ¾- to 1 ⅛-in.-od jackets. G & W Electric.

Socket Wrenches 724

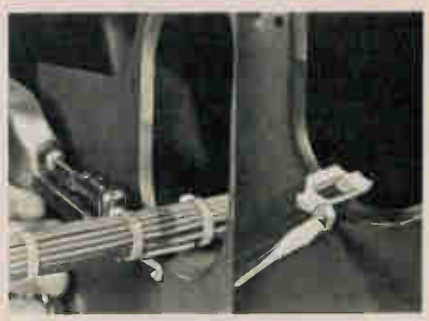
Two socket-wrench sets feature a ratchet designed for getting into tight work areas. One is reportedly a 20-piece assortment which includes seven standard sockets, eight deep sockets, two extensions, one flex-head handle plus a ratchet. Specifications indicate



that the other is a 22-piece set which includes eight standard ¼-in. drive sockets, seven standard ⅜-in. drive sockets, two extensions, a spinner handle, an adapter, a ⅜-in. drive spark-plug socket plus a ratchet. Kraeuter.

Wire-Bunlet Clamps 725

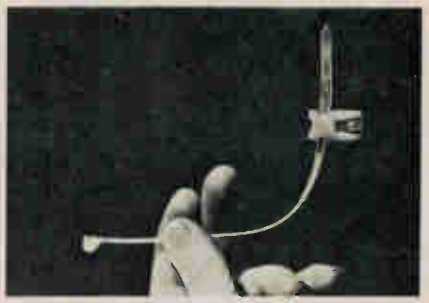
A bulkhead mounting base has been designed to hold ⅛ to 1¾-in. diameter wire bundles and protect the har-



ness against abrasion. Ties are reportedly installed through the clamp on either side of the bulkhead. Thomas & Betts.

Bundle Mounting Base 726

A mounting base has been designed for the horizontal or vertical installation of wire bundles. Specifications



indicate that the base is made of nylon, secured with a single mounting screw and accepts bundle sizes up to 4in. Thomas & Betts.

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1000 watt Power Supply

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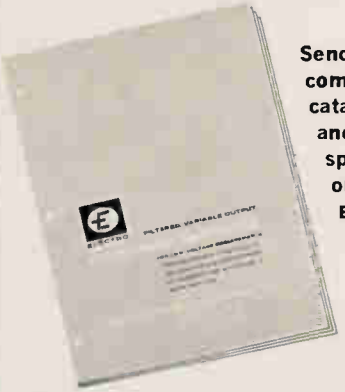

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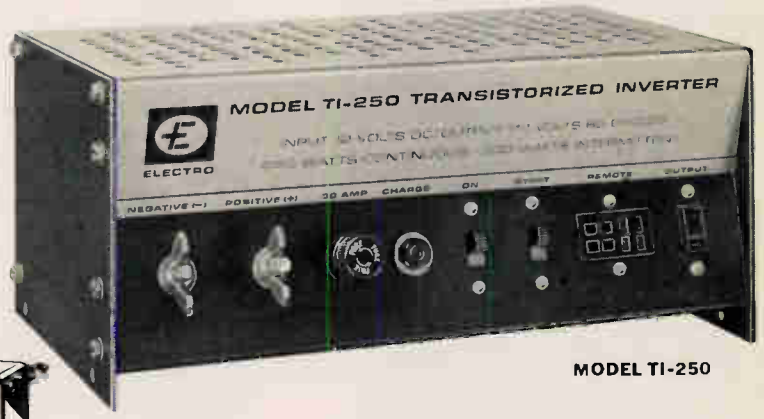
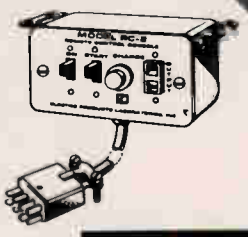
Supply 117 volt alternating current from a 12 volt battery

Three models to choose from: TI-100A, a low cost model adequate for most applications; TI-100TR, especially designed to assure correct frequency for tape recorders; Model TI-250, a larger model having a 250/300 watt output for a wider range of applications.



