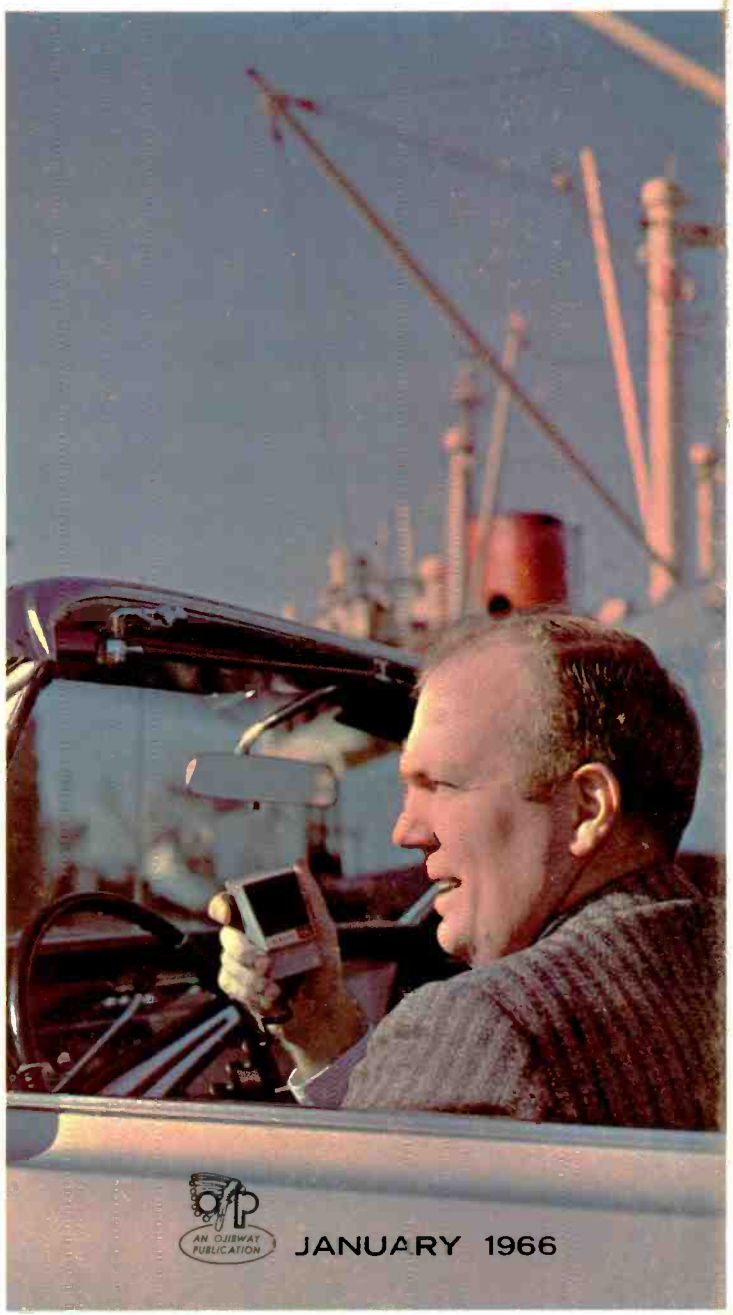
ELECTRONIC TECHNICIAN

WORLD'S LARGEST ELECTRONIC TRADE CIRCULATION

TWO-WAY RADIO COMMUNICATIONS



AN OJIBWAY PUBLICATION

JANUARY 1966

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ELECTRONIC TECHNICIAN

TEKFAX

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

GROUP 161

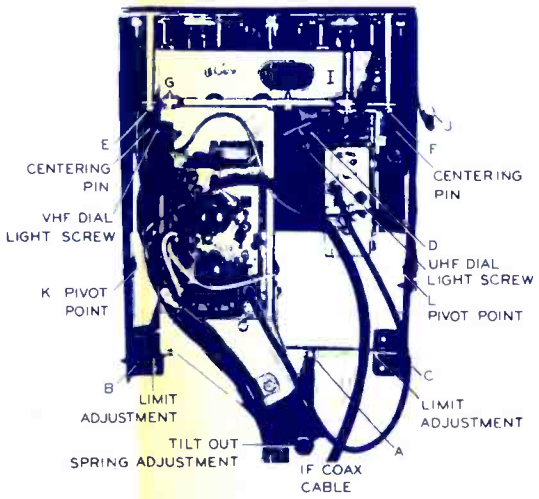
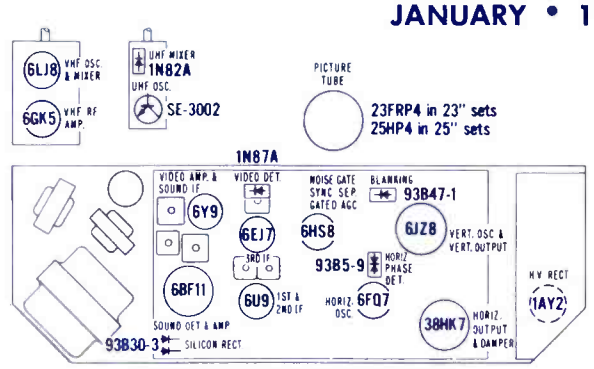
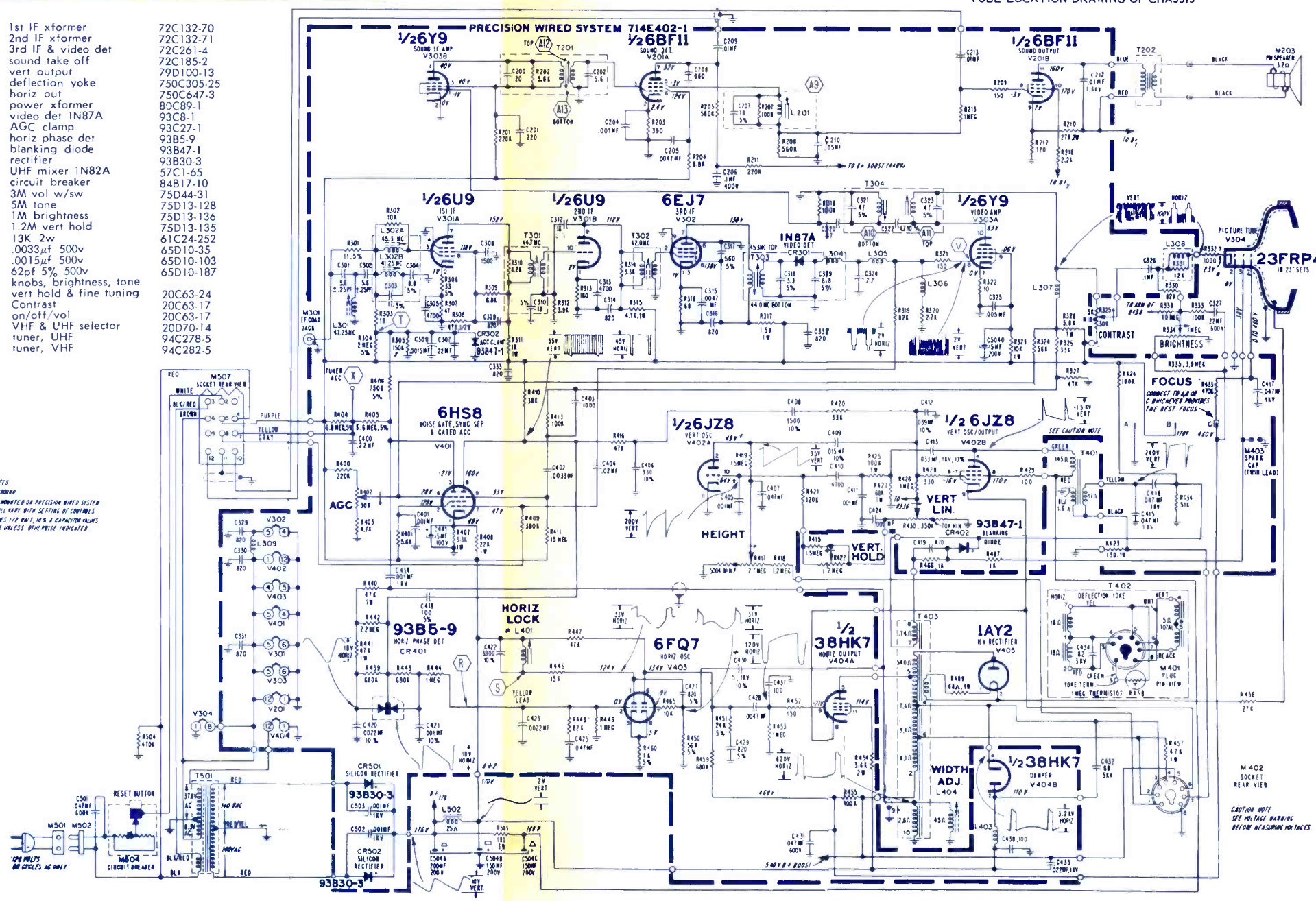


Fig. B 1G7 Tilt-Out Assembly View For Removal Instructions



TUBE LOCATION DRAWING OF CHASSIS

Symbol	Description	Admiral Part No.
R210	27K 2w	61C24-259
R301	11Ω 5% ½w	60C28-76
R304	2M 5% ½w	60C7-205
R306	33Ω 5% ½w	60C7-330
R311	1000Ω 1w	60C14-102
R315	4.7K 1w	60C14-472
R317	1.5K 1w	60C14-152
R323	10K 1w	60C14-103
R325	30K contrast	75D112-1
R334	1M brightness G7	75D111-1
R328	5.6K 7w 10%	61C24-743
R402	30K AGC control	75D101-4
R404	6.8M 5% ½w	60C7-685
R405	5.6M 5% ½w	60C7-565
R406	750K 5% ½w	60C7-754
R407	3.3K 1w	60C14-332
R408	22K 1w	60C14-223
R417	2.7M height	75D101-6
R422	112M vert hold G7	75D111-2
R423	150Ω 1w	60C14-151
R425	100K 1w	60C14-104
R427	68K 1w	60C14-683
R430	350K vert lin	75D101-5
R440, 441	47K 1w	60C14-473
R450	56K 5% ½w	60C7-563
R451	24K 5% ½w	60C7-243
R454	3.6K 2w	61C24-238
R456	27K 1w 10%	60C14-273
R457	4.7K 1w	60C14-472
R458	thermistor	60A64-1
R460	1K 5% ½w	60C28-92
R469	.68Ω 1w	60D28-98
R503	180Ω 3w	61C20-63
C209	.01μf, 500v GMV	65D10-3
C212	.01μf 1.4kv	65D10-65
C213	.01μf 500v GMV	65D10-3
C301, 302	5.6pf +.25pf 500v	65D6-170
C303	17pf 5% 500v	65D10-366
C304	6.8pf 5% 500v	65D28-141
C305	4700pf 500v	65D10-112
C306	.0015μf 500v	65D10-103
C308	1500pf 500v	65D10-349
C310, 312	18pf 5% 500v	65D10-121
C317	560pf 5% 500v	65D10-159
C318	3.3pf 5% 500v	65D10-130
C319	6.8pf 5% 500v	65D28-141
C321	47pf 5% 500v	65D10-92
C327	.22μf 1kv mylar	64C34-36
C412	.039μf 10% 600v mylar	64C26-25
C413	.033μf 10% 1kv mylar	64C2-53
C414	.001μf 1kv	65D10-147
C415, C416	.047μf 1kv mylar	64C2-33
C417	.047μf, 1kv mylar	64C2-33
C418	100pf 5% NPO 500v	65D10-105
C430	5pf 10% 1kv	65D10-345
C432	68pf 5kv	65D10-243
C434	82pf 3kv	65D10-337
C435	.002μf 1kv mylar	64C34-36
C441	5μf 100v elect	67C4-70
C502, C503	.001μf 1kv	65D10-147
C504A	200μf 200v } elect	67C15-389
C504B	150μf 200v } elect	
C504C	150μf 200v } elect	
L201	quad coil	72C132-61
L301	47.25Mc trap	72C132-55
L302	IF input coil	72C250-3
L303	RF choke	72C250-3
L304	RF choke	73C55-19
L305	RF choke	73C31-4
L306	peaking coil	73C5-53
L307, L308	peaking coil	73C55-17
L309	filament choke	73C37-2
L401	horiz lock coil	94C17-16
L403	spook choke	73C37-17
L404	width coil	94E279-2
L502	filter choke	74C18-58
T201	sound IF	72C222-6
T202	audio out	79C33-88
T301	1st IF xformer	72C132-70
T302	2nd IF xformer	72C132-71
T303	3rd IF & video det	72C261-4
T304	sound take off	72C185-2
T401	vert output	79D100-13
T402	deflection yoke	750C305-25
T403	horiz out	750C647-3
T501	power xformer	80C89-1
CR301	video det 1N87A	93C8-1
CR302	AGC clamp	93C27-1
CR401	horiz phase det	93B5-9
CR402	blanking diode	93B47-1
CR501, CR502	rectifier	93B30-3
CR801	UHF mixer 1N82A	57C1-65
M504	circuit breaker	84B17-10
R208A	3M vol w/sw	75D44-31
R208B	5M tone	75D13-128
R323	1M brightness	75D13-136
R422	1.2M vert hold	75D13-135
R805	13K 2w	61C24-252
C211	.0033μf 500v	65D10-35
C215	.0015μf 500v	65D10-103
C707	62pf 5% 500v	65D10-187
	knobs, brightness, tone	
	vert hold & fine tuning	20C63-24
	Contrast	20C63-17
	on/off/vol	20C63-17
	VHF & UHF selector	20D70-14
	tuner, UHF	94C278-5
	tuner, VHF	94C282-5



TELEVISION ALIGNMENT

ALIGNMENT TEST EQUIPMENT

The following test equipment is required for complete IF alignment:

1. Crystal calibrated signal generator to cover the IF frequency range (41.25MC - 47.25MC).
2. Sweep generator covering the 40-50MC range. It should have variable sweep up to 7MC.
3. VTVM and 2 short clip leads.
4. Two variable bias supplies
5. Oscilloscope.
6. Alignment tools 98A30-12 and 98A30-14. Matching networks are required for equipment termination.

PRELIMINARY IF ALIGNMENT

1. Connect decoupling network shown in Fig. C to test point "V" (grid of V303A). Let chassis warm up for 10 minutes before any alignment.
2. Set the tuner to channel 12, and short the antenna terminals on tuner together.
3. Feed signal through matching network to test point "G" on top of VHF tuner. See Fig. C.
4. Connect the positive terminal of the -13V bias supply to chassis ground and the negative terminal to the IF bias and RF bias points X and T. See Fig. G.

NOTE: To prevent possible damage to CR302, AGC Clamp, do not exceed 20 volts bias.

5. For location of adjusting cores and screws, see Fig. G. The VTVM voltage measured should be from 1.0V to 2.0V above residual voltage at test point "V".
6. Connect a jumper across the input coil L302. Set generator frequency to 45.1MC. Adjust L708, the mixer plate coil for maximum indication on VTVM. (See Fig. 3). After adjustment, remove the short across input coil.
7. Set the generator frequency to 45.3MC. Adjust T303 secondary top core for maximum indication on VTVM.
8. Leave generator at 45.3MC. Adjust L302A, input coil-bottom core for maximum indication on VTVM.
9. Set generator frequency to 44.7MC. Adjust T301 for maximum indication on VTVM.
10. Now set generator frequency to 42.0MC. Adjust T302 for maximum indication on VTVM.
11. Set generator frequency to 44.0MC. Adjust bottom core of T303 for maximum indication on VTVM.
12. Set generator frequency to 47.25MC. Adjust L301 for minimum indication on VTVM.
13. Set generator frequency to 41.25MC. Adjust L302B-top core for minimum indication on VTVM.

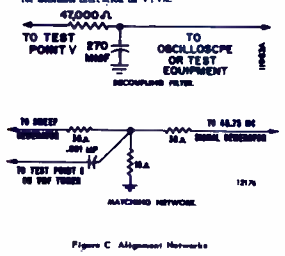


Figure C Alignment Networks

IF SWEEP ALIGNMENT

1. Disconnect RF generator from "G" and connect sweep generator high side to test point "G" through matching network shown in Fig. C, low side directly to tuner (See Fig. 3). Set sweep frequency to 43MC, sweep width approximately 7MC. If external marker generator is used, loosely couple high side to sweep generator lead, low side directly to tuner. Marker frequencies are indicated on IF Response Curve, see figure D.
2. Disconnect VTVM and connect oscilloscope high side to test point "V" through a decoupling filter (figure C), low side to chassis. Set channel selector to channel 12 or other high unused channel where the fine tuning does not affect the curve. Maintain -13 volt IF and RF bias.
3. Maintain sweep voltage to provide 3 volts peak to peak on oscilloscope, check curve obtained against ideal response, see figure D. Keep marker outputs as low as possible.
4. If necessary, correct 41.25MC and 47.25MC traps to markers on curve by adjusting L302B and L301. See Fig. D. Decrease IF bias to 1 volt and increase marker output and scope gain if necessary to see marker and base line.
5. The IF response curve should now appear as shown in Fig. D. If necessary, round the nose of the curve with the core of input coil L302. Also, if necessary, position the carrier with core to T301.

OVER-ALL VHF AND IF RESPONSE CURVE CHECK

Set AGC control fully to the left. Channel Selector on channel 12. Connect negative 7 volt bias supply to test point "T" (IF AGC) and negative 2 volt bias supply to test point "X" (RF AGC), positive to chassis. See Fig. G.

Important: Before proceeding check signal generator against frequency standard for calibration.

Attach the sweep generator at the VHF tuner antenna terminals, high side through 1200 ohm resistor, low side through 1200 ohm resistor. Place a 330 ohm resistor across the antenna terminals and a 47 ohm resistor across the generator output.

Connect oscilloscope high side to test point "V" through decoupling filter, low side to chassis.

Compare the response obtained to the ideal curves shown in Fig. F. If curve is not within tolerance, slightly adjust the IF transformers to obtain the correct curve. It should never be necessary to turn the slug more than one turn in either direction. If curve is satisfactory on channel checked, all other channels should be satisfactory. IMPORTANT: When sweep output is reduced, response curve amplitude on scope should also decrease, but curve shape should remain the same. If curve shape changes, reduce sweep output and/or scope gain until shape does not change.

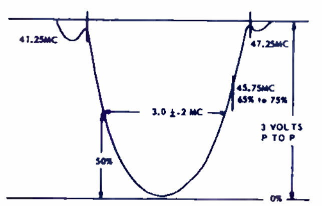


Figure D Ideal IF Response Curve

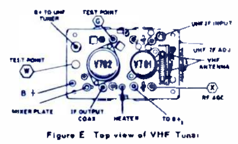


Figure E Top view of VHF Tuner

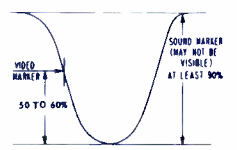


Figure F. Ideal Over-all VHF and IF Response Curve.

VHF AMPLIFIER AND MIXER ALIGNMENT

The tuners are turret types that feature high stability and trouble-free operation. The inductors of this tuner consist of individual channel strips and in general RF and mixer alignment is permanent. Individual channel oscillator slugs are adjusted by the fine tuning knob. See figure E for tuner adjustment locations. If it is definitely determined that complete tuner alignment is required, return tuner to Admiral Distributor for repair or replacement.

ALIGNMENT OF UHF IF INPUT USING A TRANSMITTED SIGNAL

Alignment of UHF IF input coil (part of VHF tuner), should be made if UHF reception is poor and after usual causes of poor UHF reception have been checked.

To align UHF IF input coil tune in UHF channel with normal picture and sound. Using non metallic alignment tool very carefully adjust slug L706A for best picture, consistent with good sound. For VHF tuner adjustment locations, see figure E.

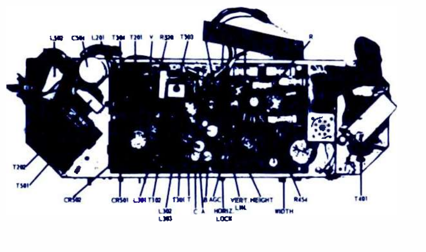


Figure G Top view of Chassis showing Alignment Locations. Dashed lines indicate adjustment nearest chassis.

4.5MC SOUND IF ALIGNMENT

1. Tune in normal picture on strongest TV station. Allow about 15 minutes for set to warm up. AGC control must be in proper adjustment. Adjust other controls for normal operation. Refer to chassis views and schematic for alignment locations.
2. Using a non-metallic alignment tool (part no. 98B30-12), and starting with L201 turned slug to the top of its form, screw it several turns into the form until the loudest and clearest position is found. There may be two points (approximately ½ turn apart) at which the sound is loudest. The slug should be centered over the innermost of the two points.
3. Reduce the signal at the antenna terminals until there is considerable hiss in the sound. For best results, use a step attenuator connected between antenna and antenna terminals. The signal can also be reduced by disconnecting the antenna and fastening it near the antenna terminals. It is important to keep the signal below limiting (hissing) as the alignment progresses.
4. Adjust T201 top slug for maximum output and minimum hiss. If this slug requires considerable adjustment, touch-up L201.†
5. Adjust T201 bottom slug for maximum output and minimum hiss.
6. Adjust T304 bottom slug for maximum output and minimum hiss. NOTE: The top slug is a 4.5mc trap. Do not adjust it as part of sound alignment.
7. If above alignment is correctly made, no further adjustment is required. However, if sound remains distorted at normal volume (when receiver is properly tuned), repeat entire procedure.

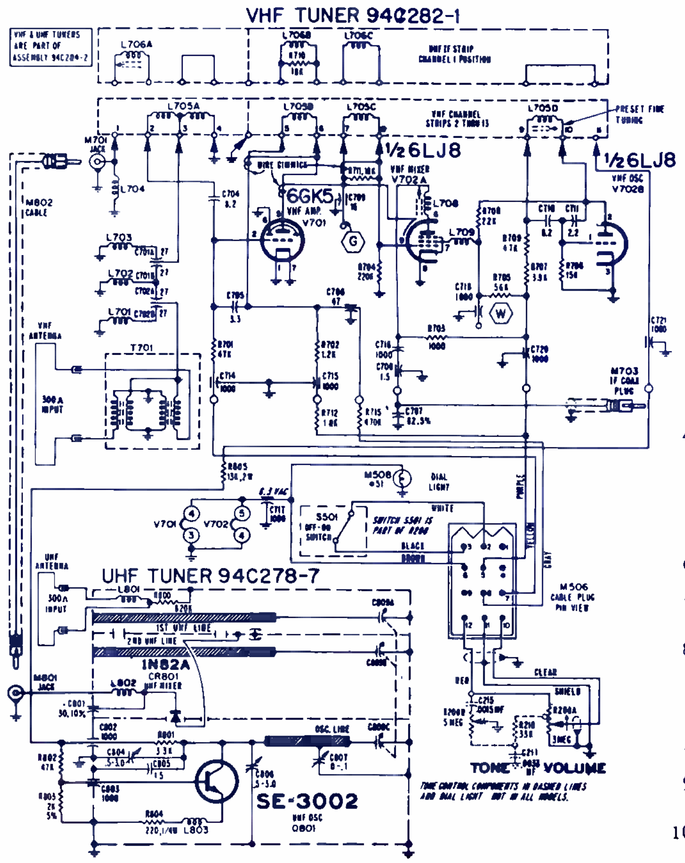
†Do not readjust L201 further unless sound is distorted. Readjustment of L201 beyond this point will require all sound adjustments to be repeated.

ALIGNMENT OF 4.5 MC TRAP

Alignment of 4.5 MC (beat interference) trap "A11" requires use of a hexagonal non-metallic alignment tool (part number 98A30-12).

To align 4.5 MC trap "A11", tune in television station with beat interference pattern in picture. While closely observing picture, adjust slug "A11" for minimum interference pattern.

Note that adjustment "A11" is top slug (slug farthest from bottom of coil). Use caution so as not to disturb bottom slug (slug nearest bottom of coil) as sound IF alignment will be affected.



ADMIRAL
TV Chassis G7 Series

CHASSIS TILT-OUT ASSEMBLY REMOVAL

To remove tuners and control assembly:

1. Pull off all knobs on tilt-out panel.
2. Remove cabinet back and unplug tuner IF coax lead at chassis.
3. Disconnect the white plug connecting the tuner assembly wires to the chassis.
4. Disconnect the contrast control cable by pulling connector from end of control shaft.
5. Disconnect spring A from bracket on inside of cabinet front. (See fig. B for the remaining steps).
6. Remove screws B & C.
7. Remove screw D located between the tuners.
8. Remove screws E & F while supporting tuner assembly. Ease tuner assembly off centering pins, then down and out. Screws G, H & I retain the control cluster bracket.