MODEL TI-250



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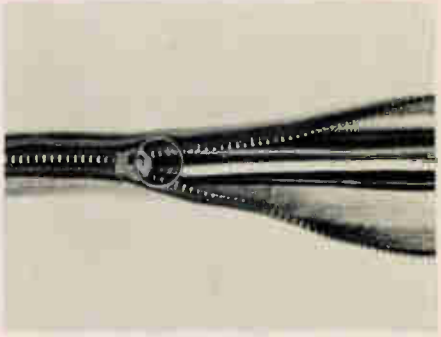
NEW PRODUCTS

Telephone Answering System 727

A telephone answering system has been designed to include a tape recorded greeting or announcement that can be changed remotely by telephone. Announcement cycles reportedly range from a standard 60sec to 3min with optional accommodations for special requirements. Specifications indicate that the system is made up of a solid-state unit, half the size of a breadbox, that is installed at the "home" phone; and a pocket-sized "telekey" that the user carries for making remote, exclusive connections to his own telephone system from any other remote telephone. Record-O-Phone.

Zip-On Sheath 728

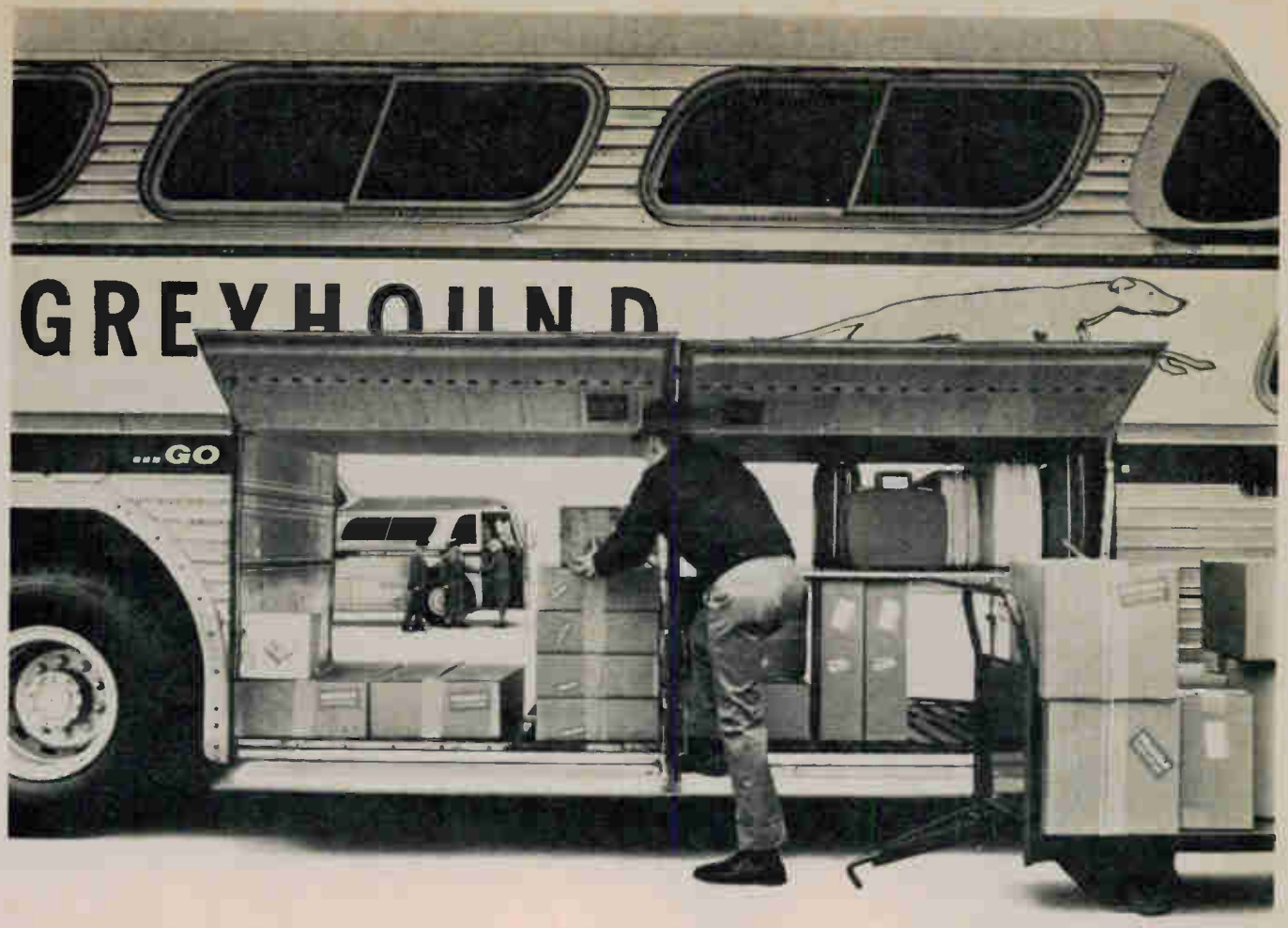


Announced is a metallic zip-on sheath that is designed to provide electromagnetic shielding for communications cables. The manufacturers' specifications indicate that the cable shield is an all-metal shielding jacket of knitted mesh that can be zipped around any shape before or after the installation of a cable harness. The zipper manufacturer reports that it has a 5 lb closing force and a 40 lb per in. resistance to a lateral opening. Metex.

Deck Switches 729

Announced is a series of deck switches that is reportedly produced in an assortment of four deck pole configurations: a single nonshorting pole per deck with 20deg spacing and 2 to 18 stops, a single shorting pole per deck with 10deg spacing and 2 to 34 stops, two nonshorting poles per deck with 20-deg spacing and 2 to 9 stops, or two shorting poles per deck with 10deg spacing and 2 to 16 stops. Specifications indicate that all switches are rated at 1kv RMS maximum breakdown voltage and that a torque of only 15 to 18in. lb is required for 30 deck stacked switches. Cole.

Stockroom on wheels!



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NEWS OF THE INDUSTRY

JFD Announces Two New Auto Antennas

The Brach Div. of JFD Electronics Co., Brooklyn, N.Y., is expanding its line of auto antennas to include electric models. Two new models — a front-mount and a rear-mount — are announced along with a rear-mount extension kit.

The front-mount antenna, model 86-6753, has a five-section mast that extends to 46in. The motor develops 18 to 20 lb thrust to raise or lower the antenna even in sub-zero weather. This model includes 56in. of cable, and a 6ft electric harness with an up-and-down control switch and bracket.

The rear-mount antenna, model 86-6756, has the same five-section, 46in. mast and the same 18 to 20 lb thrust-developing motor. It also includes 180in. of shielded cable, 180in. electric harness extension with an up-and-down control switch and bracket, and a rear-mount adapter pad.

The rear-mount extension kit, model 86-6755, is optional with model 86-6753. This kit consists of a 180in. cable extension and a 180in. electric harness extension with an up-and-down control switch and bracket and a rear-mount adapter pad.

Hy-Gain Names Distributor Sales Manager

J. L. Taylor has been named sales manager for distributor products by Hy-Gain Electronics Corp. of Lincoln, Neb. The company manufactures antennas for amateur, CB and business band radio, which are sold through distributors.

Harman-Kardon Strengthens Sales Organization

Harman-Kardon, major manufacturers of high fidelity components and compact music systems, appoints the Jack Berman Co. as regional sales representatives in southern California.

Shown from left are Jack Berman, president, Jack Berman Co.; Sidney Harman, president, Jervis Corp., parent company of Harman-Kardon; Walter Goodman, president, Harman-Kardon; and Irving R. Stern.