To remove tilt-out escutcheon assembly:

9. Remove the screw that fastens ground lug J to the picture tube escutcheon.
10. Remove retaining rings at pivot point K & L. Lift assembly carefully up and out from front of cabinet.

ELECTRONIC TECHNICIAN TEKFAX

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

977

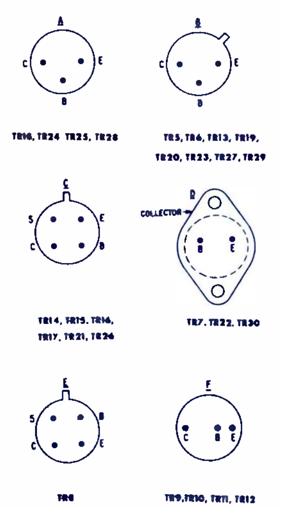
ZENITH
TV Chassis
1M30T20

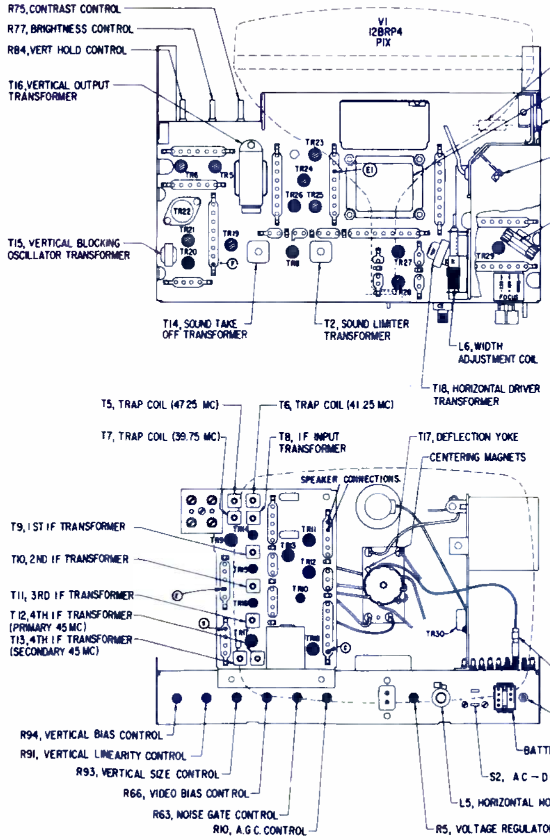
JANUARY • 1966

TRANSISTOR COMPLEMENT

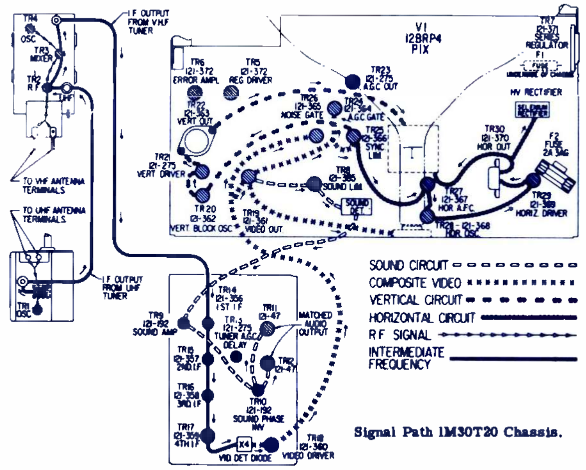
SYMBOL	FUNCTION	TYPE	SIMILAR TO	BASING DIAGRAM	ZENITH PART NUMBER
TR 1	UHF Oscillator	PNP		B	121-304
TR 1	UHF Oscillator	PNP		B	121-336
TR 2	RF Amplifier	PNP		G	121-329
TR 3	RF Mixer	PNP		G	121-330
TR 4	RF Oscillator	PNP		G	121-331
TR 5	Regulator Driver	PNP		B	121-372
TR 6	Error Amplifier	PNP		B	121-372
TR 7	Series Regulator	PNP		D	121-371
TR 8	Sound Limiter	PNP	2N 990	E	121-385
TR 9	Sound Amplifier	PNP	2N 4077	F	121-192
TR 10	Sound Phase Inverter	PNP	2N 4077	F	121-192
TR 11	Sound Output	PNP	2N 270	F	121-47 Matched
TR 12	Sound Output	PNP	2N 270	F	121-47 Pair
TR 13	Tuner AGC Delay	PNP		B	121-275
TR 14	1 ST. I.F.	PNP		C	121-356
TR 15	2 ND I.F.	PNP		C	121-357
TR 16	3 RD. I.F.	PNP		C	121-358
TR 17	4 TH. I.F.	PNP	2N 2612	C	121-359
TR 18	Video Driver	PNP	2N 3672	A	121-360
TR 19	Video Output	NPN		B	121-361
TR 20	Vert. Oscillator	PNP	2N 1303	B	121-362
TR 21	Vert. Driver	PNP		C	121-275
TR 22	Vert. Output	PNP	2N 1136A	D	121-363
TR 23	AGC Output	PNP		B	121-275
TR 24	AGC Gate	NPN	2N 3643	A	121-364
TR 25	Sync Limiter	NPN	2N 3643	A	121-366
TR 26	Noise Gate	NPN	2N 1308	C	121-365
TR 27	Horiz. AFC	NPN	2N 3641	B	121-367
TR 28	Horiz. Oscillator	PNP	2N 1305	A	121-368
TR 29	Horiz. Driver	NPN	2N 3567	B	121-369
TR 30	Horiz. Output	PNP		D	121-370

PIN CONNECTIONS FOR TRANSISTORS
(BOTTOM VIEWS OF TRANSISTOR OR SOCKET)





Trans. No.	Transistor Part No.	DESCRIPTION
TR5	121-372	REGULATOR DRIVER
TR6	121-372	ERROR AMPLIFIER
TR7	121-371	SERIES REGULATOR
TR8	121-385	SOUND LIMITER
TR9	121-192	SOUND AMPLIFIER
TR10	121-192	SOUND PHASE INVERTER
TR11	121-47	AUDIO OUTPUT (MATCHED)
TR12	121-47	AUDIO OUTPUT (MATCHED)
TR13	121-275	TUNER A.G.C DELAY
TR14	121-356	1ST I.F
TR15	121-357	2 ND I.F
TR16	121-358	3 RD I.F
TR17	121-359	4 TH. I.F
TR18	121-360	VIDEO DRIVER
TR19	121-361	VIDEO OUTPUT
TR20	121-362	VERTICAL OSCILLATOR
TR21	121-275	VERTICAL DRIVER
TR22	121-363	VERTICAL OUTPUT
TR23	121-375	A.G.C OUTPUT
TR24	121-364	A.G.C GATE
TR25	121-366	SYNC LIMITER
TR26	121-365	NOISE GATE
TR27	121-367	HORIZONTAL A.F.C
TR28	121-368	HORIZ. OSCILLATOR
TR29	121-369	HORIZONTAL DRIVER
TR30	121-370	HORIZONTAL OUTPUT



Signal Path 1M30T20 Chassis.

MODEL AND CHASSIS INFORMATION

MODEL	TYPE	CHASSIS	VHF TUNER	UHF TUNER	PICTURE TUBE
ROYAL 1290L,Y	Transistor Portable	1M30T20	Transistor 175-802	Transistor 175-39	12BRP4

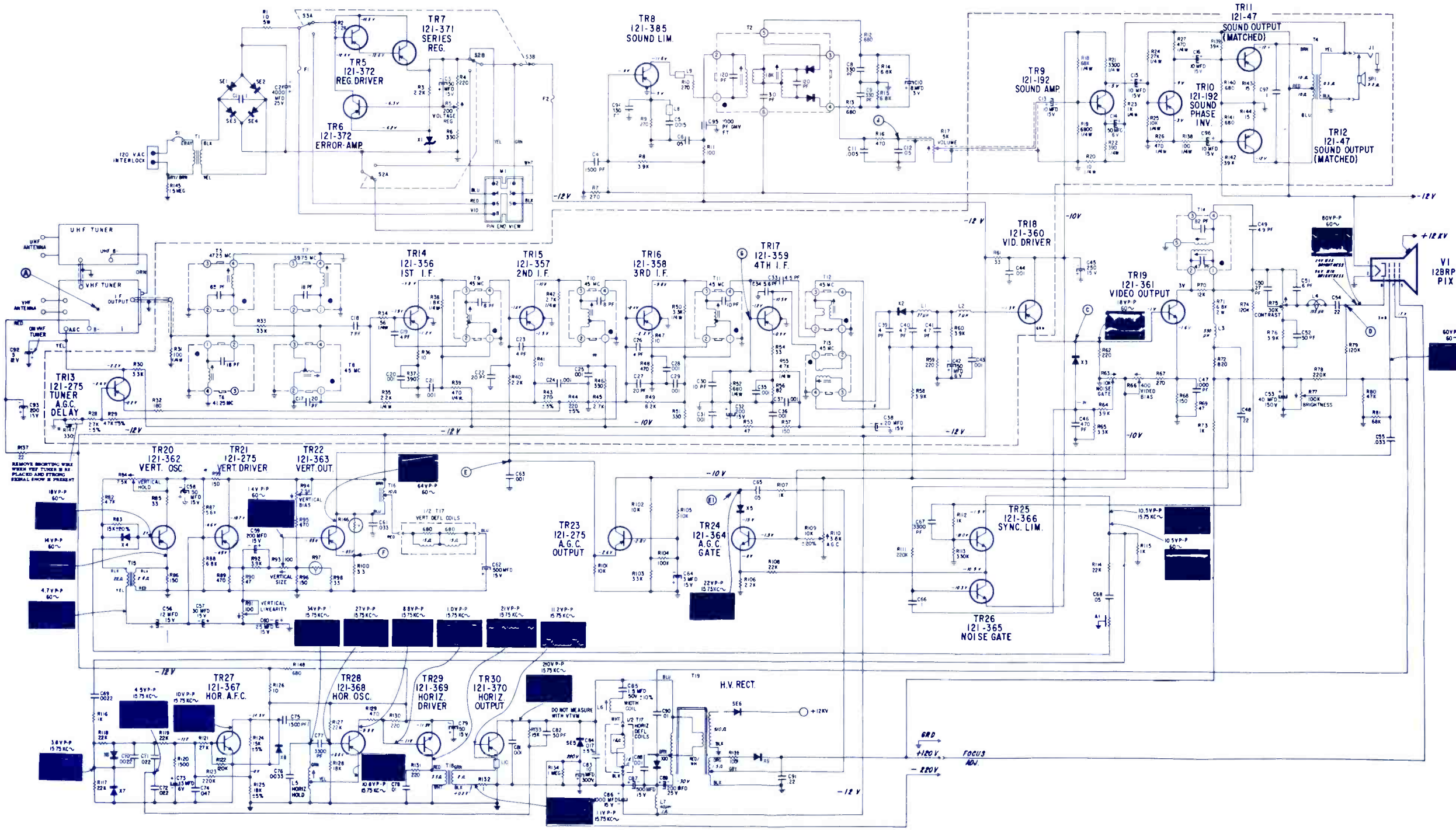
SPECIFICATIONS

POWER USED AT 120 VOLTS 60 CYCLES	POWER USED AT 12 VOLTS DC	OVERLOAD PROTECTION (AC LINE)	SOUND POWER OUTPUT (Undistorted)
45 Watts	17.5 Watts	Circuit Breaker * (.8A)	.5 Watts

* The 1M30T20 Chassis also has a 2 ampere fuse (Type 3AG OR AGC) in the B-12 Volt circuit (fuse clip mounted, right-hand side top of chassis) and a 2 ampere, pigtail type fuse in the "external" battery circuit (mounted underside of chassis).

Symbol	Description	Zenith Part No.
C2	4000μf elect 25v	22-4598
C3	50μf elect 15v	22-4567
C4	1500pf mica 300v	22-3179
C10	8μf elect 3v	22-4563
C13	10μf elect 15v	22-3448
C14	50μf elect 6v	22-4566
C16	10μf elect 15v	22-3448
C18	7pf disc 10% 500v	22-5126
C30	10pf disc 10% 500v	22-5129
C32	200μf elect 15v	22-4571
C33	4.5pf disc 5% 500v	22-4587
C34	5.6pf disc .5pf 500v	22-5194
C38	20μf elect 15v	22-4565
C39	4pf disc .25pf 500v	22-5128
C40	4.7pf gimmick 10% 500v	22-3041
C41	4.7pf gimmick 10% 500v	22-3041
C42	50μf elect 6v	22-4566
C45	250μf elect 15v	22-4578
C46	470pf disc 10% 500v	22-3363
C47	.001μf disc 10% 1000v	22-17
C52	50pf disc 500v	22-3515
C53	40μf elect 150v	22-5121
C56	12μf elect +20-10% 15v	22-4575
C57	30μf elect +20-10% 15v	22-5189
C58	50μf elect 15v	22-4567
C59	200μf elect 15v	22-4571
C60	25μf elect +20-10% 15v	22-4576
C62	500μf elect 15v	22-4572
C64	3μf elect +30-20% 15v	22-5135
C73	3μf elect +20-10% 6v	22-4574
C79	50μf elect 15v	22-4567
C82	50pf disc 500v	22-3515
C83	10μf elect 300v	22-5120
C84	.017μf molded 5% 400v	22-4599
C86	1000μf elect 15v	22-4573
C87	500μf elect 15v	22-4572
C88	.001μf 1000v	22-3748
C89	200μf elect 25v	22-4643
C92	5μf elect 12v	22-2884
C93	200μf elect 15v	22-4571
C96	10μf elect 15v	22-3448
R1	1.0Ω 10% 5w	63-6424
R5	200Ω volt reg contr	63-5478
R17	5K vol & sw	63-5458
R33	33K 10% A B only ½w	63-4008
R63	10KΩ noise gate	63-4095
R66	400Ω video bias control	63-5485
R75	30K contrast	63-4997
R77	100K brightness	63-5484
R84	7.5K vert hold	63-6374
R91	100Ω vert lin	63-5480
R93	100Ω vert size	63-5480
R94	2.5K vert bias	63-5479
R97	thermistor	63-3663
R110	3.5K AGC	63-5481
SE1	rectifier	212-57
SE2	rectifier	212-57
SE3	rectifier	212-57
SE4	rectifier	212-57
SE5	focus rectifier	212-64
SE6	HV rectifier	103-66
T1	power xformer	95-2307
T2	ratio det	95-2318
T4	sound out xformer	95-2306
T5	47.25Mc trap coil assy	95-2293
T6	41.25Mc trap coil assy	95-2292
T7	39.75Mc trap coil assy	95-2292
T8	45Mc input IF xformer	95-2303
T9	45Mc 1st IF xformer	95-2350
T10	45Mc 2nd IF xformer	95-2350
T11	45Mc 3rd IF xformer	95-2291
T12	45Mc 4th IF xformer (prim)	95-2295
T13	45Mc 4th IF xformer (sec)	95-2296
T14	sound take-off xformer	95-2298
T15	vert osc xformer	95-2308
T16	vert out xformer	95-2349
T17	yoke	95-2310
T18	horiz driver xformer	95-2304
T19	horiz sweep xformer	S-71535
L5	horiz hold assy	S-68273
X1	zener diode	103-81
X2	diode	103-23
X3	diode	103-23
X4	diode	103-51
X5	diode	103-51
X6	diode	103-51
X7	diode	103-51
X8	diode	103-51
X9	diode	103-82
X10	diode, damper	103-92
F1	fuse (2 amp pigtail)	136-24
F2	fuse (2 amp type 3AG)	136-36
S1	circuit breaker .8 amp	85-881
S2A, S2B	ac dc switch	85-869
S3A	part of volume contr R17	
S3B	part of volume contr R17	

ZENITH
TV Chassis 1M30T20



978

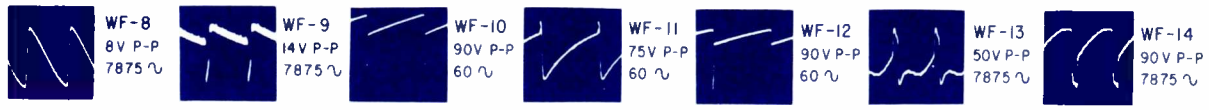
AIRLINE

TV Models
GHJ-1466A,
GHJ-1566A,
GHJ-1786A
GHJ-4516A,
GHJ-4546A,
GHJ-4556A

JANUARY • 1966

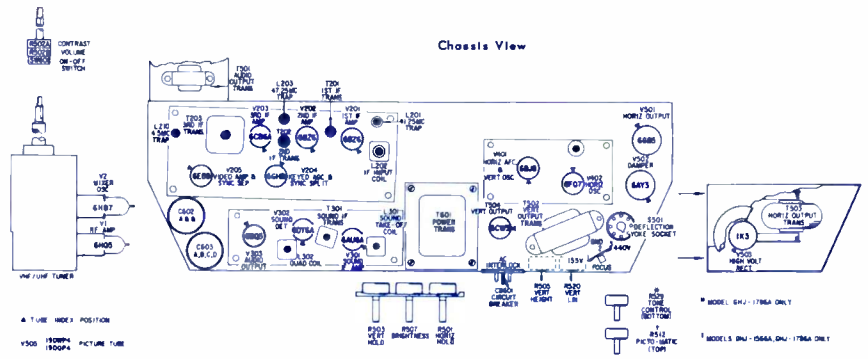
ELECTRONIC TECHNICIAN TEKFAX

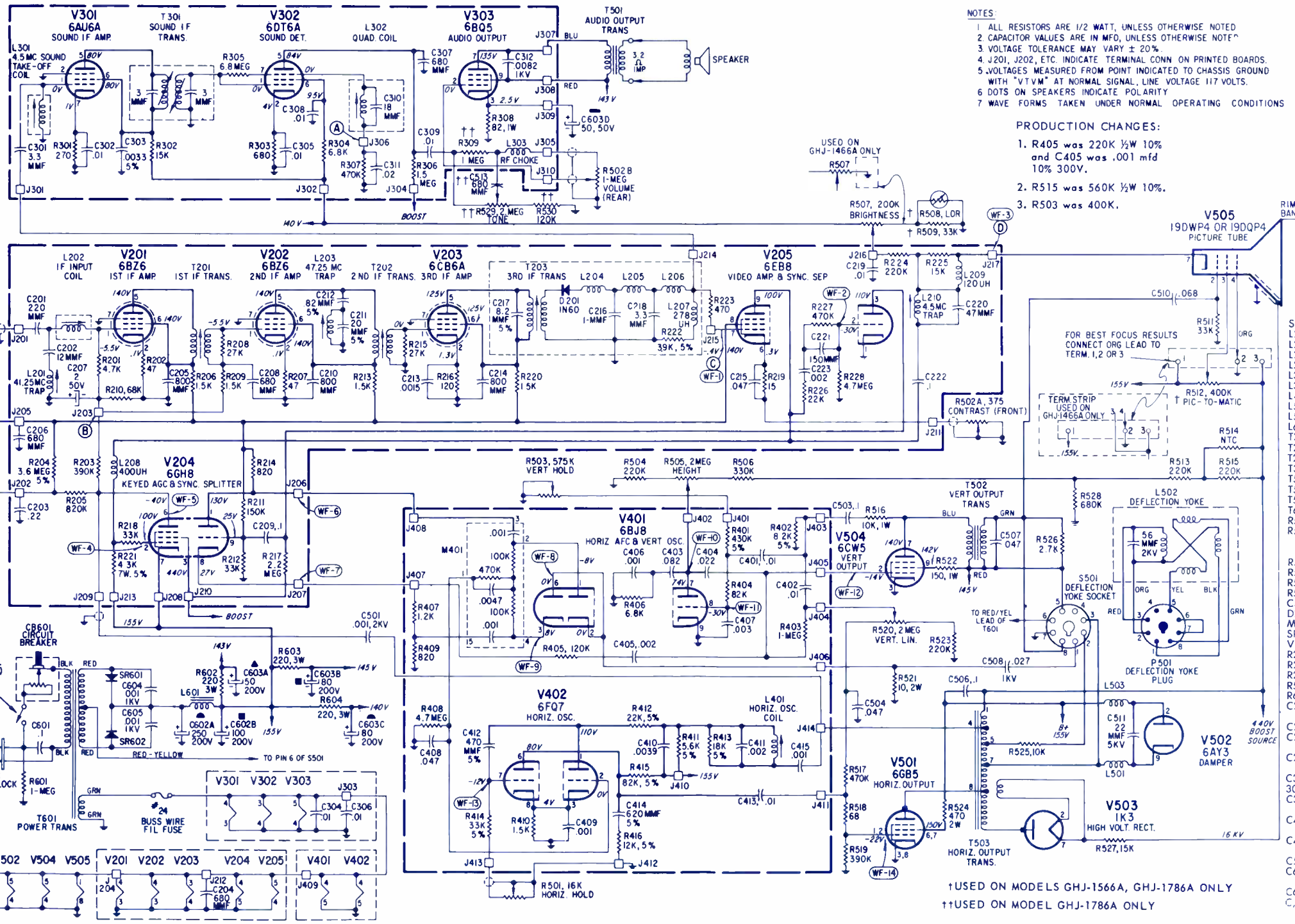
COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR SEVEN NEW SETS



TUBE AND TRANSISTOR COMPLEMENT

Ref.	Type	Function
V1	6HQ5	RF Amplifier
V2	6HB7	Mixer/Oscillator
Q51	24T-002	UHF Oscillator Transistor
V201	6BZ6	1st IF Amplifier
V202	6BZ6	2nd IF Amplifier
V203	6CB6A	3rd IF Amplifier
V204	6GH8	Keyed AGC & Sync Splitter
V205	6EB8	Video Amplifier & Sync Separator
V301	6AU6A	Sound IF Amplifier
V302	6DT6A	Sound Detector
V303	6BQ5	Audio Output
V401	6BJ8	Horiz. AFC & Vertical Oscillator
V402	6FQ7	Horizontal Oscillator
V501	6GB5	Horizontal Output
V502	6AY3	Damper
V503	1K3	High Voltage Rectifier
V504	6CW5	Vertical Output
V505	19DWP4 or 19DQP4	Picture Tube





NOTES:
1. ALL RESISTORS ARE 1/2 WATT, UNLESS OTHERWISE NOTED
2. CAPACITOR VALUES ARE IN MFD, UNLESS OTHERWISE NOTED
3. VOLTAGE TOLERANCE MAY VARY ± 20%.
4. J201, J202, ETC. INDICATE TERMINAL CONN ON PRINTED BOARDS.
5. VOLTAGES MEASURED FROM POINT INDICATED TO CHASSIS GROUND WITH "VTVM" AT NORMAL SIGNAL, LINE VOLTAGE 117 VOLTS.
6. DOTS ON SPEAKERS INDICATE POLARITY
7. WAVE FORMS TAKEN UNDER NORMAL OPERATING CONDITIONS

PRODUCTION CHANGES:

1. R405 was 220K ½W 10% and C405 was .001 mfd 10% 300V.
2. R515 was 560K ½W 10%.
3. R503 was 400K.

VHF

Channel 2 ..... 15mv. Channel 7 ..... 20mv.
Channel 5 ..... 15mv. Channel 13 ..... 20mv.

UHF

Channel 14-83 ..... 50mv. avg.

SENSITIVITY

Sensitivity (To produce 20 volts peak to peak at input to picture tube. Measured according to I.R.E. standards. All controls, including fine tuning, set for maximum video output. Video signal measured between grid and cathode of picture tube).