Mr. Stern recently announced the merger of his sales organization with the Berman Co. He is a former partner in Shepard-Stern Co., which previously represented Harman-Kardon products in southern California. In addition to the Harman-Kardon line, Mr. Stern brings the Koss and Rek-O-Kut lines to the Berman organization which has been serving as sales reps for Garrard and Shure.

ITT and Rayonier Merge

The boards of directors of International Telephone and Telegraph Corp. and Rayonier announce approval of a merger agreement under which Rayonier will become a wholly owned subsidiary of ITT.

Terms of the transaction call for the exchange of .1975 shares of ITT common stock and .2675 shares of a new ITT $4.50 preferred stock for each share of Rayonier common stock. The preferred stock will be convertible into ITT common stock at $122 per share.

The merger agreement is subject to the approval of Rayonier stockholders who will meet on March 6, 1968, to vote on the matter and receipt of a favorable tax ruling and certain other legal conditions.

Antenna Specialists Announce Distributor Indentification Program

The Antenna Specialists Co. has launched an extensive distributor identification program, according to Robert Beebe, director of sales. The campaign identifies the company's specialists distributor as "The Man behind the Stripes," and establishes him as the outstanding expert and specialist in the field of industrial and communications antennas in his area.

Full-page color advertisements stressing the distributor's knowledge of technical antenna theory, extensive practical experience and his high degree of personal integrity will begin appearing in leading consumer electronic publications shortly.

Springdale Electronic Corp. Will Specialize in Parts Distribution

Joel Heitner, founder and former president of Connecticut Industrial Electronics, has announced formation of a new business, Springdale Electronic Corp.

Mr. Heitner is in partnership with Dick Teller, who started Connecticut Industrial with Mr. Heitner. Springdale Electronic will specialize in the distribution of electronic parts, according to its founders.

Self-Threader For Recording Tape Developed

The Reeves Soundcraft Div. of Reeves Industries has developed a Mylar "self-threader" tab, featuring color-coding and numbering, to readily indicate the front and rear ends of reels.

The company said the accessory fills a long-time need for a simple and effective method of threading tape reels.

The "self-threader" is easily attached by pressing the gummed section of the tab to the glossy side of the tape. The tab will create an automatic threading of the reel when the recorder is started, and will provide in excess of 100 automatic threadings without replacement, the company said.

NBS Conference on Precision Electromagnetic Measurements

The National Bureau of Standards (NBS) announces that the 1968 Conference on Precision Electromagnetic Measurements will be held June 25-28, at the Boulder Laboratories Boulder, Colo. This meeting will be the sixth in the biennial series begun in 1958. The conference is sponsored by the NBS Institute for Basic Standards (U.S. Dept. of Commerce), the group on Instrumentation and Measurement of the Institute of Electrical and Electronics Engineers (IEEE) and the U. S. Commission I of the International Scientific Radio Union (URSI). The Bureau of Continuation Education of the University of Colorado will handle the local arrangements.

NEWS OF THE INDUSTRY

Taft Broadcasting Affiliates

Walter A. Schwartz, president of the ABC Radio Network, announces that the Taft Broadcasting Co. will affiliate all of its FM radio stations with the new American FM Radio Network, which premiered Jan. 1, 1968.

The stations, serving five of the top 50 major radio markets in the country, are WKRC-FM, Cincinnati; WGR-FM, Buffalo; WDAF-FM, Kansas City; WTVN-FM, Columbus; and WBRC-FM, Birmingham.

Lear Jet Stereo 8 Adds Distributors

Four new Lear Jet stereo 8 distributors are announced by Joel Rowley, marketing manager for consumer products, stereo division. These distributors will carry the full line of Lear Jet stereo 8 home and auto cartridge playing systems.