SPECIFICATIONS

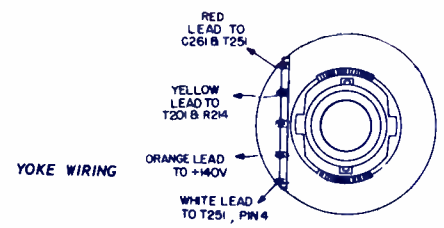
Operating Voltage	110–120VAC 60cps
AC Power Consumption	175 watts
Tuning Range	Channels 2 thru 83
Antenna Input Impedance	300 ohms Balanced
Intermediate Frequencies (Picture IF)	45.75 MC
(Sound IF)	41.25 MC
(Intercarrier Sound IF)	4.5 MC
Power Output	2 Watts (Max)
Speaker	3" x 5" P.M. .68 oz. Magnet 3.2 ohms V.C.I. (400 cycles)

Symbol	Description	Airline Part No.
L201	coil, 41.25 Mc trap	109-028400
L202	coil, video IF input	109-028500
L203	coil, 47.25 Mc trap	109-028700
L210	coil, 4.5 Mc trap	109-029500
L301	coil, 4.5 Mc sound take-off	109-029700
L302	coil, quadrature	109-029900
L401	coil, horiz osc	110-028200
L501	coil, RF choke	111-026701
L502	deflection yoke & plug	027-030100
L601	coil, filter choke	032-002500
T201	xformer, 1st IF	109-028600
T202	xformer, 2nd IF	109-028800
T203	xformer, 3rd IF	109-028900
T301	xformer, Sound IF	109-029800
T501	xformer, audio out	031-008700
T502	xformer, vert out	033-009700
T503	xformer, horiz out	033-009800
T601	xformer, power	033-009600
R501	16kΩ horiz hold	055-044000
R502A, B	control, dual 375Ω contrast (A); 1M vol (B) with push-pull switch	055-043800
R503	400kΩ vert hold	055-043900
R505	2M height	055-043400
R507	200kΩ brightness	055-044100
R520	2M vert lin	055-043400
CB601	circuit breaker	099-002700
D201	diode, video det	1N60
M401	horiz AFC pac	134-039100
SR601	rectifier, silicon	004-002700
VDR501	resistor, voltage dependant	057-001100
R204	3.6 M, 5%	CB5536
R221	4.3kΩ, 7w, 5% WW	053-432750
R222	3.9kΩ, 5%	CB5239
R514	thermistor, NTC	057-001000
R603, 604	220Ω, 3w	065-011300
C202	12 pf, 5% NPO, ceramic disc	DD-120
C207	2 µfd, 50v, elect	034-023300
C211	20 pf, 5%, NPO, ceramic disc	862-200651
C212	.82 pf, 5%, NPO, ceramic tubular	889-820651
C302, 305, 308, 309	.01 µfd, GMV, ceramic disc	DD-103
C312	8200 pf, 1kv, ceramic disc	816-822721
C412	470 pf, 5%, 300v, silver mica	045-007800
C414	620 pf, 5%, 300v, silver mica	045-007900
C502	16 µfd, 25v, NP, elect	034-020800
C602A, B	250 µfd, 250v (A) 100 µfd 200 volt (B), elect	034-023200
C603A, B, C, D	50 µfd 200v (A), 80 µfd 200v (B), 80 µfd 200v (C), 50 µfd 50v (D), elect	034-023100

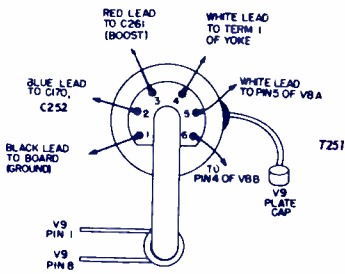
†USED ON MODELS GHJ-1566A, GHJ-1786A ONLY
††USED ON MODEL GHJ-1786A ONLY

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

Symbol	Description	GE Part No.
R164	25K contrast	ET49X541
R205	1.2M 30% vert hold	ET49X534
R206	500K height	ET49X535
R209	2M vert lin	ET49X536
R151	12K 2w	ET14X104
R163	4700 3w	ET14X133
R270	1.6Ω (resistive lead, HV filament)	ET65X36
R401	5Ω 5w WW	common
R402	100 5w WW	common
R403	160 5w WW	ET14X200
C402A	300µf 175v	ET31X268
C402B	200µf 150v	
C402C	10µf 150v	
C402D	100µf 150v	
C51-54	470 1400v GMV HiK	ET22X151
C152	24 5% NPO	ET18X123
C161	6pf N750	ET18X424
C162, C163	4.7 20% NPO	ET18X501
C165	5 N750	ET18X416
C166	10 5% N750	ET18X310
C168	5000 GMV 450v HiK	ET22X96
C201	120 5% NPOK	ET18X559
C254	390 N750	ET18X576
C258	5000 GMV 450v HiK	ET22X96
C259	62 NPO	ET18X592
C262	280 4000v N1600	ET18X374
C301	47 5% N750	ET18X253
C303	2.2 5% composition	ET21X45
C304	120 N750	ET18X559
C307	3900 1kv SSHK	ET22X144
C308	18 N470	ET18X399
C310	5000 GMV 450v HiK	ET22X96
C401	1000 GMV 1400v HiK	ET22X58
C404	.01µf GMV 1400v HiK	ET22X47
L145	coil choke 5.6µh	ET36X815
L150	coil link shunt	ET36X816
L151	coil 47.25Mc trap	ET36X753
L152	coil 1st IF grid	ET36X754
L153	coil 2nd IF Plate (primary)	ET36X757
L154	coil video det (secondary)	ET36X587
L155	coil 44Mc resonant 36.2µh	ET36X583
L158	coil audio take off	ET36X663
L159	coil 120µh 7% single Pi	ET36X817
L160	coil 227µh special	ET36X758
L201A, B	coil 219Mc 1.8µh	ET36X722
L253A, B	yoke deflection 20MM toroidal	ET76X41
L251	coil horiz osc	ET35X51
L252	coil 3µh choke	ET36X633
L301A, B	coil audio interstage	ET36X818
L302	coil quad	ET36X665
T150	xformer IF	ET61X161
T201	xformer vert out	ET64X114
T251	xformer horiz out	ET77X92
T301	xformer audio out	ET64X100
	UHF tuner transistorized (replace ET85X52)	ET85X50
	UHF tuner transistorized (replace ET85X50)	ET85X52
	VHF tuner 13pos manual triode	ET86X245



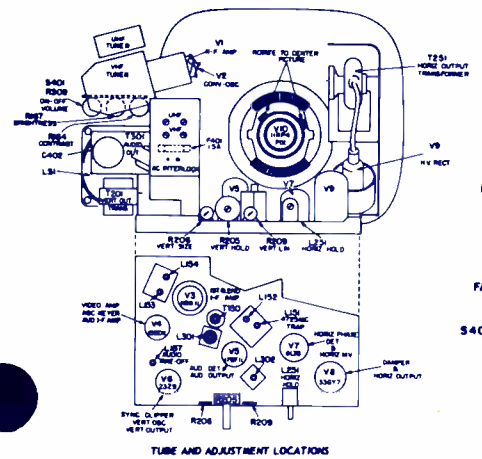
YOKE WIRING

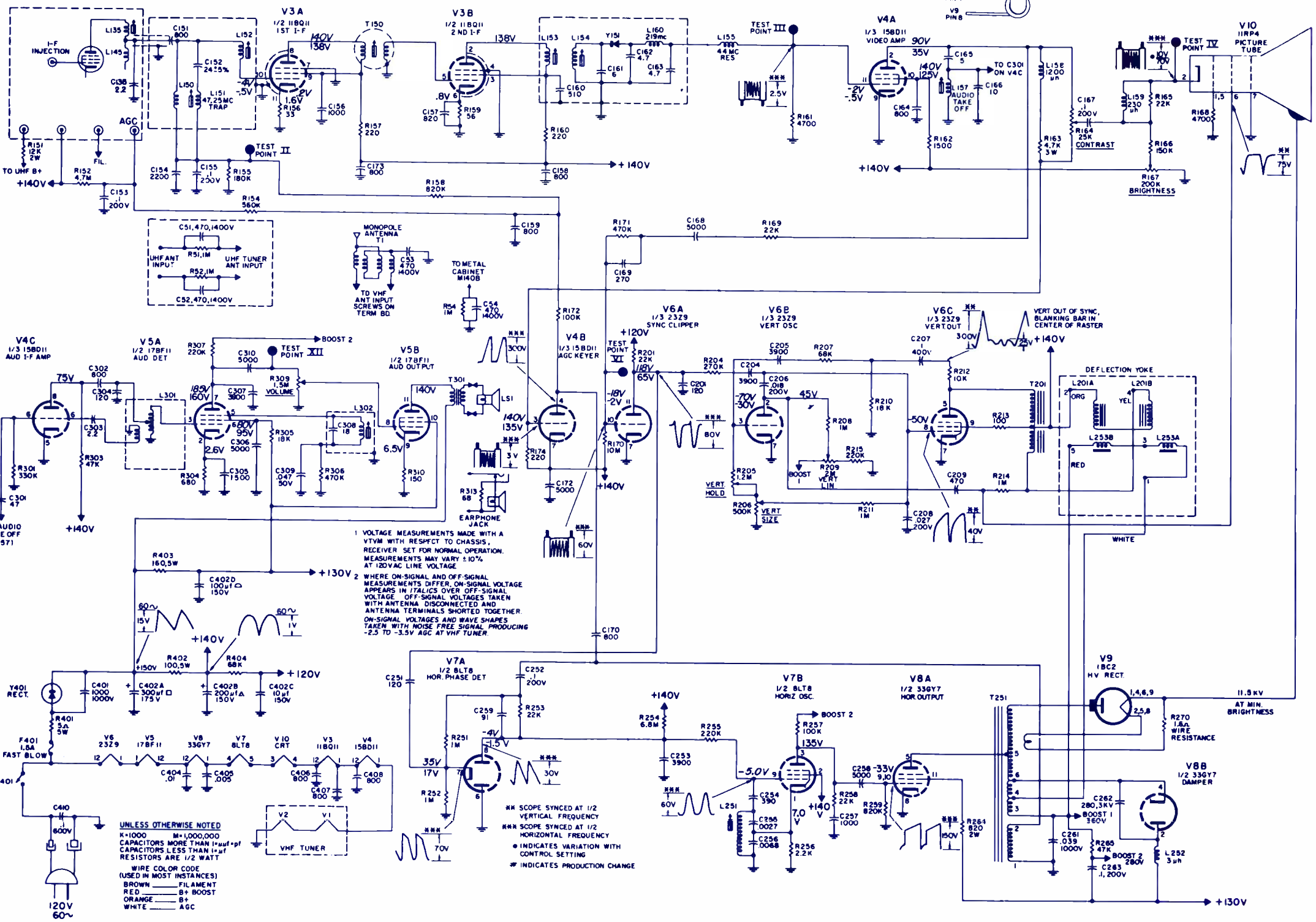


T251 WIRING

TELEVISION RECEIVER SPECIFICATIONS	
POWER INPUT RATING:	Frequency ..... 60 cycles Voltage ..... 110–128 volts Wattage at 120 Volts ..... 110 watts Standard Chassis
R-F FREQUENCIES:	Channels VHF ..... 2 through 13 Frequencies ..... 54–88MC, 174–216MC Channels UHF ..... 14 through 83 Frequencies 470–890MC
OPERATIONAL FREQUENCIES:	Picture IF Carrier ..... 45.75MC Sound IF Carrier ..... 41.25MC Intercarrier Sound 4.5MC
AUDIO POWER OUTPUT:	Maximum ..... 1 watt
LOUDSPEAKER:	Type ..... Alnico PM Voice Coil Impedance @ 400 Cycles ..... 3.2 ohms
ANTENNA:	External Terminals: Impedance: 300 ohms balanced to ground

TUBE AND SEMICONDUCTOR COMPLEMENT		
SYMBOL	FUNCTION	TYPE
V1	R-F Amplifier	(See Tuner)
V2	VHF Mixer-Osc.	
V3	1st & 2nd I-F Amplifiers	11BQ11
V4	Video Amp., AGC Keyer 4.5 mc. Aud. Amp.	15BD11
V5	Audio Det., Audio Output	17BF11
V6	Vert. Osc., Vert. Output, Clipper	2329
V7	Hor. Phase Det., Hor. Osc.	8LT8
V8	Horizontal Output, Damper	33GY7
V9	H.V. Rectifier	1BC2
V10	Picture Tube	11RP4
Y151	Video Det. Crystal Diode	ET16X1
Y401	Silicon Power Rectifier	ET57X30


TUBE AND ADJUSTMENT LOCATIONS



1 VOLTAGE MEASUREMENTS MADE WITH A VTVM WITH RESPECT TO CHASSIS, RECEIVER SET FOR NORMAL OPERATION. MEASUREMENTS MAY VARY ±10% AT 120VAC LINE VOLTAGE

WHERE ON-SIGNAL AND OFF-SIGNAL MEASUREMENTS DIFFER, ON-SIGNAL VOLTAGE APPEARS IN ITALICS OVER OFF-SIGNAL VOLTAGE. OFF-SIGNAL VOLTAGES TAKEN WITH ANTENNA DISCONNECTED AND ANTENNA TERMINALS SHORTED TOGETHER.

ON-SIGNAL VOLTAGES AND WAVE SHAPES TAKEN WITH NOISE FREE SIGNAL PRODUCING -2.5 TO -3.5V AGC AT VHF TUNER.

UNLESS OTHERWISE NOTED
K=1000 M=1,000,000
CAPACITORS MORE THAN 1=µuf=pf
CAPACITORS LESS THAN 1=µf
RESISTORS ARE 1/2 WATT

WIRE COLOR CODE (USED IN MOST INSTANCES)
BROWN ____ FILAMENT
RED ____ B+ BOOST
ORANGE ____ B+
WHITE ____ AGC

* SCOPE SYNCED AT 1/2 VERTICAL FREQUENCY
** SCOPE SYNCED AT 1/2 HORIZONTAL FREQUENCY
● INDICATES VARIATION WITH CONTROL SETTING
# INDICATES PRODUCTION CHANGE

980

PHILCO
TV Chassis 16J27

ELECTRONIC TECHNICIAN TEKFAX

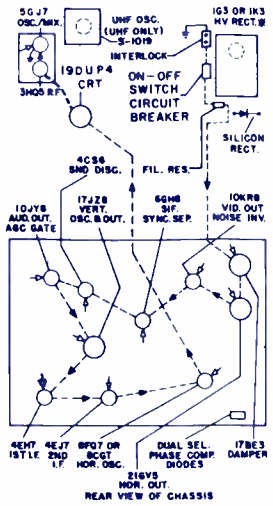
COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR SEVEN NEW SETS

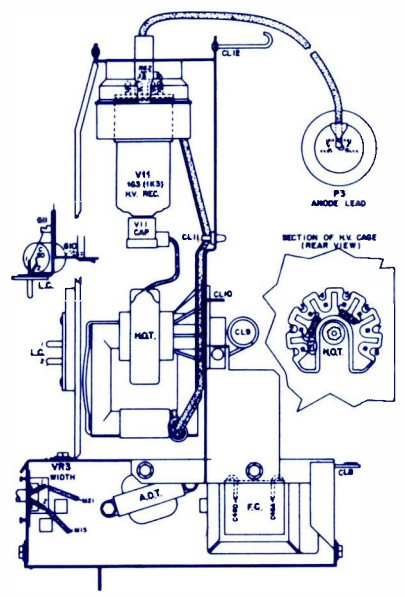
JANUARY • 1966

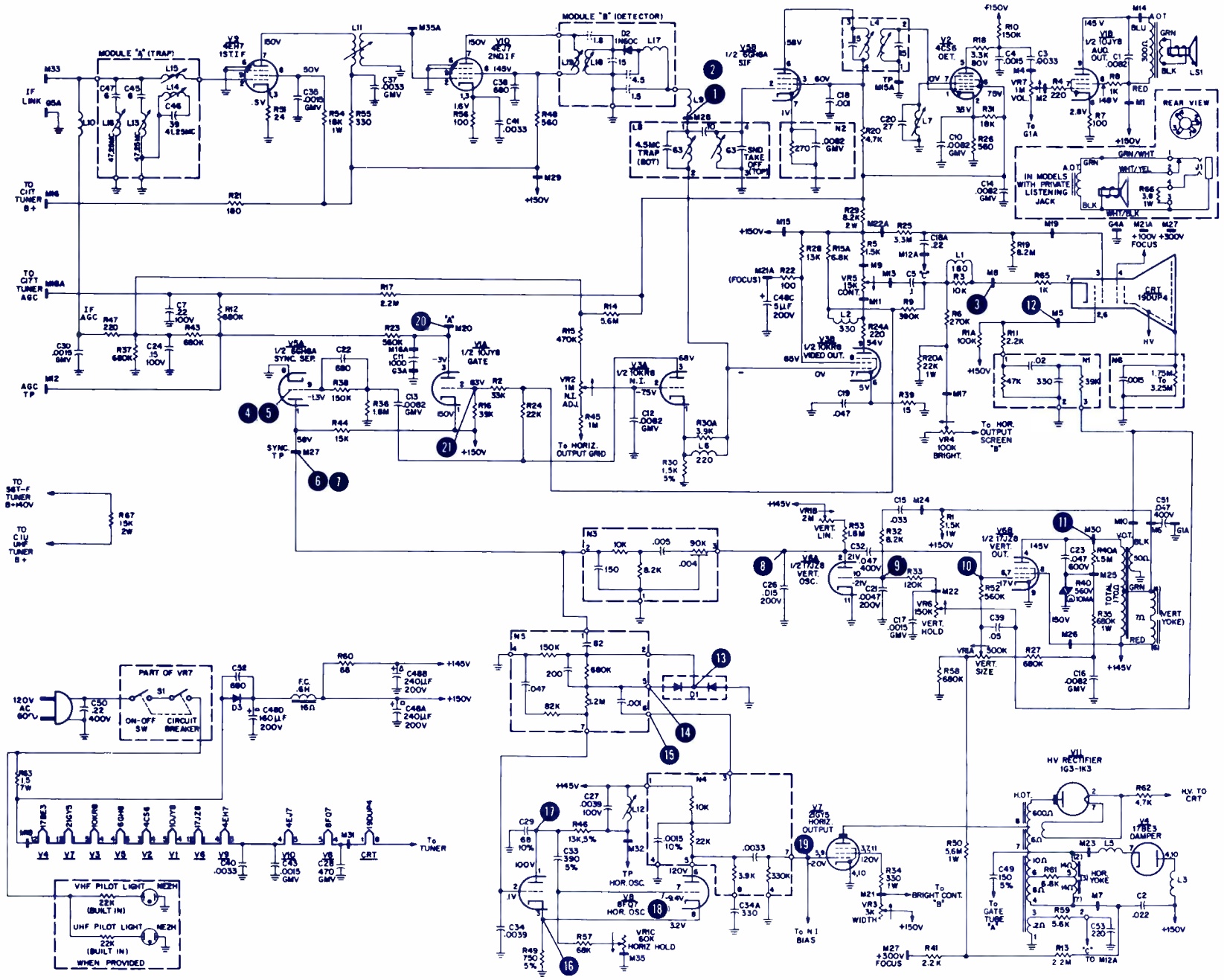
16J27 VOLTAGE AND RESISTANCE CHART

TUBE	USE	PIN NUMBERS 1	2	3	4	5	6	7	8	9	10	11	12
V1 10JY8	Aud. Det. & Gate	150V 12kΩ	83V 36kΩ	-3V 1.3MΩ	FIL	FIL	2.8V 100Ω	0V 260Ω	148V 12kΩ	145V 12kΩ			
V2 6CB6	Sound Detector	0V 6Ω	3.5V 500Ω	FIL	FIL	80V 200kΩ	75V 12kΩ	0V 3.5Ω					
V3 10ER8	Video Det. & B.I.	-.05 300Ω	-7.5 900kΩ	68V 35kΩ	FIL	FIL	5V 15Ω	0V 300Ω	65V 25kΩ	54V 12kΩ			
V4 17BE3	Damper	FIL	INF	INF	150V 12kΩ	INF	INF	HV 9MΩ	INF	INF	150V 12kΩ	INF	FIL
V5 6BH8	Snd. IF & Sync Sync Sep.	58V 12kΩ	0V 2Ω	80V 12kΩ	FIL	FIL	58V 12kΩ	1V 270Ω	GND	-1.3V 1.8MΩ			

TUBE	USE	PIN NUMBERS 1	2	3	4	5	6	7	8	9	10	11	12
V6 17JZ8	Vert. Osc. & Output	FIL	21V 3.8MΩ	INF	145V 12kΩ	INF	-17V 1.8MΩ	-17V 1.8MΩ	150V 12kΩ	GND	-21V 200kΩ	GND	FIL
V7 21BY5	Horiz. Output	FIL	INF		120V GND	0V GND	-20V 300kΩ	120V 12kΩ	120V 12kΩ	120V 12kΩ	-20V 300kΩ	0V GND	120V 12kΩ	FIL
V8 8FQ7	Horiz. Osc.	100V 25kΩ	1V 2.2MΩ	3.2V 750Ω	FIL	FIL		120V 45kΩ	-9.4V 95kΩ	3.2V 750Ω	GND		
V9 9EH7	1st Vid. IF	5V 24Ω	0V 420kΩ	5V 24Ω	FIL	FIL	GND		150V 12kΩ	50V 20kΩ	GND		
V10 9EJ7	2nd Vid. IF	1.6V 100Ω	0V 0Ω	1.6V 100Ω	FIL	FIL	GND		150V 12kΩ	145V 12kΩ	GND		







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 10 11 ETC., 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

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 ES-550B Precision Oscilloscope.

Symbol	Description	Philco Part No.
C37	.0033μf	30-1283-40
C45	6 pf	30-1251-70
C46	39 pf, 41.25 Mc trap	30-1251-71
C47	6 pf	30-1287-12
C48	elec. 160/240/240/5 @200v	30-2601-33
C49	150 pf	30-1246-31
C53	220 pf	30-1294-19
D1	diode, phase comp	34-8037-1
D2	diode, 2nd det	34-8022-6
D3	diode, silicon rectifier	34-8054-7
F.C.	filter choke, .6 hy, 16Ω	32-10010-8
H.O.T.	xformer, horiz output	32-10008-7
L1	coil, 180 mh plate series	32-4762-7
L2	coil, 330 mh plate shunt	32-4762-20
L3	choke, RF 60 mc damper	32-4112-62
L4	xformer, interstage	32-4745-8
L5	choke, RF 60 Mc damper	32-4112-62
L6	coil, 220 mh 2nd det	32-4762-25
L7	coil, quadrature	32-4876-1
L8	xformer, 4.5 Mc trap & snd take-off	32-4688-11
L9	coil, ch 6 beat	32-4645-7
L12	coil, horiz stab	32-4754-3
L15	coil, 1st grid pole	32-4652-79
L18	coil, video det	32-4652-79
L19	coil, 2nd IF plate	32-4652-78
N1	retrace supp	30-6024-9
N2	SIF cathode	30-6031-16
N3	vert integrator	30-6030-12
N4	horiz osc C1-N4 cap., .0015 μf 10% C2-N4 cap., .003 μf R1-N4 res., 10kΩ R2-N4 res., 22kΩ R3-N4 res., 3.9kΩ R4-N4 res., 330kΩ	30-6057-1
N5	phase comparer	30-6035-2
N6	isolation	30-6058-2
R31	18kΩ, snd det bleeder	
R35	680kΩ, 1w, vert bias	
R40	varistor, 560v @ 10 ma	33-1373-6
R63	1.5Ω, 7w, filament drop	33-1363-134
S1	switch, on off & circuit breaker	
V.O.T.	xformer, vert out	32-10012-5
VR1	3 section vert size 500K vert line 2 M horiz hold 60k	33-5595-8
VR2	noise adjust, 1M	33-5613-1
VR3	width, 3k	33-5591-30
VR4	brightness, 100k	33-5605-36
VR5	contrast, 15k	33-5605-38
VR6	vert hold, 150k	33-5605-37
VR7	on-off volume & circuit breaker	33-5605-50
	perma-circuit panel, VOS	27-10657-9
	perma-circuit panel, VIF trap (Module "A")	27-10561-9
	perma-circuit panel, VIF det (Module "B")	27-10561-4
	VIF detector panel assy (Mod. "B")	38-10115
	VIF trap panel assy (Mod. "A")	38-10116
	yoke & cable assy	76-12942-7
	yoke cover & clamp	76-13432-3
	tuner, UHF TT-152A	76-13872-1
	tuner, VHF TT-162A	76-13579-6