The new distributors are: Cooper-Louisville, 118-22 E. Main, Louisville, Ky.; Continental of Hawaii, 905 Halekauwila St., Honolulu; Bill Fisher Auto Air Conditioning, 901 Broadway, Little Rock, Ark.; Carswell Distributing Co., S. Stratford Road, Winston-Salem, N. C.; and Godwin Distributing Co., 1227 Spring St., N. W., Atlanta, Ga.

Sales-Management Seminars

How to merchandise music at every level from schoolroom to over-the-counter salesmanship will be the provocative theme of the 1968 series of sales-management seminars sponsored by the National Assn. of Music Merchants in five cities across the nation starting on Sunday, Feb. 18.

Specific sales techniques with the emphasis on "Persuasion: the Hidden Side of Selling" will be discussed by a top sales executive. Max Sacks, a veteran of 35 years of salesmanship in another valuable feature at the annual seminar.

In addition to the "Move to Music" and Max Sacks' presentation, each of the seminars will have an outstanding local headline speaker at luncheons. The lineup of dates, places and speakers for the five seminars are as follows:

Eastern. Philadelphia, Feb. 18-19, Marriott Motor Hotel. William H. Zeswitz, president of the Zeswitz Music House in Reading, Pa., will speak on "Using 'Move to Music' in Your Business."
John J. Liney, Jr., will talk on his famous "Henry" cartoon character at luncheon.

Southwestern. Dallas, March 3-4, Marriott Motor Hotel. James C. Saied, president of Saied Music Co., in Tulsa, Okla., will speak on "Using 'Move to Music' in Your Business." Raymond Mitchell, manager of American Insurance Co.'s bank department, will discuss "The Modern-Day Thief."

Southeastern. Atlanta, March 17-18, Marriott Motor Hotel. F. D. Streep, president of Streep Music Co. in Orlando, Fla., will discuss "Using 'Move to Music' in Your Business." Ed. W. Hines, executive vice president of Georgia Savings & Loan League in Atlanta, will talk on "To Sin in Silence."

Western. San Francisco, April 7-8, Hotel Mark Hopkins. William K. Dunkley, president of Dunkley Music in Boise, Idaho, will present "Using 'Move to Music' in Your Business." Paul Speegle, director of public relations of Roos/Atkins department store in San Francisco, will be guest speaker.

Midwestern. Chicago, April 21-22, Marriott Motor Hotel. Charles M. Faulhaber, president of Ward-Brodt Music Co. in Madison, Wis., will speak on "Using 'Move to Music' in Your Business."
Joseph T. Meek, president of Illinois Retail Merchants Assn., will be guest speaker.

KAAR Electronics Holds West Coast Service Seminar

KAAR service dealers from points as far apart as Anchorage, Alaska and San Diego, Calif., attended a week-long seminar in Mountain View on two-way radio communications equipment service techniques.

In addition to learning how to

service marine radar, radiotelephones and land mobile solid-state equipment. seminars were held on the design of HF/SSB and VHF/FM systems. Special emphasis was placed on tone and selective calling circuits.

Congress Slow in Deciding Weights and Measures Standards

George Washington, Thomas Jefferson and scores of other presidents have asked Congress to decide on Weights and Measures Standards for the United States, and we are still awaiting their decision. Although Congress once authorized a Treasury Dept. employee, Ferdinand Hassler, to collect standards of weights and measures from Europe, no federal standards were ever adopted. The United States is in the strange position of having its standards of weights and measures dependent on state, not federal, adoption.

Americans use at least 85 different weights and measures. Length comes by the inch, foot, yard, chain, rod, furlong, league and mile. Area may be in square miles or acres. Volumes and weights are stated in teaspoons, tablespoons, pints, quarts, pecks, gallons, barrels, bushels, drams, gills and cords. There are three different tons, two different pounds, three different ounces, three quarts and three miles.

The rest of the world is a bit confused by American weights and measures, and the problem is fast becoming acute. Japan, Korea, India and Britain are among recent converts to the metric system—now used by well over 90 percent of the world's population.