ELECTRONIC TECHNICIAN **TEKFAX**

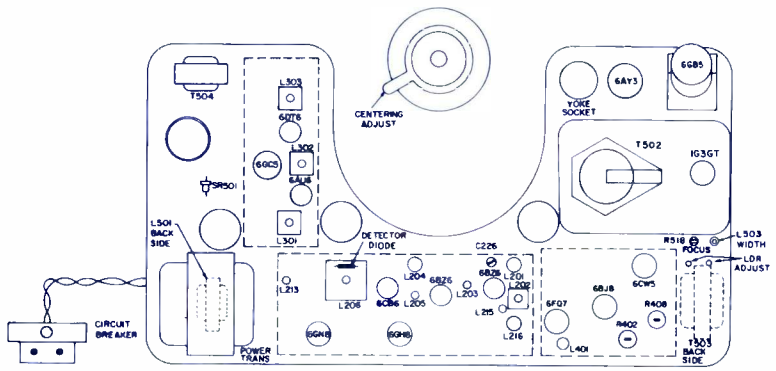
981

MAGNAVOX
TV Chassis T907 Series

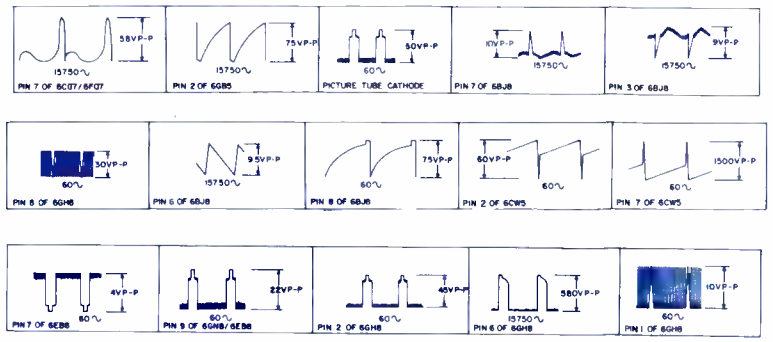
JANUARY • 1966

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

CHASSIS LAYOUT



VOLTAGE WAVEFORMS



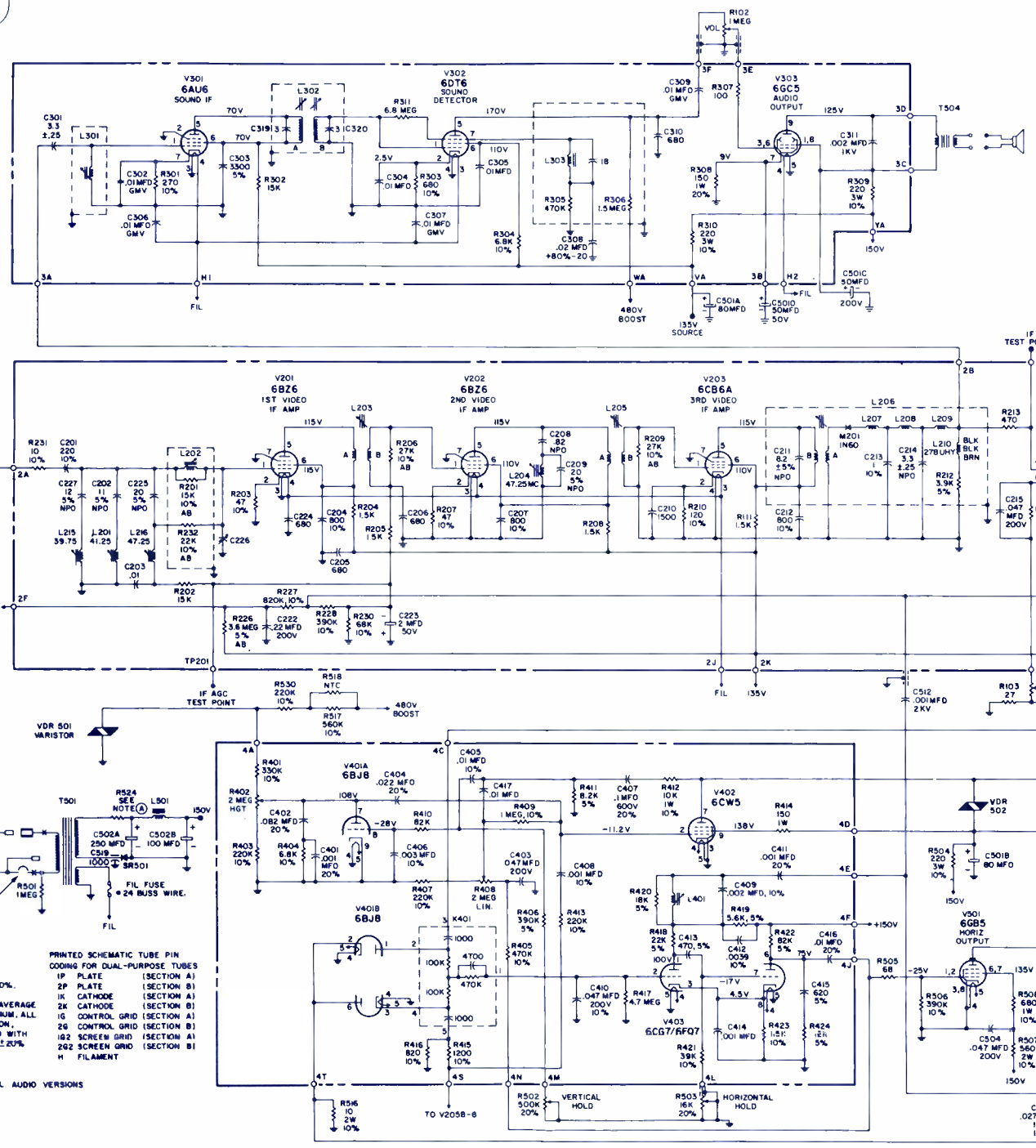
SPECIFICATIONS

Power Source Rating		I-F System	
Frequency	60 cycles	Picture I-F	45.75MC
Voltage	117 volts AC	Sound I-F	41.25MC
Wattage	175 watts	Intercarrier Sound I-F	4.5MC
Tuning Range	Channels 2-83	Audio System	
Antenna Input Impedance		Output Impedance	3.2 ohms
VHF/UHF	Balanced 300 ohms	Power Output	1 watts

TUBE COMPLEMENT

Ref.	Function	Type	Ref.	Function	Type
V1	R-F Amplifier	6HQ5	V302	Audio Output (When Used)	6GC5
V2	Mixer Oscillator	6HB7	V401	Vertical Oscillator & Horiz. AFC	6BJ8
V201	1st Video I-F Amp.	6BZ6	V402	Vertical Output	6CW5
V202	2nd Video I-F Amp.	6BZ6	V403	Horizontal Oscillator	6FQ7/6CG7
V203	3rd Video I-F Amp.	6CB6	V501	Horizontal Output	6GB5
V204	Video Amp. & Sync Sep.	6EB8/6GN8	V502	Damper	6AY3
V205	AGC Amp. & Sync Splitter	6GH8	V503	H. V. Rectifier	1G3GT
V301	Sound I-F Amp.	6AU6	V504	Picture Tube	See Schematic
V302	Audio Detector	6DT6			

Symbol	Description	Magnavox Part No.
L201	41.25Mc trap	360843-1
L202	video IF input coil	360848-1
L203	1st video IF coil	360849-1
L204	47.25Mc trap	360842-1
L205	2nd video IF coil	360849-1
L206	3rd video IF coil	360849-2
L207	90Mc tweet coil	360852-2
L208	177Mc tweet coil	360852-3
L209	43Mc tweet coil	360852-1
L210	278μhy peaking coil	360853-1
L211	43Mc tweet coil	366852-1
L212	400μhy peaking coil	360853-2
L213	4.5Mc trap	360851-1
L214	120μhy peaking coil	360853-3
L215	39.75Mc trap	360850-1
L216	47.25Mc trap	360842-1
L301	4.5Mc sound take-off coil	360845-1
L302	4.5Mc sound IF coil	360846-1
L303	quad coil	360847-1
L401	horiz osc coil	360854-1
L501	filter choke	320125-1
L502	RF choke	360783-1
T501	power xformer	300210-1
T502	HV xformer	360998-2
T503	vert out xformer	320316-1
T504	audio out xformer	320120-2
	deflection yoke assy	703046-7
C101	33pf 5% NPO	250508-3305
C101	47pf, 5% NPO	250508-4705
C208	.82pf 5% NPO	250088-184
C209	20pf 5% NPO	250373-2005
C211	8.2pf 5% NPO	250373-8298
C217	47pf 10% NPO	
C223	elect 2μf 50v	270082-701
C225	20pf 5% NPO	250373-2005
C301	3.3pf ±.25pf NPO	250373-3397
C303	3300pf 5%	
C311	2000pf 2000v	
C411	silver mica, 1000pf 1000v	250365-554
C413	silver mica 470pf 5% 300v	250364-347
C415	silver mica 620pf 5% 300v	250365-350
C501	elect 80/80μf 200v	270021-110
C501	elect 80/80/50μf 50v	270021-105
C502	elect 250/100μf 200v	270021-104
C502	elect 250/100/5μf 200v	270021-108
C507	47pf 10% 5000v	
C509	5000pf 1000v	
C512	1000pf 2000v	
C514	paper .027μf 10% 1000v special	250290-13
C519	feed thru 1000pf	250539-1
R217	4300 5% 7w	240086-2
R226	3.6M 5%	
R309	220 3w	230150-302
R310	220 3w	230150-302
R504	220 3w	230150-302
R507	560 2w WW	240090-1
R518	thermistor	230130-2
R101	375 contrast	220126-85
R102	1M off-on vol	220135-18
R402	2M height	220166-3
R408	2M vert lin	220166-3
R502	500K vert hold	220146-67
R503	16K horiz hold	220146-55
R520	200K brightness	220146-10
R522	400K LDR range adjust	220146-35
R523	2.5M focus	220146-18
R531	50K contrast (magnalux versions)	220146-60
LDR501	LDR	230156-1
VDR501	VDR	230167-2
VDR502	VDR	230167-2
SR501	silicon rectifier	530082-2
M201	video det diode (1N60)	530065-1
PC401	horiz AFC pac	250377-1
	VHF tuner	340040-1
	VHF tuner (907-03)	340047-1
	UHF tuner	340072-1



UNLESS OTHERWISE SPECIFIED:
ALL RESISTORS ARE 1/2W, 20%
ALL PAPER CAPACITORS ARE 400V, 20%.
ALL CERAMIC CAPACITORS ARE MMF, 500V, 20%.
ALL ELECTROLYTICS ARE 200V.
VOLTAGES & WAVEFORMS MEASURED WITH AVERAGE SIGNAL INPUT, CONTRAST CONTROL AT MAXIMUM, ALL OTHER CONTROLS SET FOR NORMAL OPERATION, LINE VOLTAGE 120V, DC VOLTAGES MEASURED WITH VTVM TO CHASSIS GROUND. TOLERANCE OF ±20% NORMAL ON ALL READINGS.

(A) R524, 2.5Ω-10W USED ONLY ON EXTERNAL AUDIO VERSIONS

PRINTED SCHEMATIC TUBE PIN CODING FOR DUAL-PURPOSE TUBES

1P	PLATE	(SECTION A)
2P	PLATE	(SECTION B)
1K	CATHODE	(SECTION A)
2K	CATHODE	(SECTION B)
1G	CONTROL GRID	(SECTION A)
2G	CONTROL GRID	(SECTION B)
1G2	SCREEN GRID	(SECTION A)
2G2	SCREEN GRID	(SECTION B)
H	FILAMENT	

982

RCA VICTOR
TV Chassis
KCS142XA

ELECTRONIC TECHNICIAN TEKFAX

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

JANUARY • 1966

RCA TUBE AND TRANSISTOR COMPLEMENT

KCS142XA Chassis

Type	Function
RCA 4JD6	1st Picture I-F Amplifier
RCA 4JC6	2nd Picture I-F Amplifier
RCA 11KV8	Video Amplifier and Sound I-F Amplifier
RCA 6HZ6	Sound Det. and Audio Amp.
RCA 6HG5	Audio Output
RCA 8LC8	Sync Sep. and AGC
RCA 13GF7	Vert. Osc. & Vert. Output
RCA 8FQ7	Horizontal Sweep Oscillator and Control
RCA 17JB6	Horizontal Sweep Output
RCA 17AY3	Damper
RCA 1G3GT/1B3GT	High Voltage Rectifier
RCA 19DQP4	Pan-o-Ply Kinescope

A crystal diode is used for the Picture 2nd Detector. Two RCA type 1N3194 silicon rectifiers are used for low voltage rectification.

KRK125F VHF Tuner (TMA100B)

Type	Function
RCA 3GK5	R-F Amplifier
RCA 5KE8	R-F Oscillator and Mixer

KRK120RD UHF Tuner

Type	Function
RCA S1037	UHF Oscillator

A 1N82 crystal is used as the UHF mixer.

KRS28A Remote Control Amplifier

Type	Function
RCA Q901 (2N2613 Transistor)	1st Amplifier
RCA Q902 (2N2614 Transistor)	2nd Amplifier
RCA Q903 (2N2614 Transistor)	3rd Amplifier
RCA Q904 (2N2614 Transistor)	Driver Amplifier
RCA Q905 (2N2614 Transistor)	Volume Down Relay Keyer
RCA Q906 (2N2614 Transistor)	Channel Relay Keyer
RCA Q907 (2N2614 Transistor)	Volume Up Relay Keyer

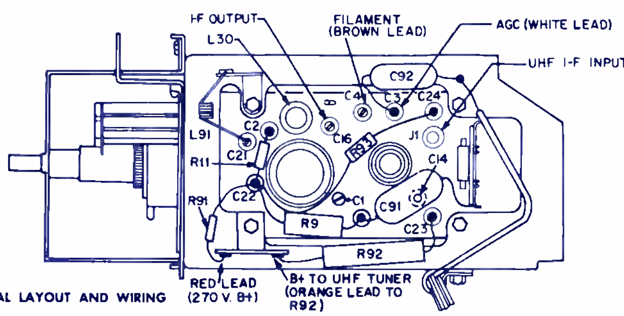
Two RCA type 1N3194 silicon Rectifiers are used for low voltage rectification.

CHASSIS REMOVAL

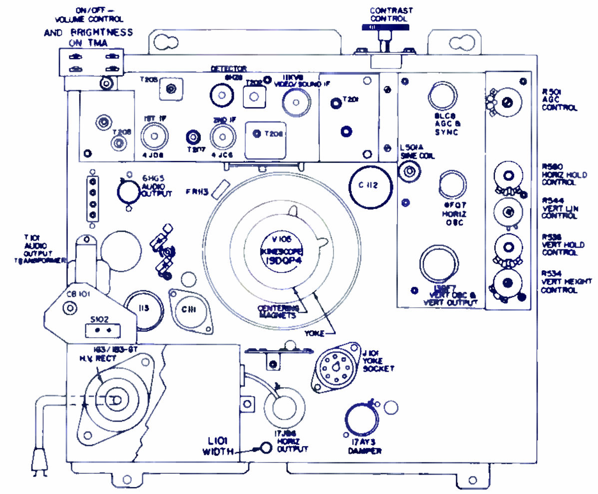
The knobs must be removed from the brightness control, volume control, the VHF tuner shaft, and the UHF tuner shaft in order to remove the chassis.

To disassemble the instrument, remove the six screws securing the receiver back. Disconnect the antenna and remove the back. Remove four nuts from tuner mounting assembly. Disconnect remote control plug and remove tuner assembly. Remove four hex-head fasteners (two above and two below the chassis). Disconnect the yoke plug and the two speaker pin plugs at the speaker. Remove the chassis partially and disconnect the second anode lead.

To remove the kinescope, remove the long compression bolt which secures the mounting strap of the kinescope.



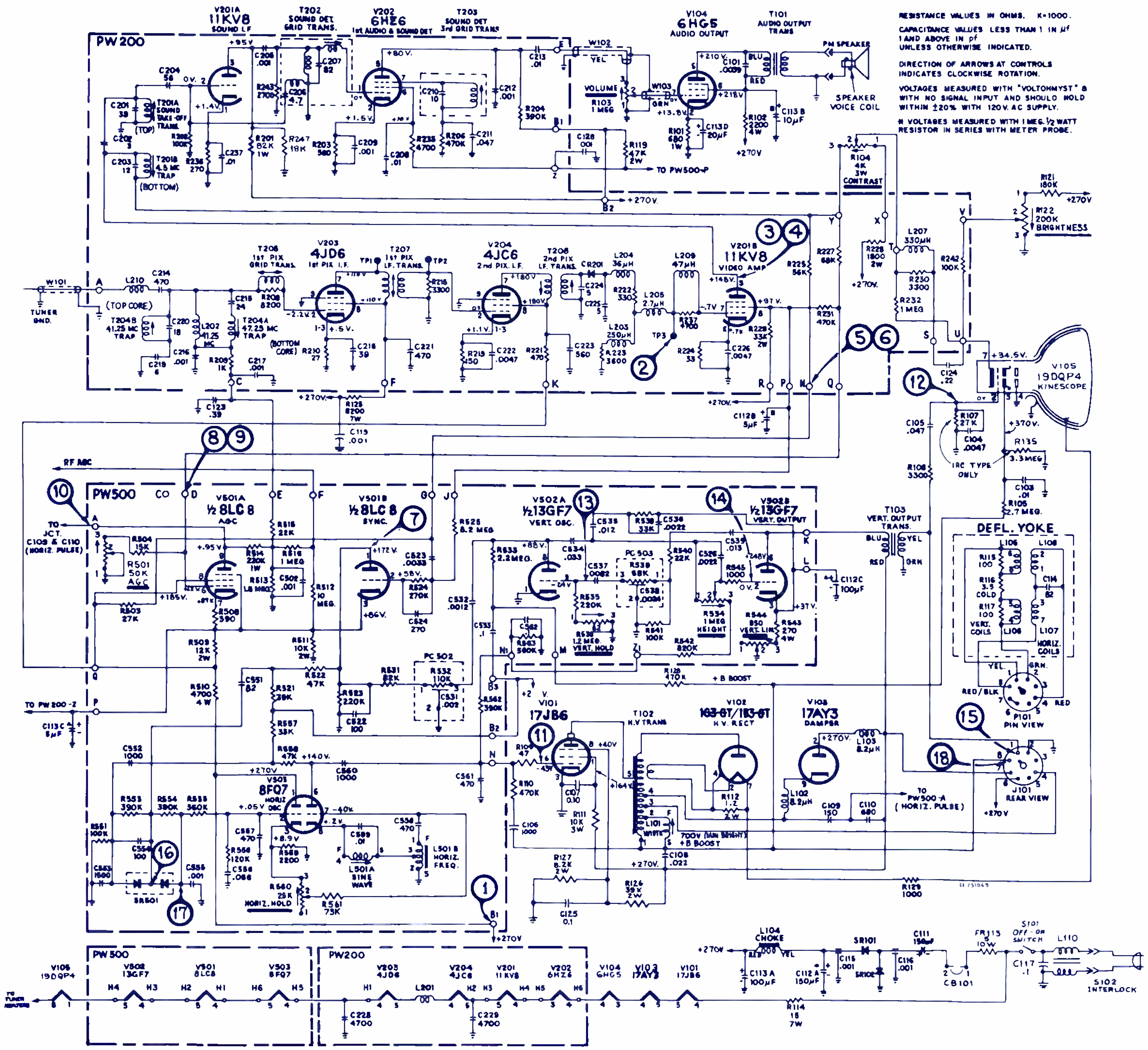
KRK125F VHF TUNER EXTERNAL LAYOUT AND WIRING

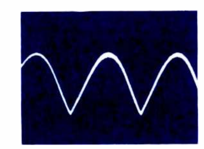


ELECTRICAL SPECIFICATIONS

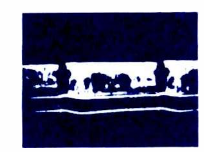
ANTENNA INPUT IMPEDANCE	300 ohms balanced
AUDIO POWER OUTPUT RATING	1.5 watts maximum
FOCUS	Electrostatic, Fixed Focus
INTERMEDIATE FREQUENCIES	
Picture I-F Carrier Frequency	45.75 mc.
Sound I-F Carrier Frequency	41.25 mc.
PICTURE SIZE	Approx. 172 sq. ins. on a 19DQP4 Kinescope
POWER INPUT	120 Volts AC, 60 cycle
POWER RATING	155 watts
SWEEP DEFLECTION	Magnetic
TELEVISION R-F FREQUENCY RANGE — All Models	
Any of 12 VHF Channels	54 mc. to 88 mc., 174 mc. to 216 mc.
Any of 70 UHF Channels	470 mc. to 890 mc.
VIDEO RESPONSE	To 3.2 mc.

RESISTANCE VALUES IN OHMS. K=1000.
CAPACITANCE VALUES LESS THAN 1 IN µf 1 AND ABOVE IN pf UNLESS OTHERWISE INDICATED.
DIRECTION OF ARROWS AT CONTROLS INDICATES CLOCKWISE ROTATION.
VOLTAGES MEASURED WITH "VOLTOHMYST" ® WITH NO SIGNAL INPUT AND SHOULD HOLD WITHIN ±20% WITH 120V AC SUPPLY.
✱ VOLTAGES MEASURED WITH 1 MEG ½ WATT RESISTOR IN SERIES WITH METER PROBE.



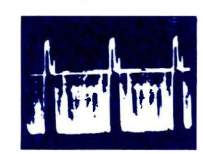


1 VERT RATE 3.5 V P P
TERM B1 PW500
270V B+ BUS

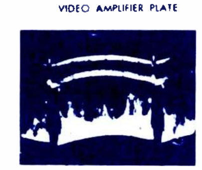


2 VERT RATE 1.5 V P P
2ND DETECTOR
TP3

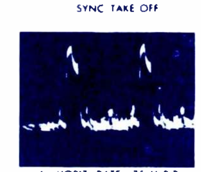
3 VERT RATE 80 V P P
V201B PIN 9
VIDEO AMPLIFIER PLATE



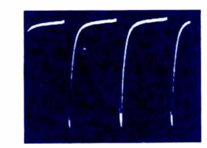
4 HORIZ RATE 80 V P P
V201B PIN 9
VIDEO AMPLIFIER PLATE



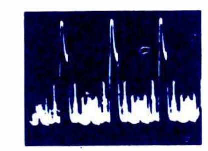
5 VERT RATE 25 V P P
TERM N PW200
SYNC TAKE OFF



6 HORIZ RATE 25 V P P
TERM N PW200
SYNC TAKE OFF

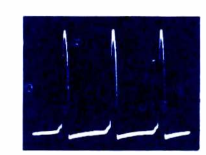


7 HORIZ RATE 65 V P P
V501B PIN 1
SYNC AMPLIFIER PLATE

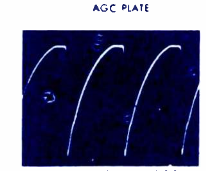


8 HORIZ RATE 32 V P P
TERM D PW500
AGC GRID

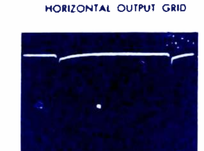
9 VERT RATE 32 V P P
TERM D PW500
AGC GRID



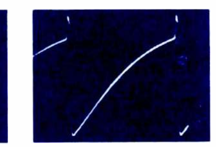
10 HORIZ RATE 650 V P P
TERM A PW500
AGC PLATE



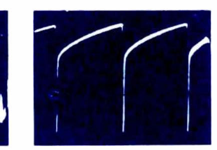
11 HORIZ RATE 165 V P P
V101 PIN 6
HORIZONTAL OUTPUT GRID



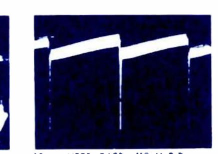
12 VERT RATE 80 V P.P
PIN 2 V105
KINESCOPE GRID



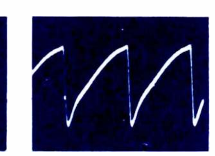
13 VERT RATE 100 V P P
V502A PIN 9
VERTICAL OSCILLATOR GRID



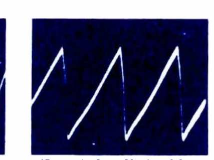
14 VERT RATE 365 V P P
V502B PIN 2
VERTICAL OUTPUT GRID



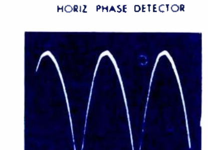
15 VERT RATE 110 V P P
PIN 1 J101 (YOKE SOCKET)
VERT OUTPUT TRANS SEC



16 HORIZ RATE 10 V P P
CATHODE JUNCTION SR501
HORIZONTAL PHASE DETECTOR



17 HORIZ RATE 1 V P P
ANODE SR501 C555
HORIZ PHASE DETECTOR

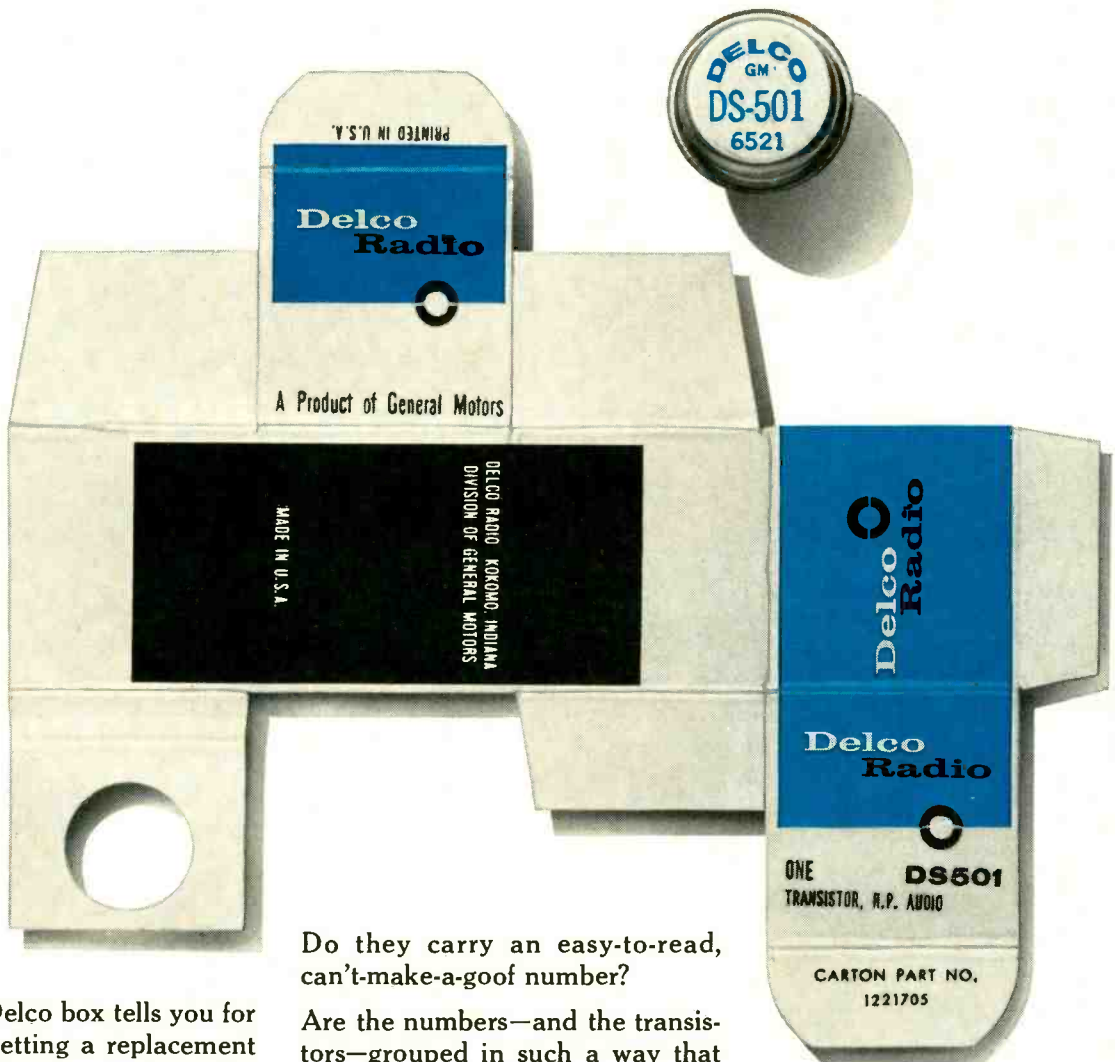


18 HORIZ RATE 325 V P P
PIN 8 J101 (YOKE SOCKET)
(B BOOST) HORIZ YOKE WINDINGS

Balloons ①, ②, etc. shown on schematic indicate points of observation of the waveforms

Symbol	Description	RCA Victor Part No.
C101	ceramic .0039µf ±10%, 1000v	109060
C103	ceramic .01µf, +100-0%, 1000v	113639
C109	ceramic 150 pf, ±10%, 4000v., N2200	109955
C110	ceramic 680 pf, ±10%, 1000v	
C112	3 section elect	113165
C113	4 section elect	113167
C115	feed-thru-1000pf, +100 −0%, 500v	109689
C116	feed-thru 1000 pf, +100-0% 500v	112720
C202	ceramic, radial leads, 3 pf, ±1 pf, 1000v., N750	112720
C203	ceramic, 12 pf, ±10%, 500v., N150	
C204	ceramic, 56 pf, ±20%, 500v., N750	109932
C215	ceramic, 24 pf, ±5%, 500v., N075	
C218	ceramic, 39 pf, ±10%, 500v., N150	
C219	ceramic, 6 pf, ±0.5 pf, 500v., NPO	109931
C220	ceramic, 18pf, ±5%, 500v., NPO	
C224	ceramic, 5pf, ±0.5 pf, 500v., NPO	
C522	ceramic, 100 pf, ±10%, 500v., N750	105674
C551	ceramic, 82 pf, ±10%, 500v., N750	104214
C554	ceramic, 100pf, ±10%, 500v., N750	105674
C560	ceramic, 1000 pf, ±10%, 1000v	105778
L101	coil, width	112974
L110	reactor, line choke	114293
L202	coil, AGC	113171
L203	coil, peaking 250 µh	109944
L204	coil, peaking 36 µh	109758
L205	reactor, choke 2.7 µh	107463
L501A, B	coil, horiz osc	109947
PC502	circuit-printed component (includes C531-R532)	112628
PC503	circuit-printed component	109325
PW200	circuit-printed IF video circuit (less tubes)	114997
PW500	circuit-printed deflection circuit (less tubes)	114999
R102	WW 2200Ω, ±10%, 4w	103352
R104	contrast	113886
R111	fixed film, 10,000Ω, ±10%, 3w	213756
R112	WW, 1.2Ω, ±5%, 2w	113284
R113	resistor, fuse, 5Ω, ±10%, 10w	
R114	WW, 15Ω, ±10%, 7w	114966
R125	WW, 8200Ω ±5%, 7w	113149
R501	control-AGC	113150
R510	fixed film, 4700Ω, ±10%, 4w	113156
R534	height	112850
R536	vert hold	113162
R543	WW, 270Ω, ±10%, 4w	114967
R544	vert lin	109384
R560	horiz hold	113163
R561	fixed film-73,000Ω, ±5%, ½w	113157
SR101	rectifier, silcon 1N3914	113945
SR102	rectifier, silcon 1N3914	113998
SR501	rectifier, selenium	113998
T101	xformer, output	109474
T102	xformer, hi-voltage	113100
T103	xformer-vert out	113599
T201A, B	xformer, 4.5 Mc sound take off	113096
T202	xformer, sound det grid (includes C206-C207)	109949
T203	xformer, sound det 3rd grid (includes C201)	109951
T204A, B	xformer, 1st pix IF grid trap	109948
T205	xformer, 1st pix IF grid	113425
T207	xformer, 2nd pix IF	113097
T208	xformer, 3rd pix IF	109158
R115	resistor, 150Ω, ±10%, ½w. (part of yoke)	113099
R117	resistor, 150Ω, ±10%, ½w (part of yoke)	502115
R116	thermistor, temperature compensating 3.8Ω cold (part of yoke)	502115
	yoke, deflection	107464
		109532A

The cover gives you the whole story.



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

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

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

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

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

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

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

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

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

United Delco

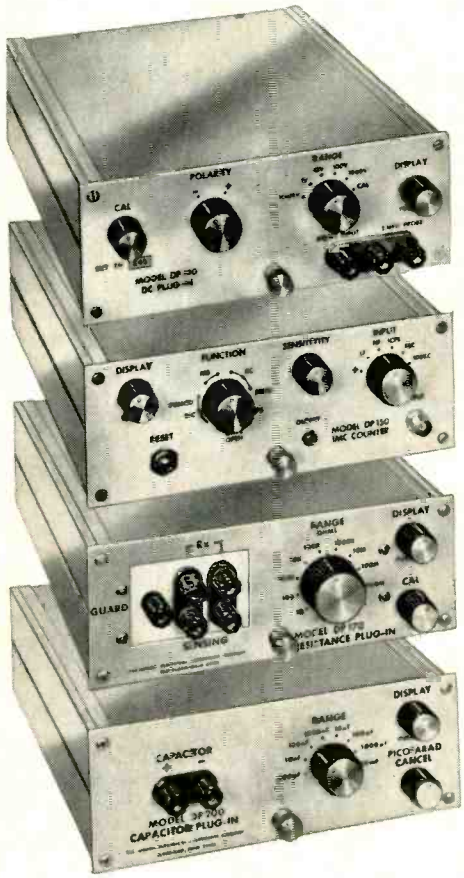
DELCO RADIO, Div. of General Motors, Kokomo, Ind.

. . . for more details circle 24 on postcard

Brand NEW FROM HICKOK

DMS-3200 Digital Measuring System

DMS-3200 Main Frame **$320**
(shown with DP-100)



DP-100
DC Voltmeter
Plug-in
$175

DP-150
1 MC Counter
Plug-in
$175

DP-170
Ohmmeter
Plug-in
$240

DP-200
Capacity
Meter
Plug-in
$240

HIGHLIGHT FEATURES

3-digit Biquinary Tube Read-out
Plug-in Flexibility
All-electronic
Fully-transistorized
Modular Design
Fully Field-tested
Automatic Polarity Indication
Automatic Decimal Point Indication

AS A DIGITAL DC VOLTMETER (DP100 Plug-in)

Range 0.1 millivolts to 1000 volts
Accuracy ±0.1% FS, ±0.1% of reading
True integrating voltmeter design
10 megohms input impedance at all times

AS A DIGITAL 1 MC COUNTER (DP150 Plug-in)

±0.005% accuracy: Resolution 1 part in 10^7
(Overrange capability with sector read-out permits 3-digit display to be equivalent of a 7-digit instrument)
Frequency measurement range 0.1 cps to 1 mc
Period measurement range 0.1 ms to 999 seconds

AS A DIGITAL OHMMETER (DP170 Plug-in)

Range 0.01 ohm to 1,000 megohms
Accuracy ±0.1% FS, ±0.2% of reading

AS A DIGITAL CAPACITY METER (DP200 Plug-in)

Range 1.0 picofarad to 10,000 microfarads
Accuracy ±0.1% FS, ±0.2% of reading

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JANUARY 1966
VOL. 83 NO. 1

ELECTRONIC TECHNICIAN

WORLD'S LARGEST ELECTRONIC TRADE CIRCULATION

AN OJIBWAY PUBLICATION

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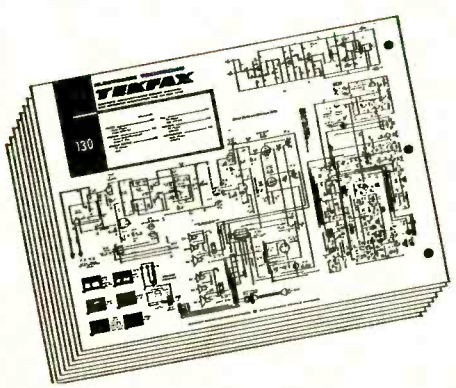
Cover

Two-way radio communications equipment has become a necessity in business and industry. Thousands of service-dealers and technicians are selling, installing and servicing the equipment across the country.

FEATURES

DEPARTMENTS

TEKFAX ..... 16 PAGES OF THE LATEST SCHEMATICS



ADMIRAL: TV Chassis G7 Series
AIRLINE: TV Models
GHJ-1466A, GHJ-1566A, GHJ-1786A
GHJ-4516A, GHJ-4546A, GHJ-4556A

GENERAL ELECTRIC: TV Chassis VB

MAGNAVOX: TV Chassis T907 Series

PHILCO: TV Chassis 16J27

RCA VICTOR: TV Chassis KCS142XA

ZENITH: TV Chassis 1M30T20

EDITOR'S MEMO

The 'Die-Hards'

More than a year ago in this column (November 1964) we lauded The Federal Communications Commission's efforts to preserve the Citizens Radio Service which was fast becoming a "giant hobbyist party line." We believed that "proper regulations would help CB radio grow and become one of the important sales and service sectors in the two-way communications market."

New FCC regulations have been in effect now for some time. But a substantial group who hold CB licenses are still carrying on with their "hobby-talk" on CB channels and in various news-stand publications. CB equipment is being used and promoted as a substitute for amateur radio equipment—avoiding and ignoring "ham" licensing responsibilities and violating laws of the land.

Not too long ago, for example, we heard a TV-radio shop manager trying to get a message through to one of his trucks. He was repeatedly jammed by a group of other stations who, ostensibly, were "rehearsing" in a Civil Defense "net." The "act" was an obvions subterfuge to carry on clandestine hobby-talk.

But what is even worse, these pseudo-amateurs are being spurred on and encouraged by some CB equipment manufacturers and distributors, who still push CB equipment to hobbyists in various ways. They continue, in effect, to promote the idea in the minds of these hobbyists and prospective hobby-type buyers that CB equipment can be used in place of "ham" radio equipment—sans license responsibilities.

It is now time for the FCC to begin using its well-organized facilities to police and crack down on CB license holders who are continuing to clutter up CB spectrum-space while the communications efforts of the legitimate license holder—private-citizen, business, industrial and emergency-communications—are being jammed and interfered with in many areas of the country.

It is time to smoke the pseudo-amateurs—the "die-hards"—out of CB into the open. Let them study and get ham licenses. In the legitimate amateur fraternity they *separate* the men from the boys.

Courier gives you the most powerful sales-clincher in the CB business:

a 10 year factory guarantee!

Nothing's more potent in closing a sale than a strong guarantee by the manufacturer. And now Courier gives you the strongest guarantee in the CB world: 10 full years on any Courier CB transistorized radio—the TR-6 at $129 and the TR-23S at $169. Both complete with microphone and a long list of attractive features.

Even without its ten year guarantee, the Courier line's low prices would be enough to ring the Anvil Chorus on the cash register. But Courier goes even farther—with limited dealerships to protect your mark-up. Courier's CB line is no football.

So if you're interested in a CB line with profit, with a sales-clinching manufacturer's guarantee, quality and features, find out about a Courier CB dealership. Fill in and mail the coupon. It may be the best thing you've ever done with a five-cent stamp.

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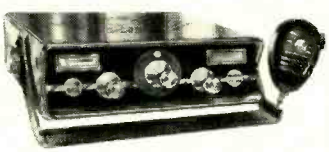
COURIER TR-6
$129



23 channels
COURIER TR-23S
$169

Dept. ET-61

eci. electronics communications inc.
56 Hamilton Avenue, White Plains, N.Y.

Yes! I'd like to know more about Courier's transistorized CB line with the 10 year guarantee, and dealership opportunities.

Name_____

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Address_____

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LETTERS TO THE EDITOR

Hot Box—Cold Room

You've probably heard this one before but here's what happened to us. We took a Philco console chassis to the shop for repair. Since the owner and his wife both worked, no one was at home during the day. We gave them a small portable to use during the time we had the console. Next day the owner called and said "the portable works fine but when we use it the house gets cold." Now here was a switch! We thought that we had heard everything. But we decided to check. We found that the customer was correct. The Portable had been placed on top of the console cabinet which had been pushed back near the wall. Being a hot little tin box, the portable put out plenty of heat — right under the wall thermostat of the furnace. The cure? We separated the TV from the thermostat and the furnace worked fine too.

WILLARD W. WAITE

Wellington, Ohio

Sony Transistorized TV

This may save some technicians a headache. This small Sony portable TV, Model 5-303W, showed picture fading out after it had been on for awhile but the sound never varied. All controls appeared to work properly when the video disappeared. A good video signal showed on the scope on both sides of the 10μf capacitor coupling into the 2SC15 video output transistor. The 0.2μf capacitor coupling to the CRT from the transistor collector was disconnected at one end and a scope check at the collector showed that the signal polarity was the same here as on the transistor base and very weak. The 0.1μf capacitor was reconnected and the lights were turned off in the shop. A very weak negative picture could be observed on the screen. A series of voltage checks to ground was next made at the transistor base, collector and emitter. These were all low, with the collector voltage showing the greatest drop from normal values. All resistors in the circuit checked within tolerance. A new transistor was substituted but no change took place so the original was replaced. The capacitor across the 33 Ω emitter resistor couldn't make this much difference in signal, so I gave attention next to the 100μf capacitor in series with the 500 Ω contrast control. This capacitor showed no leakage on the RX1 ohmmeter scale but on the RX100 scale it showed shorted. When it was replaced the picture came in fine.

M. G. GOLDBERG

St. Paul, Minn.

More On Precision Apparatus

Tell Howard Williams, who asked for Precision Apparatus's address, not to waste his time writing this company. Nearly a year ago I sent them my VOM to be repaired and after a reasonable time, when the VOM didn't arrive, I wrote them a letter inquiring about its repair. The letter was not answered and several more letters were not answered either. In fact, after a year, I have given up hope of recovering my VOM.

JULIO BELLBER

New York, N.Y.

• I sent a check for $3 to Precision Apparatus, the check was cashed but I never received the information.

CLARENCE A. VEALE

Hazleton, Pa.

• *We have received many letters from readers and from other sources stating they could not obtain service from Precision Apparatus Co., Inc., formerly of 70-31 84th Street, Glendale 27, N.Y. and that the company was no longer doing business as usual. This company was reported in 1964 and early 1965 as being located at 819 King Street, Woodmere, L.I., N.Y. It was once listed in catalogs and purchasing guides either as an associate or subsidiary of Paco Electronics Co., Inc. or Pactronics but was not listed in the 1965 Radio Electronic Master. A recent report, which we believe to be reliable, indicates that the company is presently in business at 80-00 Cooper Avenue, Glendale, L.I., N.Y. We do not know to what extent. In the meantime we suggest that readers who have received no replies to letters sent to this company inquiring about service or who sent checks for service and received no service (although checks were cashed) and those who sent test instruments for repair without receiving back the instruments, once again attempt to obtain normal service from this company. If this fails, please notify ELECTRONIC TECHNICIAN immediately giving all details. FLASH: A last minute press release received here says that the test instrument business of Precision Apparatus has been purchased by B&K Manufacturing Co., a division of Dynascan Corp. Under these circumstances it may be advisable to wait for the fog to clear up and then try to get satisfaction from the new owners.—Ed.*

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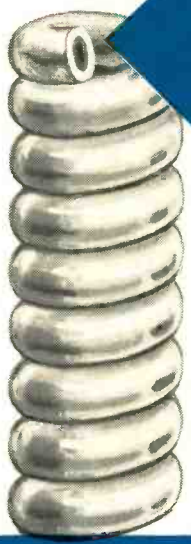


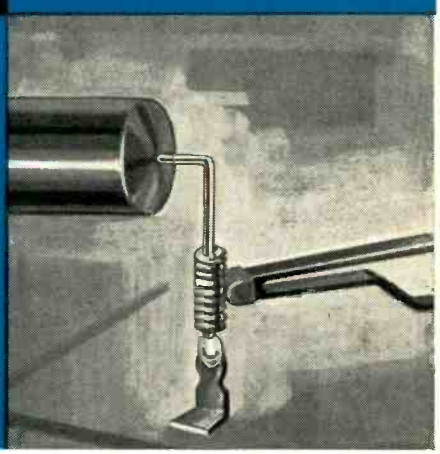
Nine times actual size

Once again, Sprague helps the TV-radio service industry by solving difficult servicing problems . . . parts replacement on printed wiring boards, in "inaccessible" chassis nooks, and on crowded terminal lugs. Mechanically sturdy and electrically reliable, the KWIKETTE provides *quick*, expert, "one-handed" soldered connections as easy as A-B-C!

A SNIP LEAD... it's quick!

B SLIP ON KWIKETTE... it's quick!

C APPLY HEAT... it's quick!



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

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

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A Service Dealer-Marketing Program

Part II (Conclusion)

■ A previous article (ELECTRONIC TECHNICIAN, November 1965, page 90) analyzed the question of marketing as the science of running a business. This included realistic goals, budgeting and the break-even point, organization, the service mix, advertising and sales promotion. Advertising was discussed from the viewpoint of its role in the service business. The amount spent on advertising is usually limited, however. This is because the average service dealer only has limited promotional funds. In this connection, efforts should be made to work with distributors and manufacturers in co-op programs. The service dealer must also use promotional materials made available to him by his suppliers. It just does not make sense for a dealer with a limited promotional budget to discourage or throw away materials which have been given to him at little or no charge. The smart service dealer will encourage, and even ask for, any and all such materials that his suppliers may have available.

Allocate money for advertising on a 'dollars and cents 'basis

Here again, we asked for Mr. Frank Moch's generous cooperation and wide range of experience in the service field. We asked him to comment on the role of advertising the service business, and here are his remarks:

"On the subject of advertising, here again a great variation exists. It appears that direct mail is the most productive and cost justifiable means for services."

Mr. Moch's comments make good sense and tie in perfectly with what has been said previously. Mailing pieces are readily available to you from manufacturers and distributors. All you need do is pay the postage. If you are not doing this, you may not be getting your share of the service market in your area. It is entirely possible that in trying to save pennies, you have lost out on dollars. Try to re-evaluate your own advertising program. Remember, the marketing conscious service dealer is constantly striving for ways to bring in new business and increase profits.

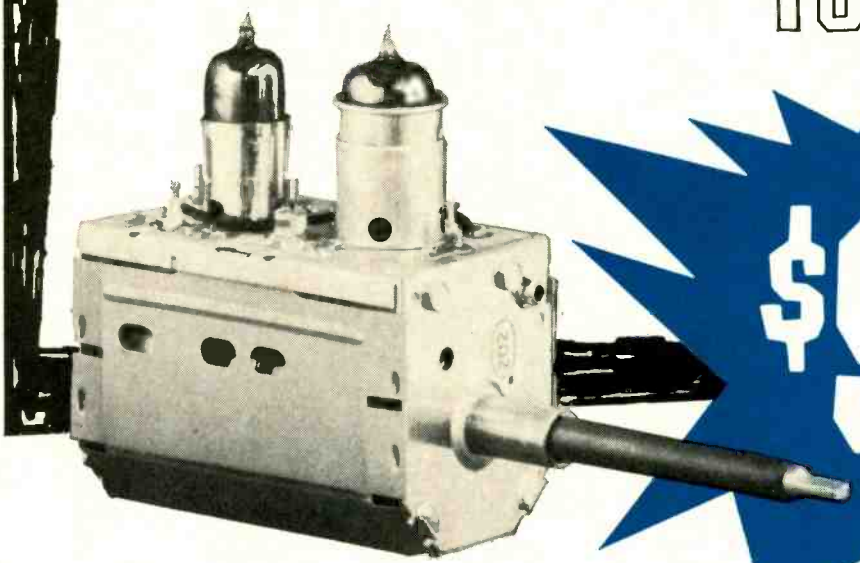
Dollars and Cents Advertising

We will now dig deeper into the subject of advertising in terms of dollars and cents. Although no specific formula can be applied to all situations, we must outline some system of determining just how much to spend on advertising during any given period.

We must first realize that advertising is a budgeted expense. We cannot obtain results by allocating funds in "scatter-gun" fashion. We must determine what the objectives of any given campaign will be and then allocate funds according to the

Continued on page 90

Complete TUNER REPAIR for only $9.50



Sarkes Tarzian, Inc., largest manufacturer of TV and FM tuners, offers unexcelled tuner overhaul and factory-supervised repair service. Completely-equipped and conveniently-located Service Centers offer fast, dependable and factory-supervised repair service on all makes and models. Centers are staffed by well-trained technicians, assisted by engineering personnel.

Tarzian-made tuners received one day will be repaired and shipped out the next. More time may be required on other makes. Every channel—not just the channels existing in any given area—is checked and re-aligned per original specifications. Exclusive cleaning method makes the tuner look—as well as operate—like new.

Cost, including ALL labor and parts (except tubes) is only $9.50 and $15 for UV combinations. No additional charge. No hidden costs. Too, you get a full, 12-month warranty against defective workmanship and parts failure due to normal usage.

Always send TV make, chassis and Model number with faulty tuner. Check with your local distributor for Sarkes Tarzian replacement tuners, parts or repair service. Or, use the address nearest you for fast, factory-supervised repair service.

TUNER SERVICE TSC CORPORATION

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547-49 Tonnele Avenue, Jersey City, N.J.
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SARKES TARZIAN

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TECHNICAL DIGEST

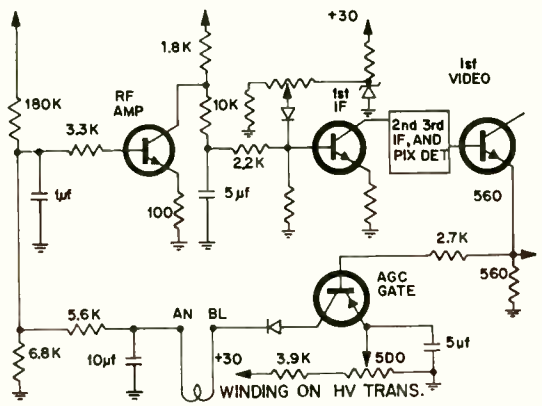
RCA VICTOR

TV Chassis KCS153—AGC Circuit Description

The AGC system used in this chassis consists of a closed loop made up of the AGC gate, the RF amplifier, IF amplifiers, 1st video amplifier, and back to the AGC gate.

The system maintains a constant 1.2v at the emitter of the first video amplifier over a wide range of signal inputs. It is a "gated" or keyed AGC system in which an AGC voltage is developed at horizontal sync time and sustains for the duration of the horizontal scan time. Sync tips only are utilized to produce the control voltage; the system is noise immune, and not affected by scene variations.