Bills have recently been introduced in the House and Senate to study this matter but no action has yet been taken.

Cornell-Dubilier Appoints District Sales Manager

Richard J. Adams has been appointed district sales manager for Indiana and Kentucky by Cornell-Dubilier Electronics. The new district office is located at 5330 E. 38th St., Indianapolis.

Two New Tubes Announced For Color TV receivers

General Electric's tube dept. has announced the availability of two new double-triode-pentode compactrons, the 6AK9 and 16AK9, for use in color TV receivers.

Specifications indicate that triode section one has an amplification

factor of 43, which is ideal for sync-chopper applications; while triode section two has an amplification factor of 20 and is suited for vertical oscillator use.

Norelco Reduces 'Carry-Corder 150' Price

The Norelco "Carry-Corder 150" cassette tape recorder has been reduced in price effective immediately.

The minimum price in cooperative advertising of the cordless, miniature machine is now $64.50, a reduction of $5 at the retail level. Dealer cost will be adjusted accordingly, it is announced by North American Philips Co.

CATALOGS AND BULLETINS

Precision Tools 400
A large number of specialized, precision tools are described in this 16-page booklet. Tools for electronics, telephone and communications equipment are described, including spring adjusters, gages, burnishers and many others. Jonard.

Electronic Components 401
A 400-page catalog lists thousands of electrical and electronic components for industrial OEM, institutional and plant-maintenance needs. Listings give specifications and prices for circuit components including semiconductors, tubes, relays, pots and switches, hardware, test instruments and tools. Almo.

Antenna Rods 402
Three sheets describe direct and universal-replacement rods for Sony and other compact TV sets. B&B Electronic.

MATV Design 403
A 24-page booklet shows technicians how to design MATV systems and covers systems for homes, dealer showrooms, apartment houses, hotels, motels, hospitals, nursing homes, schools, trailer parks, tract- and military-housing. JFD.

Solid-State Amplifiers 404
A catalog details a line of solid-state PA and other audio amplifiers and contains charts, numerous photos, technical data and a listing of accessories. Bogen.

Neon Glow Lamps 405
An eight-page illustrated brochure tells how to apply neon glow lamps to many applications. It includes discussions on light output, longevity and external conditions acting on glow lamps and gives charts for breakdown voltages, lamp measurements, electrical characteristics and dimensional diagrams. Signalite.

Cable Ties 406
A four-page cable-tie brochure covers details on four sizes of cable ties which are designed to provide an improved cable harnessing and tying system. Electrovert.

Stereo Component 407
A two-page brochure describes a solid-state AM/FM multiplex stereo tuner/amplifier which uses epitaxial planar silicon transistors in a complementary Darlington output circuit. Sansui.

LF Standards Receiver 408
A low-frequency standards receiver is described in a two-page catalog sheet. The receiver is a complete 1 MHz calibrating system providing a method for referencing frequency standards and 1 MHz oscillators against WWVB standards broadcasts. Gertsch.

Two-Way Radios 409
A bulletin covers a line of two-way mobile radios. It describes equipment having up to four frequency bands, a choice of power ratings and accessories. G-E.

MATV Accessories 410
This catalog covers lead-in components, including TV/FM MATV wiring kits for homes, matching transformers, splitters, plugs, wall plates, switches and other items. Mosley.

Parapet Antenna Mounts 411
A two-page brochure describes a parapet antenna mount for TV, FM and CB antennas. The brochure describes how the mount, making three-point contact, is installed on apartment houses, public and commercial buildings. South River.

Transistors 412
A complete selection guide for plastic transistors covers silicon annular types for industrial applications, parameters, voltage vs. current selection and other information. The guide groups transistor types into application categories, including high-speed saturated switches, audio amplifiers, low-current, small-signal amplifiers, medium-current small-signal amplifiers, nixie drivers, general purpose switches and amplifiers and dual diodes. Motorola.