Operation of the AGC circuits is as follows: As signal increases at the antenna, the output of the first video amplifier tends to increase. The increased video level is applied as an input signal to the "AGC gate." The AGC gate is rendered operative at horizontal sync time by a 30 volt negative pulse from the HV transformer which is applied to the collector of the AGC gate. At that time AGC gate amplifies the sync signal which is simultaneously occurring at the base. A positive AGC voltage is then developed, and is retained during scan time by the long



time-constant of the AGC bus. To prevent the collector to base junction of the AGC transistor from becoming forward biased by this developed AGC voltage, a diode is inserted between the AGC gate collector and the AGC bus. Such a condition would short out the AGC voltage. The positive AGC voltage so formed is then applied as forward bias on the RF amplifier transistor. This reduces the gain of the RF stage.

The RF amplifier then plays a "dual" role — in addition to its function as an RF amplifier, it amplifies and inverts the AGC signal delivering it to the base of the first IF amplifier as reverse bias. This reduces the gain of the first IF amplifier. In this manner both the RF amplifier and the first IF amplifier act to reduce the gain of the system.

The AGC output is filtered at the output of the AGC gate and additional filtering is provided at the IF AGC input.

The time constant of the system is slow enough to prevent "hang-up" of sync or AGC due to horizontal being out of sync; and still fast enough to permit AGC action on fast fluctuations.

To maintain optimum gain and signal to noise ratio and to prevent cross-modulation from occuring in the mixer, the RF amplifier is permitted to give nearly full gain on weak-to-medium input signals, most of the control being in the IF amplifier. As the signal gets increasingly stronger, the RF amplifier then assumes more control.

This is accomplished primarily by the characteristic of the RF amplifier. Further control over the "crossover" point is provided for the bias adjustment; this control sets the minimum gain of the first IF amplifier. This circuit is regulated by the use of a zener diode and isolated from the first IF amplifier by another diode.

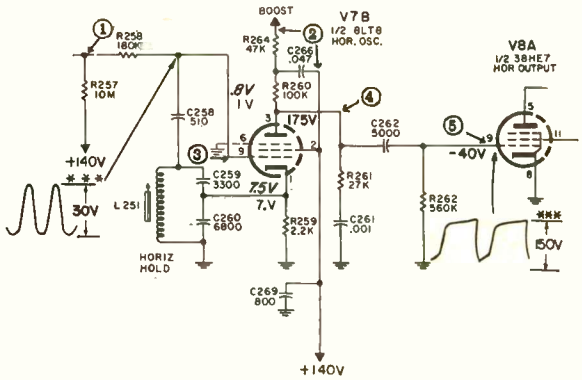
GENERAL ELECTRIC

TV Chassis DB—Horizontal Oscillator Troubleshooting Procedures

The following procedure may be used by service technicians to check the sine-wave horizontal oscillator of the DB chassis while troubleshooting the horizontal-high voltage system. It may also be applied to other G-E chassis incorporating the same type horizontal circuitry.

The partial schematic shows the oscillator circuitry with numbers identifying areas referred to in the step-by-step procedure. In actual troubleshooting, the DB (or other chassis) main-chassis schematic should be used, and common-sense troubleshooting practices followed; for example, in the event of a failure in the horizontal or high-voltage area, a preliminary visual inspection and a check of circuit voltages may furnish immediate clues to the trouble source.

1. Connect a jumper between chassis ground and the junction of R257 R258. If high voltage becomes operative as shown by the raster, it can be assumed that the difficulty is in the phase detector or another stage on that side of the oscillator. In this case, normal troubleshooting prac-



tices should be applied beginning with the phase detector output and working back.

2. If the oscillator remains suspect after Step 1, check dc voltages at the 8LT8 screen (pin 2) and the boost end of R264. Potential at both points should be approximately 140v without boost. If voltages are in this range, proceed to step 3. (No voltage at the end of R264 indicates failure in the damper or flyback circuitry.)

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COLOR TV LAB

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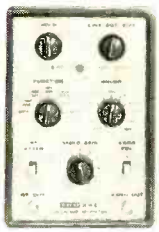
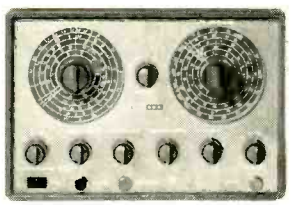
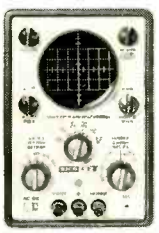


New Model 380 Solid State NTSC Color Generator generates exact NTSC color signals individually and all required dot-bar patterns. Super-compact, 4 pounds light, instant operation. **$159.95 wired only.**



Model 369 Sweep/Marker Generator for easiest, fastest visual alignment of color or B&W TV and FM RF and IF circuits. Five sweep ranges from 3-220mc. Four marker ranges from 2-225mc. Crystal marker oscillator. Post injection of markers. **$89.95 kit, $139.95 wired.**



New Model 435 Direct-Coupled Wideband Scope. Top-quality DC-4.5mc scope with 3" flat-face CRT. Zener calibrator: Outperforms 5" scopes three times its size, facilitates on-location color TV and other servicing. **$99.95 kit, $149.95 wired.**

New Model 342 FM Multiplex Signal Generator. Design lab quality. Both composite audio and FM RF outputs. Inputs for stereo audio source for store demonstrations, critical A/B listening tests. **$149.95 wired.**

New Model 1030 Regulated Power Supply. Speeds troubleshooting, design work, production line testing, electronics teaching. Variable bias and plate sources regulated to ⅓ of 1%: 0-150V @ 2ma; 0-400V @ up to 150ma. Ripple less than 3mv rms. Unregulated fil. volts of 6.3V & 12.6V, @3A. Switchable, monitoring milliammeter and voltmeter. **$59.95 kit, $99.95 wired.**

New Model 378 Audio Generator. Near-distortionless sine wave generator (<0.1% 20-20,000c) providing fast, convenient switch-selection of frequencies from 1c to 110kc (1c steps 1c-100c, 10c steps 100c-1kc, 100c steps 1kc-10kc, 1kc steps 10kc-110kc), 8-pos. 10db/step output attenuator & fine attenuator. Output meter (4½" 200ua) with 8 voltage ranges & db scale. **$49.95 kit, $69.95 wired.**

New Model 965 FaradOhm Bridge/Analyzer. "Unusually versatile" — Electronics World. 9-range, low-voltage capacitance-resistance bridge safely measures even 1-volt electrolytics. Metered bridge balance, leakage test voltage (6 DC VTVM ranges 1.5-500V), leakage current (11 DC VTAM ranges 0.15ua-15ma). DC VTVM & VTAM externally usable. **$129.95 wired.**

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Model 232 Peak-to-Peak VTVM. A must for color or B&W TV and industrial use. 7-non-skip ranges on all 4 functions. With Uni-Probe.® **$29.95 kit, $49.95 wired.**

New Model 779 Sentinel 23 CB Transceiver. 23-channel frequency synthesizer provides crystal-controlled transmit and receive on all 23 channels. No additional crystals to buy ever! Features include dual conversion, illuminated S/RF meter, adjustable squelch and noise limiter, TVI filter, 117VAC and 12VDC transistorized dual power supply. Also serves as 3.5 watt P.A. system. **$169.95 wired.**

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

New Model 753 The one and only SSB/AM/CW Tri-Band Transceiver Kit. "The best ham transceiver buy for 1966"—Radio TV Experimenter Magazine. 200 watts PEP on 80, 40 and 20 meters. Receiver offset tuning, built-in VOX, high level dynamic ALC. Unequaled performance, features and appearance. Sensationally priced at **$179.95 kit, $299.95 wired.**

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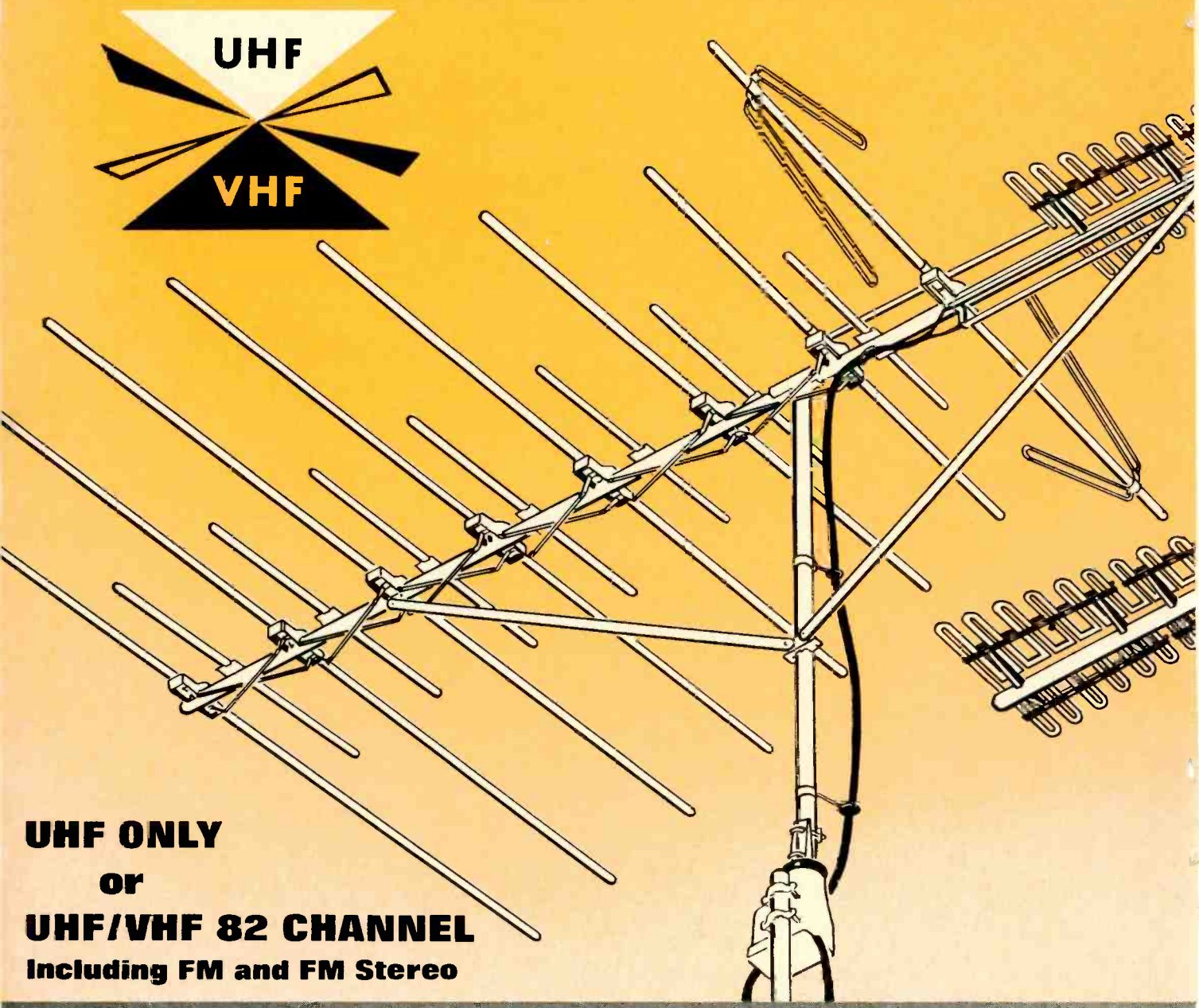
The first completely new antenna concept in years...

Revolutionary CHANNEL MASTER ULTRADYNE SERIES



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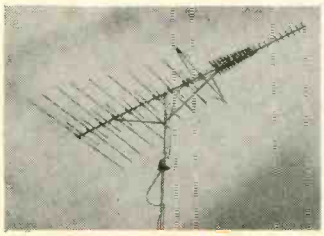
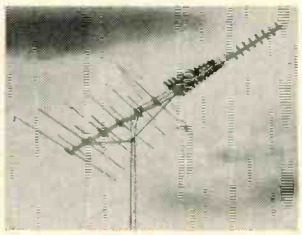
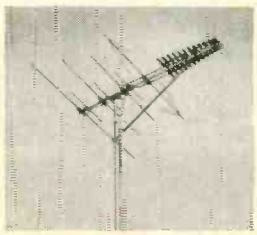


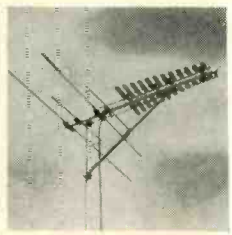
Model 3632G
for deep fringe areas



Model 3634G
for near fringe areas

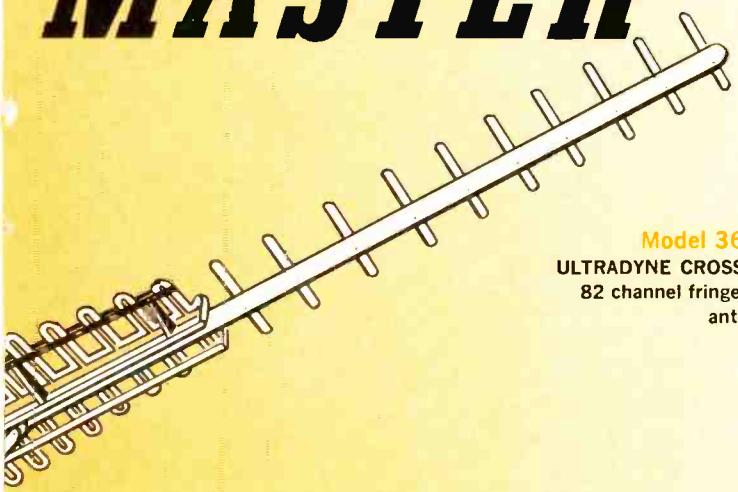


Model 3635G
for suburban areas

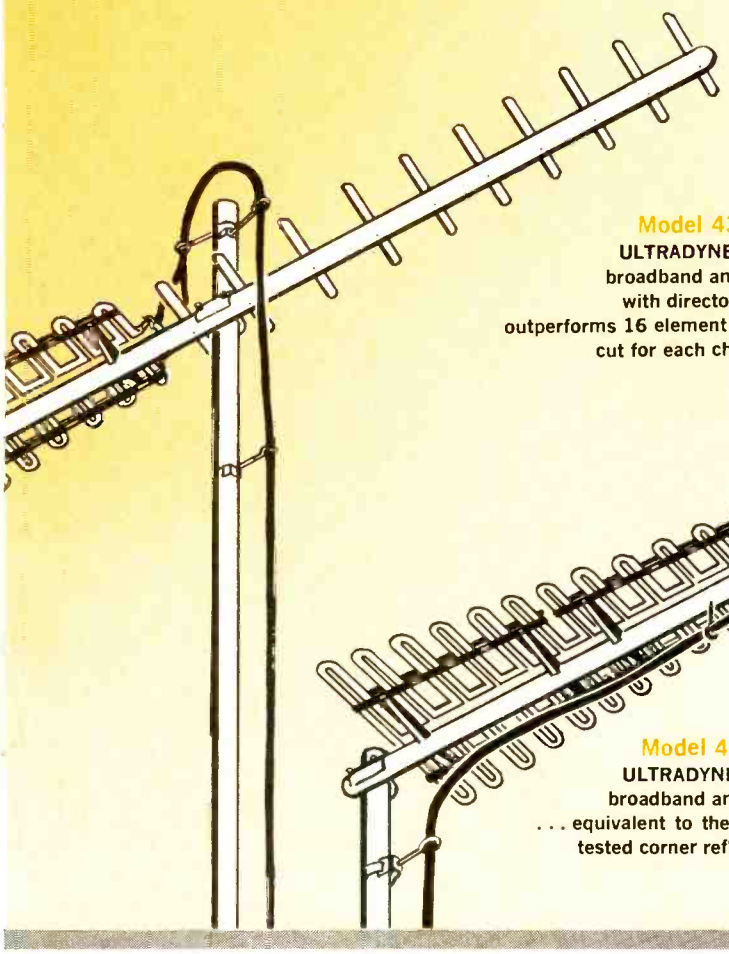


Model 3636G
for metropolitan areas

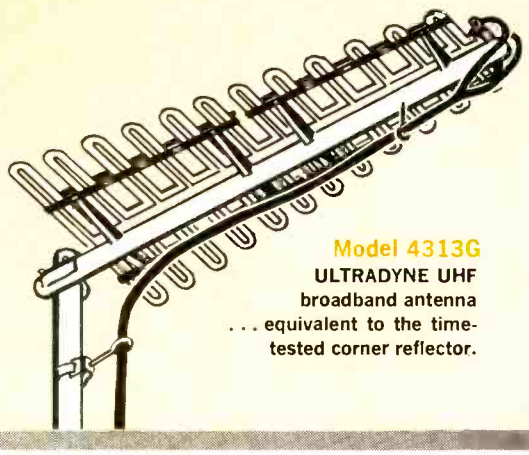
MASTER®



Model 3633G
ULTRADYNE CROSSFIRE
82 channel fringe area antenna.



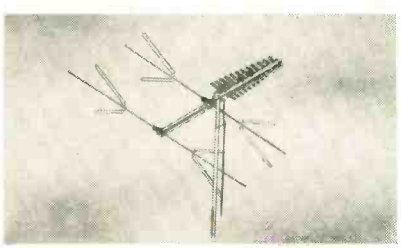
Model 4314G
ULTRADYNE UHF
broadband antenna with directors . . . outperforms 16 element Yagis cut for each channel



Model 4313G
ULTRADYNE UHF
broadband antenna . . . equivalent to the time-tested corner reflector.

BREAKTHROUGH!

The amazing electronic ghost-killing power of Channel Master's famous Coloray antenna is now combined with the ULTRADYNE principle to create an 82 channel antenna for superb color reception as well as FM and FM Stereo in ghost-plagued areas.



Model 3637G
ULTRADYNE COLORAY

. . . for more details circle 19 on postcard

COLOR AGE BREAKTHROUGH!

Model for model, new ULTRADYNE CROSSFIRES are the highest gain, highest front-to-back ratio 82 channel antennas ever developed. Unprecedented acceptance has made Channel Master Color Crossfires the best-selling VHF-FM antennas in TV history. Now, in combination with the ULTRADYNE UHF antenna, new standards of 82 channel performance are achieved.

BREAKTHROUGH!

Obsoletes so-called log periodic antennas. ULTRADYNE antennas, employing an entirely new principle, have higher gain than any log periodic antenna type on the market.

BREAKTHROUGH!

"Built-In" 300 ohm impedence actually makes the ULTRADYNE function as a length of 300 ohm transmission line at VHF. This eliminates the need for an antenna coupler when the ULTRADYNE is used in conjunction with any 300 ohm VHF antenna such as Channel Master's Famous Color Crossfires (models 3617G, 3610G, 3611G, 3612G, 3613G, 3614G, and 3615G).

BREAKTHROUGH!

Fantastic front-to-back ratios . . . over 15:1 across the entire UHF band.

BREAKTHROUGH!

Unique construction. Two stamped aluminum sections make up the entire driven element section of the antenna. This means precise control of dimensions and the elimination of connection and corrosion problems.

BREAKTHROUGH!

Three separate United States patents and two patents pending cover the exclusive design features of Channel Master's new ULTRADYNE series. No other antenna line incorporates such important technical advances. Yes, from the standpoint of gain, front-to-back ratio, impedance, construction simplicity and versatility, no other antenna comes close to the ULTRADYNE series. No wonder the entire industry knows that the truly significant advances in antenna design traditionally come from . . .

CHANNEL MASTER ELLENVILLE, NEW YORK
World's Largest Manufacturer of TV/FM Reception Equipment

TECHNICAL DIGEST

3. Using a scope, check at the control grid (pin 9) for a horizontal-frequency sine-wave indicating that the oscillator is functioning. If the waveform does not appear, or appears at considerably smaller amplitude than indicated on the schematic, troubleshoot the oscillator stage for possible tube or component failure. If the waveform appears normal, proceed to Step 4.

4. Connect the scope to the 8LT8 plate (pin 3). If the scope does not show a trapezoidal waveform of approximately 100v amplitude, check for a short or open in the plate circuitry. Otherwise, go on to Step 5.

5. Connect the scope to the driver control grid (pin 9 of the 38HE7). The display and voltage reading should conform to that obtained at the plate of the 8LT8 in Step. 4. If not, the coupling capacitor C262 may be at fault.

If the oscillator is operating and properly driving the horizontal output stage, a high-voltage failure indicates trouble — probably a tube or component failure — in the high voltage area itself.

PHILCO

Stereo Amplifiers N25ST and ND25ST—Field Service Data

When a chassis is being serviced for output transistors that have been destroyed, the normal procedure would be to check for defective components in the output circuits in addition to replacing the defective transistors. Good procedure would be to make resistance or ohmeter checks first on a cold chassis. If no defects are shown by this procedure the next step would be to apply power and make voltage checks. Should the cause of the defect be such that it shows up or becomes more evident only when power is applied, however, then the technician stands a good chance of destroying the replacement transistors before he has time to locate the cause.

This problem can easily be avoided by using a variable ac line transformer.

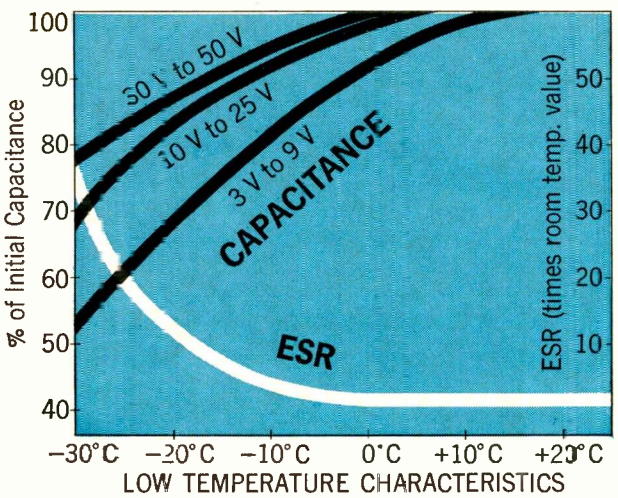
The set should be operated through the variable transformer, initially adjusted to zero or minimum line voltage. With the amplifier turned on, advance the line voltage to a relatively low potential, approximately 20v.

Although the power supply voltage will be below the operating point for the set, a B+ voltage will appear across the output transistors to ground of approximately 8v depending on the variable transformer setting and circuit variations. A voltage measurement across each transistor can then be made. The voltage division should be equal or very close across each pair of output transistors in the right and left channels. Thus the collector voltage of transistor Q7 or Q14, depending on which channel is being measured, would be 8v. The voltage and currents through the transistors, however, will be so low that the transistors would not be damaged by circuit defects.

Then measuring across the remaining transistors in each channel, collector to ground, a reading of 4v should be obtained. In other words the voltages are equally divided across each set of transistors indicating normal operation.

If any variation of the voltage division is noted, the transistors and circuits should be examined and corrections made before applying full power to the set.

Meet a new kind of Capacitor



Standard MTA Values Available			
	Case Size	Volts WVDC	MFD
D	5/16" x 3/4"	3 to 50	60-8
E	3/8" x 1"	3 to 50	175-20
F	1/2" x 1 3/8"	3 to 50	600-80

Once in a while something new comes along that seems almost too good to be true. We've just come up with one of these. It's the Mallory MTA molded electrolytic capacitor. And it not only has good quality and good performance but its price is so low that it doesn't seem possible it could be made by a reputable U. S. manufacturer. But it's made by Mallory in our new Glasgow, Kentucky plant. So you know you can rely on it for famous Mallory quality.

What makes it unusual is a different kind of construction, worked out by Mallory capacitor specialists. Its moisture-proof plastic case is molded *in one piece* around the capacitor element. There are no seals or gaskets. Moisture can't get in, electrolyte can't leak out—no matter how much mechanical abuse and thermal cycling you give it.

The result: life, reliability, and temperature stability are far superior to cardboard case capacitors and other plastic-case types. Consistently better than imported types. And even better than many metal case tubular capacitors which cost one-third more! Look at the temperature stability test chart, for instance. This is excellent performance for a low-cost miniature electrolytic. So good, in fact, that we have now rated the MTA for −30°C to +85°C.

As for reliability, here are some figures from our test lab that should reassure anyone who worries about consistent quality (and who doesn't?). In over one million piece-hours of life test at 85°C, there hasn't been a single failure. At 65°C, we've had only *one* failure in 2½ million piece-hours.

You'll recognize the MTA by its bright white plastic case. Your Mallory distributor has them in stock for your use in replacement work and in experimental circuits, in handy two-pack blister cards. Mallory Distributor Products Company, a division of P. R. Mallory & Co. Inc., P. O. Box 1558, Indianapolis, Indiana 46206.

. . . for more details circle 41 on postcard

We Don't Chase Knobs Anymore

by Mary Irving

■ We don't chase lost knobs anymore. And finding the screws that hold the TV and radio backs on isn't a problem either.

No, we don't use disposable knobs and we also haven't discovered a screw that propagates itself. The answer is a fail-safe system that keeps track of the pesky things.

We tried putting knobs in little box-tops and the screws with the knobs — but that never worked out right. The boxes invariably fell off the bench and their contents were scattered all over the floor.

Then we tried attaching the box-tops to the sets with tape — but someone always brushed against them and sent the screws and knobs flying in all directions.

"I'm ready to deliver this set — and now I can't find those blasted knobs . . ."

"There were four screws with this back and now I can only find one . . ." That's the way it always went.

Then one day, as I was standing on my head between a bunch of old chassis and the rear wall of the shop — looking for a volume control knob that had evaded my husband — I suddenly got an idea. When I finally came up for air I said: "Draw-string bags, little cloth bags, that's the answer to the missing knob and screw problem."

When you take knobs, screws, bolts or little springs off a TV, radio or Hi Fi, you put them in a draw-string bag and hang it from any handy part of the chassis.

We decided to try it right away. I went across the street to the dime-store and bought a yard of solid colored cotton for thirty-six cents. I also got some thin cotton cording for a quarter.

The first few I made up varied some in size. We found that 5 x 7 in. is just about right — or somewhat smaller.

But then we discovered that you can buy them already made up cheaper than you can make them yourself.

The system works like a charm. Now we keep a few bags hanging from a hook over the bench and some on another hook behind the counter. We carry a supply in the tube caddy, too.

Result: No more knobs on the front seat or screws rolling around loose in the truck.

This method won't make a good technician out of a bad one but it will save time and tempers and money. ■

YOU GET PRODUCT PLUS FROM YOUR SYLVANIA DISTRIBUTOR.

He'll put you in TV Guide

To give you a jump on color set repairs, your Sylvania distributor will put your name, your town, your phone number in *TV Guide*. Four ads will run this year exclusively for Independent Service Dealers carrying Sylvania's picture tubes and receiving tubes.

The plug for you will be run in localized, full-color double-page ads. Customers learn that you're the "right TV serviceman" for color set repairs. For all TV repairs.

And because you're Independent, they learn you give unbiased opinions on TV replacement parts. Sylvania knows that, more often than not, you recommend Sylvania tubes.

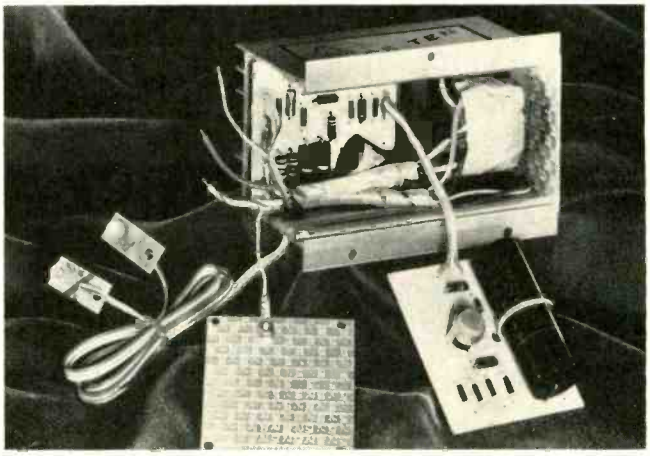
See your Independent Sylvania distributor. He'll tell you how Sylvania ads, featuring *you*, can make you your area's "right TV serviceman" for color sets. He'll tell you how to get into up to 4 *TV Guide* ads.

Sylvania Electronic Tube Division, Electronic Components Group, Seneca Falls, N. Y. 13148.

SYLVANIA

SUBSIDIARY OF
GENERAL TELEPHONE & ELECTRONICS GT&E

SCR Ignition System



■ A capacitive ignition system for all gasoline, propane or natural gas-fueled engines is said to have advantages not offered by transistorized ignition systems and eliminates rewiring the vehicle and adding an ignition relay. The system, called "Mark 10 Thunderbolt," was designed by engineers Robert G. Van Houten and John C. Schweitzer. It was also said to obsolete the 50-year-old Kettering system.

The silicon controlled rectifier system stores voltage in a capacitor until needed rather than being built up by an induction coil. Applied battery potential is converted from 12v to 400v by converter circuitry. The power supply will deliver full energy to the capacitor at engine speeds over 8000 rpm, according to the report. Comparative advantages claimed over both Kettering and transistorized ignition systems are:

Energy levels substantially exceed those of any present ignition system and are readily controlled.

The SCR system may be installed on any vehicle without change in components or in wiring simply by removing original coil wires, attaching two small blocks to coil terminals and reattaching coil wires. Average installation time is 10 minutes.

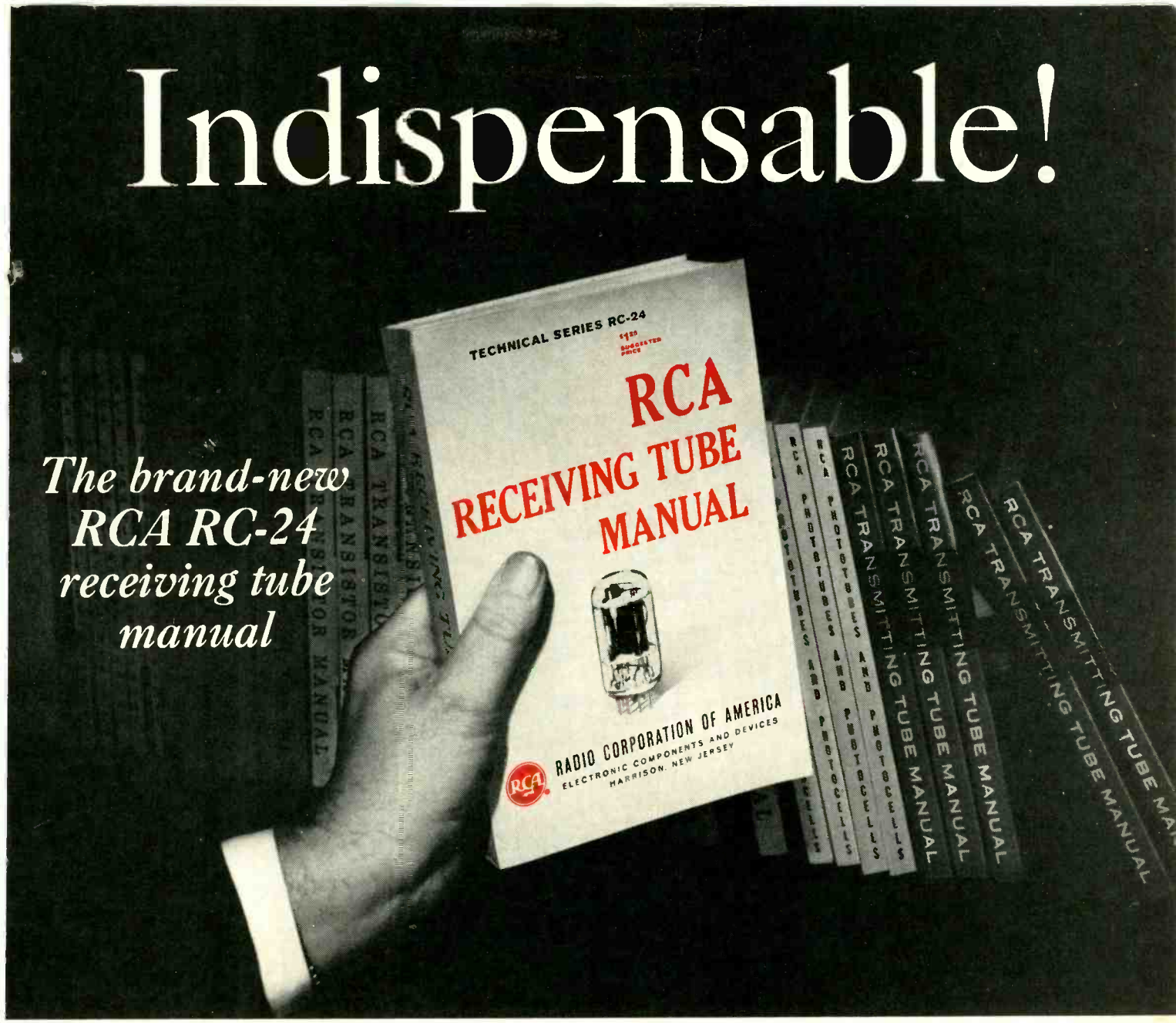
Voltage rise time using the original equipment coil is much more rapid than in the Kettering system. Rise times of some 1/20th of standard systems are possible with special coils.

Point life and dwell time are relatively unimportant. Point life is limited only by mechanical wear, since point current (250ma max) is low and applied voltage is limited to that of battery supply. Dirty or contaminated points do not degrade spark energy. The system will perform excellently with points which could not be used on either a Kettering or a transistorized ignition, it is claimed. In operation the SCR system actually cleans fouled plugs, delivers higher energy, promotes better and more complete combustion and increasing acceleration rates, the report said.

It was also reported that circuitry of the Mark 10 system are not potted and all components are commercially available. Current price is less than $50 for assembled units and less in kit form for those who wish to construct their own.

The system is manufactured by Delta Products, Inc., of Grand Junction, Colorado. ■

Indispensable!



The brand-new RCA RC-24 receiving tube manual

Complete-authoritative
A must in every technical library
A must on every work bench
More compact and easier to read than ever before

Technical design and applications data on more than 1200 receiving tubes. Check these NEW features and improvements not included in previous editions:

- Additional data on 100 new tube types
- Revised circuits section with new, simple format
- Updated picture tube characteristics chart
- Revised and updated Applications Guide
- New tube index section for ready reference
- Data section on active types only. (Discontinued and replacement types appear in a separate section.)
- Additional text material on TV in the tube applications section

Everyone concerned with electronics needs this manual . . . service technicians, engineers, radio amateurs and hobbyists. Order yours today from your nearest Authorized RCA Distributor.

Only $1.25*
**Suggested Price*

RCA Electronic Components and Devices, Harrison, N.J.

The Most Trusted Name in Electronics

SYNC ON BUSINESS

Experimenter's electronic kits have been introduced by RCA and are a good bet for those TV-radio service-dealers

who are looking for a popular product for sales diversification. The components are solid-state. At your distributor.

• • •

Keeping up with electronics technology isn't easy. But RCA Institutes offers home study courses in color TV servicing, transistors and a total of 15 specialized areas of electronics. Home study may be a good way to do it. Write Jack Friedman, RCA Institutes, Inc., 350 West 4th Street, New York, N.Y. 10014, for information.

• • •

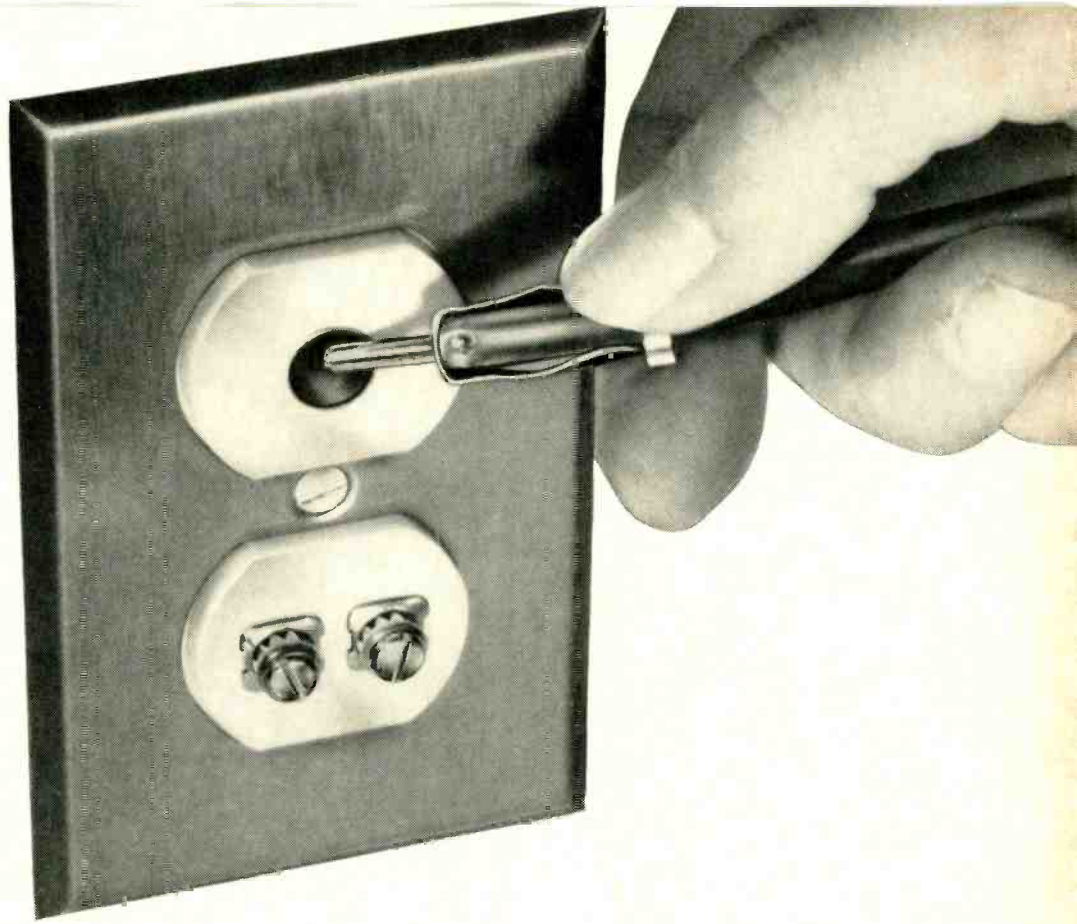
Industrial electronic products are listed in Harvey Radio's new 500-page, 1966 catalog, along with amateur radio, professional audio and consumer audio products. Write on your letterhead to Harvey Radio, 60 Crossways Park West, Woodbury, N.Y. 11797.

• • •

Transistor radios and batteries have proven to be a profitable venture for many service-dealers in hurricane, tornado and flood areas of the country. Now comes word that these items were in great demand also during the recent power blackout in the northeast part of the nation.

• • •

A transistorized remote control for FM two-way radio systems is now available from G-E. For information write Section P, General Electric Communication Products Dept., P. O. Box 4197, Lynchburg, Va.



The most important connection you can make for FULL PROFITS from FULL-HOUSE TV!

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

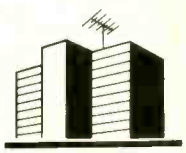
Color TV... as well as increasing FM multiplex popularity is the big reason why. Every homeowner who buys a color set instantly becomes a prospect for a residential MATV installation to operate two, three, or more receivers with maximum quality reception from one antenna.

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

IMPORTANT... Contact your Channel Master distributor now for details on a complete MATV system design and installation course.

CHANNEL MASTER
ELLENVILLE, N.Y.

M A T V



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SYNC ON BUSINESS

Proven sales stimulators are available in a free booklet issued by the Autopoint Co., A Division of Cory Corp., 3200 West Peterson Ave., Chicago, Ill. 60645.

• • •

A free Delta flash camera outfit is being given with a special assortment of the most frequently used twist mount, tubular and dipped Mylar-paper capacitors. Deal No. 38C, is available to service-dealers for $19.75. At your Arco Electronics distributor.

• • •

An introduction to single sideband plus instruction manual for their SB72 SSB CB transceiver is available from General Radiotelephone Co. 3501 West Burbank Boulevard, Burbank, Calif.

• • •

A combination BC and CB antenna for autos has been designed by Webster. It is called the A85 CB/AM combination and employs an encapsulated top-loading coil to achieve one-quarter wavelength resonance. A signal divider prevents 27Mc signals entering the AM radio. At your parts jobber or write Jim Adams, 317 Roebling Road, South San Francisco, Calif.

• • •

Automation moves on. We are once again reminded of the rapid advance toward total automation in business, industry and manufacturing as we observed a string of

diodes being inserted into printed circuit boards by a "pantograph" machine at the Ft. Washington, Pa facility of Honeywell. This machine inserts resistors, capacitors and other components. The circuit boards are being produced for process computer control systems.

There's BIG MONEY in SMALL master-antenna SYSTEMS

...and JERROLD makes the work easy

DON'T pass up the profits waiting in the small motels, apartment houses, schools, and TV dealers' showrooms in your area. They all need a low-cost, efficient master-antenna system. And *you're* the logical one to install these systems . . . quickly, easily, profitably.

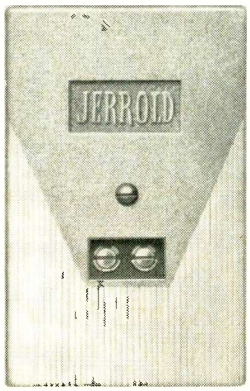
Jerrold gives you a honey of a package for these installations. You can vary it a hundred ways according to your needs.

GIBRALTAR Amplifier, Model 3440

Heart of the system is the new solid-state GIBRALTAR amplifier. Low noise figure (less than 6 db) means GIBRALTAR works well even in weak-signal areas. High output capability (more than 150,000 microvolts) lets it work in very-strong-signal areas without overload. High gain (25 db avg. hi band; 23 db avg. lo band and FM), consistent performance and maintenance-free reliability make GIBRALTAR the ideal amplifier for every small VHF system you install.

VARIABLE-TAP Room Outlets, Model VT-300

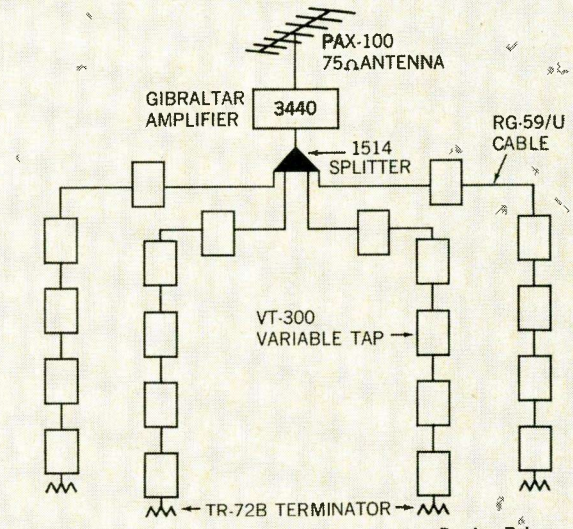
These attractive, low-priced wall outlets give you a choice of three isolation values simply by the turn of a screw. Model VT-300 is matched to 300-ohm twinlead. Also available as Model VT-75, with coaxial outlet to receiver. Ivory-colored cover plate mounts flush to wall; decorative without painting,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



JERROLD

THE NATION'S FOREMOST MANUFACTURER OF ANTENNA SYSTEMS EQUIPMENT

TYPICAL SYSTEM COST FOR 20 OUTLETS



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

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

JERROLD ELECTRONICS CORPORATION
Distributor Sales Division
15th & Lehigh Ave., Phila., Pa. 19132

I'm interested in cashing in on the small antenna-systems business.
☐ Send me complete information.
☐ Have your technical rep call on me.

Name_____

Company_____

Address_____

City_____ State_____ Zip_____

. . . for more details circle 36 on postcard

"Where have I been? If we'd get that G-E two-way radio you'd know!"

You could've reached him. General Electric two-way radio instantly reaches those people you can't reach by phone. It gives you complete control of your business.

So you run a snappy service. Quick deliveries. Speedy pick-ups. Fast emergency calls. Instant re-routing. On-the-spot changes, cancellations and sales information.

With service like this, you keep customers. And make new ones. You also get more use out of your fleet. Waste fewer manhours. Save on gas mileage. Save on telephone charges. Save time and more time. And that's money.

When a two-way radio is counted on for so much, it has to be good. That's why companies going for two-way systems, go for General Electric.

G-E started the two-way radio business. It's the world's largest electronics manufacturer. The world's largest manufacturer of electrical equipment. So who else could know more about it?

For big, busy companies or small, busy companies looking to get big, there's a complete line of appropriate General Electric high performance FM two-way radio equipment. Look into it.

Call your G-E communications consultant listed in the Yellow Pages under "Radio Communication." Or write for complete descriptive information. General Electric Company, Communication Products Dept., Section 11516, Lynchburg, Virginia.

First in Two-Way Radio

GENERAL ELECTRIC

... for more details circle 30 on postcard

ELECTRONIC TECHNICIAN

JANUARY 1966

Servicing A Modern 2-Way Communications Center

An FCC license-holding service engineer handles emergency repairs and coordinates service activities

Teltronic's top team, William F. Graham, president and general manager, Peter Sacallaris, vice president and shop manager, John J. Cristea, vice president and service manager and Rosemary Thompson, secretary-treasurer and office manager.

■ Two-way radio equipment servicing at the Montgomery County, Maryland emergency operating center is an example of modern space-age technical competence and business "horse sense" in action.

The center, located in Silver Spring, Md., a suburb of the nation's capital, is built underground and designed to maintain operation even in the case of a nuclear blast over the capital.

The equipment operates on VHF and UHF, has more than 400 mobile units, 10 VHF 250w base stations, one 250w UHF station and two UHF repeaters. The equipment operates on 11 different frequencies.

Service Organization

Around-the-clock service for this space-age communications center is performed by Teltronic Industrial Systems, Inc., under contract with Motorola. One service engineer, with a first class FCC license, is responsible for technical knowledge of the system. He does most of the emergency breakdown service and coordinates all service activities with the county. A staff of six other contract workers is instantly available for major service problems.

When the service load from simultaneous breakdowns becomes too much for one man, as many as four technicians at a time can be activated to restore equipment operation. Down-time on major equipment is generally less than one hour from the time the call is received until a technician has restored the equipment to normal service.

Emergency breakdowns represent about 30 percent of the technical effort expended on the system. Remaining time is devoted to preventative maintenance. All mobile and base station equipment is checked on a 90-day schedule. This includes frequency netting between transmitters and receivers, power output checks, receiver sensitivity and loose-wiring checks in mobile installations.

The weekly service load for the system requires about 60 technical man hours, not including a few hours logged by non-technical helpers who assist in pulling equipment for maintenance readings, meter readings on site alignments and general clean-up of mobile installations.

The county provides a field

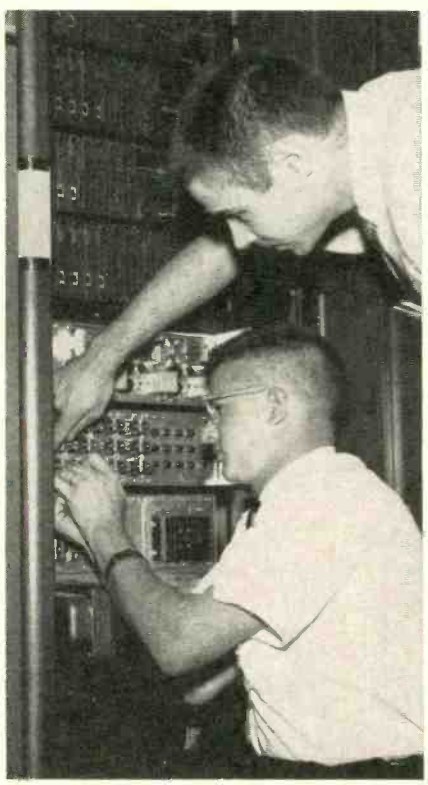
2-Way Communications Center...

Drive-in service is performed from mobile test van at customer's location.

Field-service fleet readies for take-off from headquarters. One truck was in paint shop when photo was taken.

Technician Goodell aligns receiver of transistorized mobile unit in field maintenance shop.

Bill Graham and technician Roger Goddell discuss component replacement. Modules are extended for servicing with a cable adapter.



Making adjustments to relay matrix in Motorola's 'voting' comparator which samples all incoming signals and selects the strongest.

maintenance shop with drive-in service for county vehicles four hours a day. Remaining service is provided on-site by fully-equipped field-service vans. The service company's mobile van fleet is equipped with instruments, benches, test panels, ac converters, parts and files of tech-manuals. Each truck is in constant radio contact with service headquarters.

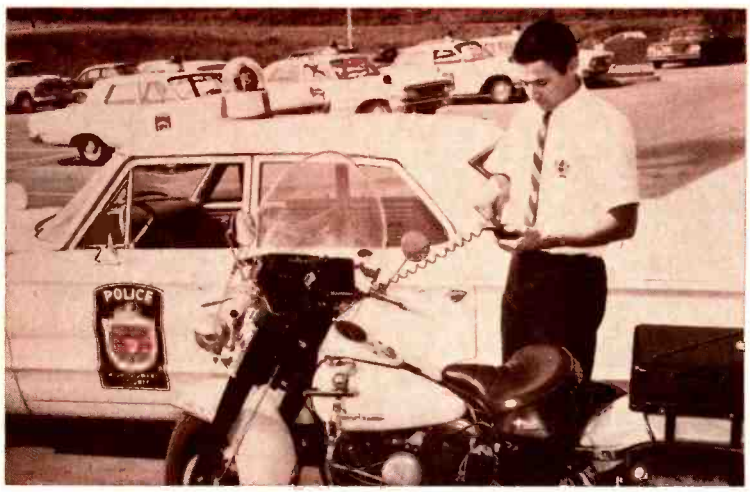
Model Service Company

According to offficials of the company, the highest quality maintenance must be provided regardless of cost. Hence, to realize a profit, the company must depend on the ability and efficiency of its technical crew.