Meter Relays 413
A six-page folder covers control, alarm and limit-type meter relays which are actuated by a photoconductor and light beam. The data includes complete circuit and dimensional details for stock models and additional information on special-order models. Simpson.

Audio Products 414
A 16-page catalog describes a broad line of audio products which includes industrial audio amplifiers, mobile amplifiers, paging systems, columnar speakers, musical instrument speakers, microphones, mixers, stands and intercoms. Geloso.

Screwdriver/Wire Stripper 415
A single-sheet form describes various sizes of a two-in-one tool which is used as a screwdriver and stripper for stranded/solid wire ranging in size from 12 to 20AWG. Holub.

Antennas, Mounts, Coils 416
A four-page brochure pictures and gives specifications on CB, amateur, commercial and business antennas, mounts and loading coils. Master Mobile.

Stereo Equipment 417
This 32-page booklet is available in quantity to legitimate service-dealers for promoting stereo component sales to prospective customers. Scott.

BOOK REVIEWS

FET CIRCUITS. *By Rufus P. Turner. Published by Howard W. Sams. 160 pages, soft cover. $3.25.*

Few books on the market are as well filled with useful circuit information as this one. A summary of basic field-effect transistor theory and characteristics is followed by a description of 82 FET circuits. Some of these circuits include audio amplifiers, audio and RF oscillators, an audio AGC amplifier, ceramic filtered superheterodyne broadcast receiver, all-wave regenerative receiver, crystal-controlled converter, beat-frequency oscillator (BFO), Q-multiplier, a circuit for selecting or rejecting an audio frequency, an audio squelch amplifier, crystal-controlled transmitter, transmitter RF amplifiers, frequency multipliers, a modulator, ac and dc relay circuits, a sound-operated relay, a phase shifter, ac and dc voltmeters, audio-frequency voltmeters, an audio frequency milliammeter, a harmonic-distortion meter and a heterodyne frequency meter. FM and TV receiver circuits are not included. This book contains all the information an apprentice electronics technician would require for constructing these circuits. Unexperienced technicians will benefit from the practical experience they will gain, while experienced technicians will benefit from studying the brief circuit descriptions for these modern shifts, the author describes resonant transistor applications.

TRANSISTOREN VERGELIJKINGSTABELLEN. *Written and published by De Muiderkring N. V., 192 pages, soft cover. Distributed by Gilfer Associates, P. O. Box 239, Park Ridge, N. J. 07656.*

The same edition of this book was published for use in both Europe and North America, and the introduction is printed in four languages. Fortunately, mathematics is universal and no translation is required for the comparable-transistor table — the major portion of this book. Semiconductors are listed in the table according to type number and matched with comparative transistors manufactured in Europe, America or Japan. Our count indicated that the listing contained 972 transistors of American origin, 818 transistors of European origin and 581 transistors of Japanese origin. This book may be a helpful guide to technicians who must substitute transistors in foreign-built radios and TV sets. The author warns, however, that additional transistor characteristic data should be obtained before substitutions are made.

ENCYCLOPEDIA OF ELECTRONIC COMPONENTS. *By Alva C. Todd. Published by Allied Radio Corp., 112 pages, soft cover. $1.*

This book describes an extremely large assortment of electronic components in alphabetical order from accelerometer to zinc-carbon battery. Some of the other components listed include: antenna (half-wave dipole), antenna (long wire), ballast resistor, capacitor (ceramic), cavity (resonator), connector (cable), crossover network, hall-effect element, meter (hot wire), relay (time delay), terminal (printed circuit) and voltage regulator (gaseous). Diagrams or sketches are generally included with the descriptions. Also frequently included are typical applications of the component. This book is interestingly written and contains information that is probably new to both inexperienced and experienced technicians. The inexperienced technician, however, may have problems with terms like major and minor antenna lobes.

ADVERTISERS' INDEX

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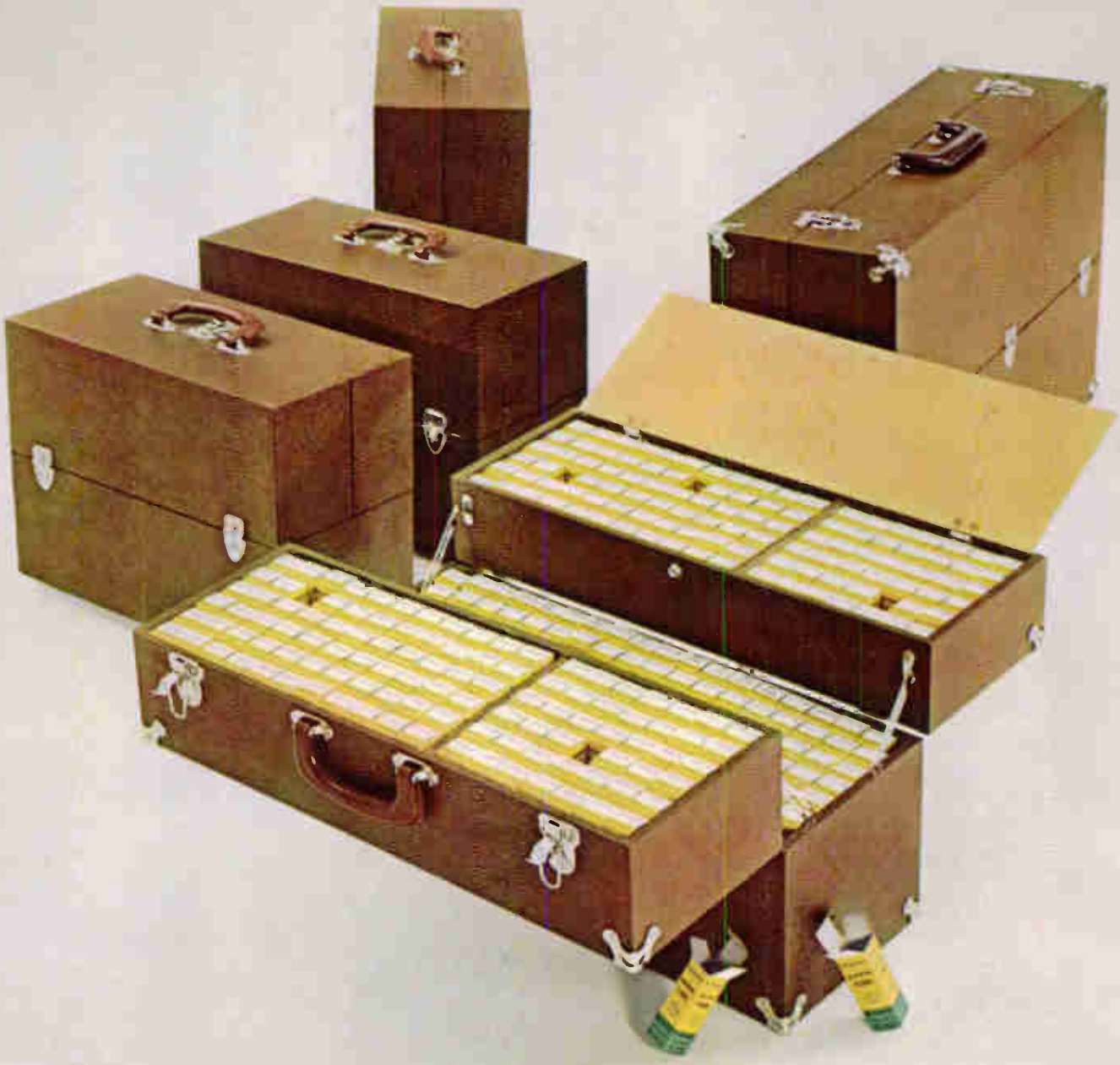

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