Service is normally provided under a yearly contract with a fixed amount of income per month. A typical business radio system, with a base and 10 mobiles, for example,

Maintenance check is performed at test bench station.

Field alignment is performed on mobile unit in police cruiser trunk. Touch-up tuning is frequently accomplished without removing unit.



Police motorcycle microphone is repaired by technician.

Technician nets receiver on frequency in the field maintenance shop.

is maintained for $76.50 per month with eight-hour a day service. Contract customers are given priority in emergencies and supplied with FCC verifications and regular preventive maintenance. The flat rate includes all parts and labor. Additional work—installations and relocations — is extra. Contracts and fixed price projects are cost-analyzed monthly to determine rates, employee bonuses, efficiency and new accounts. Most service work is performed in the field, with concentration on large fleet systems where the customer makes equipment available at his place of business.

In-House Technical Training

Each technician is closely observed for talents and abilities that may need further development. For example, some may be strong on circuit troubleshooting but lack system comprehension. Others may be experts in practical experience but lack communications theory. These abilities and shortcomings are evaluated to determine the type of counselling or training required to coach technicians into competent professionals. The "finished product" must be equally capable of soothing dissatisfied customers, scheduling work-loads, estimating contracts and replacing defective resistors or capacitors.

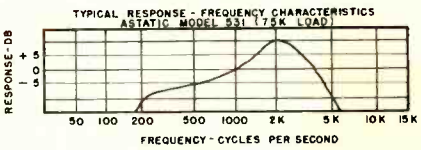
When a technician is qualified to handle systems alone, he is assigned specific accounts and is placed on a salary-plus-incentive bonus plan which makes it possible to exceed the average salary paid for this type of work. The bonus is based on the technician's efficiency in performing all of the essential details of contract service and a portion of the contract profit is returned to him. ■

Adjustments being made on microwave station. This 8-channel system ties in remote base station sites in the upper parts of the county.

Essentials For Selecting

Choose the microphone having a response characteristic which gives maximum modulation to voice-frequencies that provide optimum intelligibility

by Theodore Lindenberg and Robert Shenc



Service technicians who work with two-way communications equipment recognize its special microphone requirements. And the reasons given for "tailored response" or "shaped frequency response characteristics," in reference to communications mikes, can frequently be confusing and misunderstood.

A guide to choosing the correct microphone for radio communications can be formulated simply: Select a microphone having a response characteristic which gives maximum modulation to voice-frequencies that provide optimum intelligibility. Let's briefly consider some of the important factors involved.

Limiting Factors

Radio communications equipment manufactured today is designed to eliminate all radiated audio signal outside the passband of 300 to 3000 cps. A service technician who works with both Hi Fi sound (tape recorders, public address/music distribution systems, etc. that require broadcast quality microphones), and communications equipment microphones, should be prepared to explain the great difference existing between each requirement.

In Olsen's "Elements of Acoustical Engineering," reference is made to an "Articulation Index." To quote Olsen, "A high order of articulation can be obtained with a response-frequency characteristic of very limited range."

The FCC rules help avoid "splatter" in transmission and establish the usable frequency range between 300 and 3000 cps. This limitation protects adjacent bands. But it does not rule out intelligibility if the appropriate microphone is employed to take greatest advantage of the audio passband prescribed.

Human Voice Characteristics

A frequency-response-range curve of the average male voice is shown in Fig. 1. Note the appreciable roll-off in the high frequency region. It would follow that a microphone with a response characteristic that is the reciprocal of this curve (See Fig 2) would result in uniform modulation amplitude for the input signal to the transmitter. (Assuming nearly flat amplification characteristics exist in the transmitter over the frequency range limited by law.)

Based on the curve shown in Fig. 2, and realizing that frequency response limits are clearly defined by the FCC, good engineering design of a communications microphone should follow this curve over as much of the passband as possible and should permit roll-off beyond these limits so the transmitter filtering is not required to eliminate undue amounts of energy beyond the passband. (See Fig. 3.)

Keep in mind, too, that the design of a microphone for mass production must necessarily be based on *average* voice characteristics. In-

2-Way Microphones

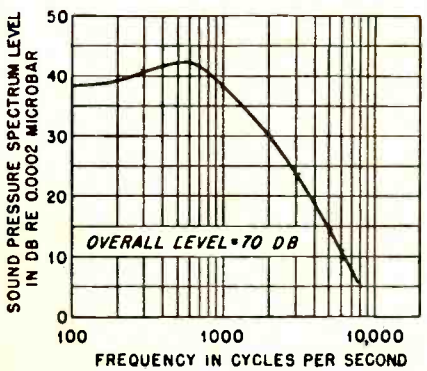


Fig. 1—Average male voice response curve. Courtesy McGraw-Hill.

dividual voice characteristics and personal preferences can and do take precedence in the final selection of a microphone by a customer. But the prime consideration will usually be maximum performance of the equipment used with respect to range and intelligibility.

Talk Power

"Talk power" is not measured in watts! Because radio transmitting equipment modulates the input signal in proportion to the levels at which the signal is presented to the input circuit, it is advantageous, for the clarity and intelligibility at the receiving end, if the input signal to the transmitter is flat.

Presentation to the transmitter of a voice frequency signal, with maximum modulation at all points in the usable voice frequency range is referred to as "talk power." If the microphone you select accomplishes this result, the transmitted signal will have the best possible chance of getting through. ■

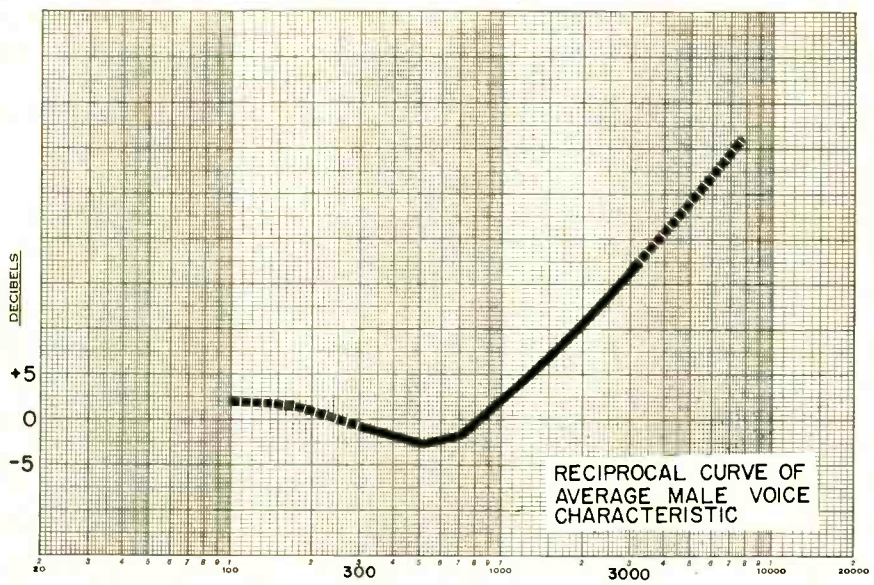


Fig. 2—Reciprocal curve of average male voice characteristic.

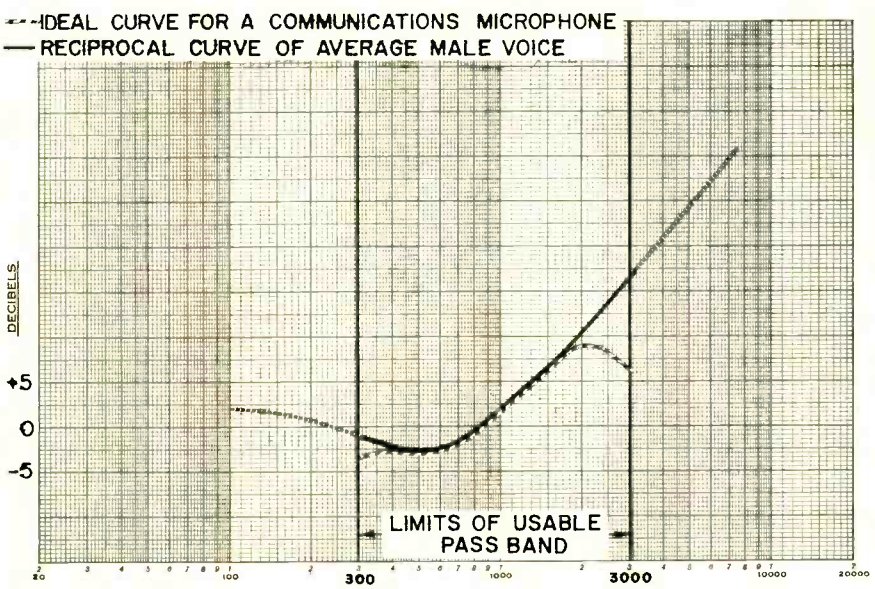


Fig. 3—Ideal communications mike curve and reciprocal curve of average male voice.

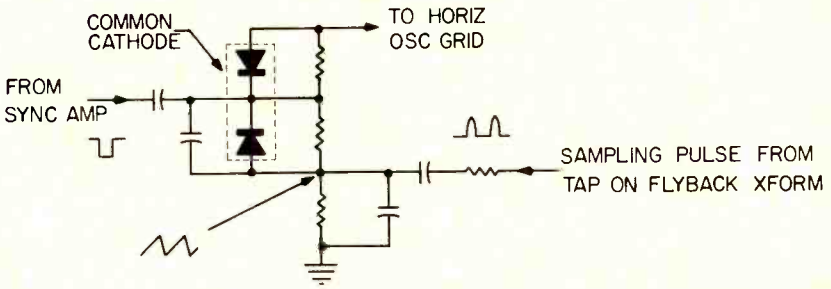


Fig. 2—Common-cathode type phase detector.

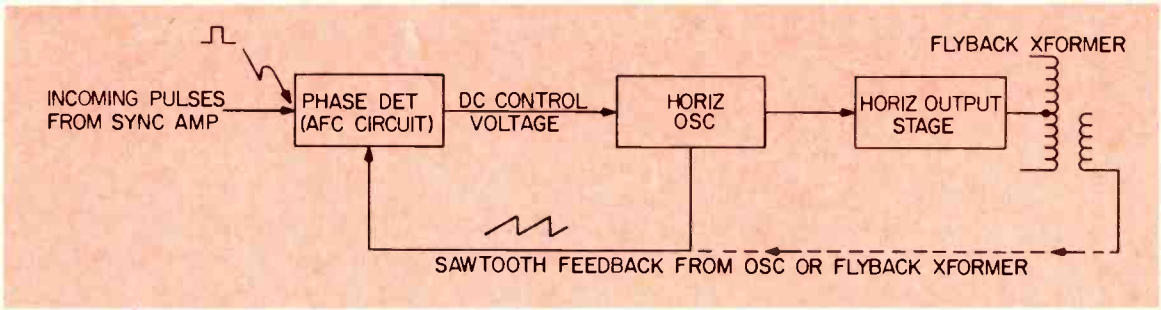


Fig. 1—Block diagram of a typical AFC network.

SERVICING HORIZONTAL PHASE DETECTORS

Know how dual diodes function and save hours of troubleshooting time in TV's trickiest circuit

by Harry J. Abramson

■ Horizontal phase detector circuits are called various names—AFC detector, comparator, horizontal sync discriminator—but whatever the name, they all compare the incoming sync with the receiver's horizontal sweep oscillator. If a phase or frequency difference occurs, a dc voltage, called "correction bias," is developed and fed back to the grid of the horizontal oscillator, which adjusts its frequency to the incoming sync.

AFC Circuits

Two kinds of horizontal phase detector circuits are used today: the diode and triode circuit. Several methods are used to develop output voltage in each system. But manufacturers from Admiral to Zenith use solid-state dual diodes in horizontal phase detector circuits. The balanced diode phase detector is popular.

An understanding of this component can save you hours of troubleshooting time in what most technicians consider TV's trickiest circuit. A typical block diagram of an AFC network is shown in Fig. 1.

Although solid-state dual diodes are simple components, containing two closely matched diodes to assure electrical balance, they may cause some critical TV troubles when they develop faults. They differ from conventional diodes by being highly insensitive to temperature variations. General electrical parameters of most AFC dual diodes are shown in Table I. Manufacturers began using dual diodes in TV receivers primarily because of their ruggedness, resistance to temporary overloads, easy circuit application, compactness, long life, stability and low cost. The most used phase detector circuit is the common cathode type as shown in Fig. 2.

This circuit became popular in the late 1950's when the dual semiconductor diode was introduced. It practically obsoleted the series connected circuit shown in Fig. 3, which required out-of-phase sync or sampling

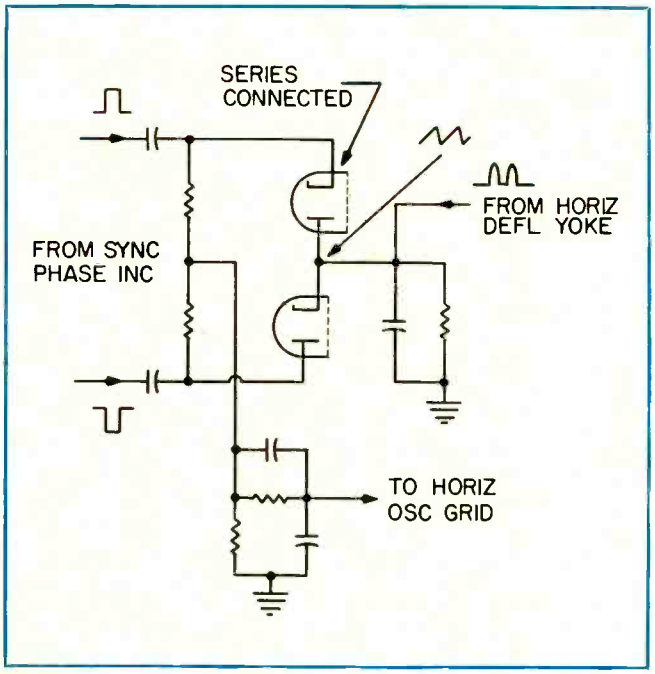


Fig. 3—Series connected phase detector.

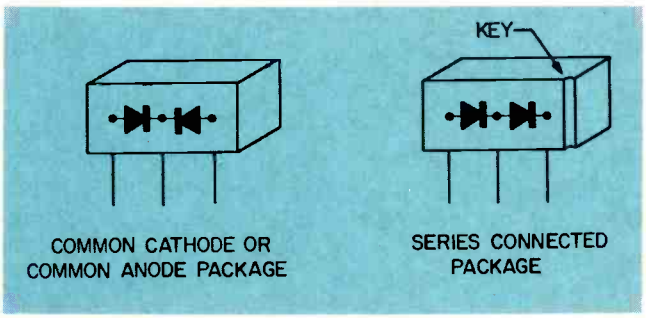


Fig. 4—Dual diode packages showing key on series connected package.

pulses. This type also required a sync phase-splitter tube, but the common cathode circuit needed only a single-ended input from the sync separator.

Trouble Symptoms

Some symptoms of defective phase detector diodes are:

1. Bending or horizontal displacement.
2. Tearing or jitter.
3. Complete loss of horizontal sync.
4. Intermittent loss of raster.

On first consideration it appears impossible for a faulty AFC system to cause a loss of raster. Although it rarely happens, a defective AFC diode can allow an excessive negative bias to reach the oscillator grid, cut off the oscillator and kill the high voltage. The oscillator will resume operation and the raster will re-appear *when the sync pulse is removed from the phase detector*. This fault can usually be verified by checking the horizontal oscillator grid voltage with a VTVM.

Troubleshooting

If your troubleshooting approach is logical, horizontal AFC faults can be isolated easily. Make these checks, however, before you remove a chassis from the cabinet:

1. Check all sync control settings. Many sync troubles have been traced to "do-it-yourselfer" tampering with phasing or ringing coils in oscillator circuits.
2. Check the tubes in the horizontal circuit. Then substitute them. Not once but two or three times—even if the old tubes check good.
3. If dual diodes are plug-in types and accessible—substitute them. If these efforts don't produce satisfactory results, then pull the chassis.

When the horizontal frequency goes off, you know this is caused by a loss of horizontal sync or a drifting oscillator. But if the diagonal bars can be locked in place, then the AFC section is working. If it were not, the bars would continue running. On the other hand, trouble in the AFC circuit can cause the oscillator to go way off frequency if it applies an improper control signal. For instance, if one diode becomes defective by lower than normal conduction, the voltage-cancelling action in its output circuit would be lost and the resulting AFC voltage would drive the sweep oscillator far off frequency. The more positive the AFC voltage, the lower the oscillator frequency; the lower the voltage, the higher the frequency. A very negative voltage will drive the oscillator grid to cut-off.

When the AFC system is good but the oscillator drift is excessive, the entire picture pulls off-center, exhibits pulling and finally breaks up into diagonal bars which lock in sync. The AFC system can bring the oscillator back on the correct frequency within certain limits when its natural frequency drifts up or down. Outside these limits, control is lost and the picture breaks up.

A quick and simple check for proper AFC operation is to rotate the horizontal hold control and monitor the output with a voltmeter to determine if the AFC voltage is varying. If the dc voltage on the output of the AFC stage remains the same or varies *nonlinearly*, the AFC circuit is not working properly.

Where the AFC circuit feeds a cathode-coupled multivibrator, another rapid check can determine whether an instability trouble is in the oscillator or in the AFC circuit. This is done by grounding the multivibrator input grid and adjusting the oscillator frequency slug until the picture is in sync or floats across the screen. If this occurs, the AFC circuit is at fault and the sweep oscillator is probably operative.

Assuming the trouble is isolated to the AFC circuit, the phase detector diodes should be checked only by

substitution. Measuring the forward and reverse resistance is not conclusive unless the diodes are shorted or open. This is because they may not match under load because of heat variations.

Certain manufacturers have balanced assortments of dual diodes available. A balanced assortment of diodes for the average size shop is shown in Table II.

The coverage afforded by these diodes is illustrated in Table III. The common cathode type is an absolute must. It is used in over 90 percent of recent TV models. The series connected variety is still used by some manufacturers, however.

Replacement Tips

Polarity. Two different phase detector diode packages are made. The common cathode and common anode types are similar since they cannot be installed backward. But the series connected type, if placed in the circuit backward, can cause critical or no horizontal sync. One corner of the case of the series connected types has a diagonal cutoff (Fig. 4) to indicate polarity. This assures replacement in the same position as the original.

Replacing single diodes. When two single diodes are used in AFC circuits, both diodes must be closely matched. An unbalanced circuit can cause faulty operation. It is good practice to replace both units with a balanced dual diode package.

Checking diodes. The resistance of both diodes should be within 20 percent of each other in both the forward and reverse directions. The reverse resistance for germanium units should not be less than 150K while selenium units should be discarded if less than 75K. Forward resistance generally runs 200Ω or less. If the meter shifts or creeps during measurement, discard the unit. It may become defective in a short time. Dual diodes should not be checked in-circuit since the load resistors may be of different values or out of tolerance. If in doubt about the condition of diodes—substitute known-to-be-good components.

Installation. Dual diodes are frequently mounted very close to PC boards. When replacing, coiled wire connectors prove very helpful. And diodes should be installed with their long leads. These long leads dissipate heat and make it possible to position the diodes away from a heat dissipating component. ■

Table I

Electrical Ratings Per Section

Max. RMS input volts, resistive load	40v
Max. peak inverse volts, capacitive load	68v
Max. peak inverse volts, resistive load	56v
Max. dc output current	1ma
Max. continuous dc volts	20v
Max. capacitance unbalance	20pf

Ambient temperature range: −55°C to +85°C

Table II

Suggested Dual Diode Stock

Quantity	Type	No. of Manufacturers Using
5	Common Cathode	26
3	Series Connected	19
2	Common Anode	4

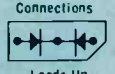
TV DUAL DIODES

REPLACEMENT INFORMATION

COMMON CATHODE

MANUFACTURER	PART NO.	MANUFACTURER	PART NO.
Admiral	93B5-6, 9 93C26-7, 9	Muntz Olympic	SR004 RF5465-1 RF5794-1
Airline	66X21 296V004H01	Packard Bell	72053
Coronado	66X21, 25	Philco	34-8034
Curtis Mathes	9LR2-S 21A2	RCA	34-8037-1, 2, 3 109328, 109474 1107832-7,
Dominion	702-810		9, 10, 11
Electrohome	14-501-Q1		
Emerson	817062 817074 817126	Setchell-Carlson Silvertone	9LR2 86-9-1 86-18-1
Federal I.T.T.	K1615 P15		624-0007 D51
GE	6GC1 ET16X10 K115J510-1, 2 K117J460-1, 2 WT16X7	Sylvania	109328 624-0006 624-0007 13-85943-1, 2, 3
Hallicrafters	27C226 027-300-226	Tel-Rad Travler	TRC-P4 SR6 SR13
Hoffman	10031 744002 744006	Truetone Wells-Gardner	SR20 66X21, 25 66X21, 25
International Rectifier	DD04	Westinghouse Workman	296V004H01 SD4
Magnavox Motorola	530093-1 48C751656 48K741255	Zenith	103-20 103-32

Connections



Leads Up

SERIES CONNECTED

MANUFACTURER	PART NO.	MANUFACTURER	PART NO.
Admiral	93A5-2 93B5-3, 4, 5, 6	Olympic Packard Bell	RF5794 72030
Airline	SR15	Silvertone	B-45-110
Citizenship Radio	34-8037		B-48-110 B86-4-1A
Coronado	SR15		D76
Dominion	14-503-01		86-3-1
Electrohome		Sonora	SR15
Emerson	817062 817962	Sylvania Tel-Rad	13-93889 TRC-55
Federal I.T.T.	K1616 P16	Travler	SR10 SR15
GE	6GD1 K118J966-1 WT16X9	Truetone Webcor	SR10 SR15 65P113
International Rectifier	DD05		G9P17741 65P124-1
Magnavox Motorola	5330045-1, 2, 3 48B742698 48K741752 48K742698 48K754153 65K744238	Workman Zenith	SD5 633977

Connections

Leads Up

COMMON ANODE

MANUFACTURER	PART NO.
Federal I.T.T.	K1617 P17
GE	6GX1 118J966-2 WT16X8
International Rectifier	DD06
Motorola	48K751724
Packard Bell	72036
RCA	107268
Workman	SD6

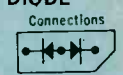
Connections

Leads Up

SPECIAL MOTOROLA SIX CELL DIODE

MANUFACTURER	PART NO.
International Rectifier Motorola	DD07 48C65831A02

Connections



Leads Up

Courtesy International Resistance Co.

Volume Limiting In Communications

Understand basic two-way equipment circuits and make your servicing job easier

by Thomas R. Hasket P. E.

Outercom FM50A.

Aerotron 6N15/SLT rated at 35w.

■ The fundamentals of two-way radio system volume limiting, intelligible speech and typical clipper-filters, were explored in a previous article (ELECTRONIC TECHNICIAN January 1965, page 44). This article analyzes some limiting circuits used in typical equipment presently being serviced in the field.

Automatic Deviation Limiting

Although an FM transmitter can't be overmodulated in the same sense that an AM transmitter can, too much audio *will* produce overswing, or excessive deviation. In VHF/FM two-way communications equipment, for example, ±5kc is the deviation limit. A greater swing will cause receiver distortion because IFs are narrow-banded. More important, FM overmodulation causes adjacent-channel interference which disrupts other services. Hence, the FCC requires new equipment used in VHF low and high bands to contain ADL circuitry. Basically, this means that a clipper-filter is used ahead of the modulator. Circuits used in a number of transmitters will be reviewed here.

The first example covers a number of VHF/FM low and high-band mobile transceivers made by one manufacturer. Various models are used which have 15, 30, 35 and 100-w power inputs. The ADL circuit is shown in Fig. 1. Audio from the microphone is amplified by V201A. The screen of this tube contains a standard FM pre-emphasis circuit (R204 and C204). This produces the desired signal-to-noise ratio for the highs. After passing through V201A, audio goes to the double-diode clipper, CR201/202. Note that the clip-level and speech-gain is fixed. Distortion products generated by the clipper are rolled off by R210 and C208, an integrator in V201B's grid. V201B's clipped audio output feeds through a lowpass filter (C211, L201 and C212). Together with the interstage coupling capacitors, this limits frequency response to a passband extending from 300 to 3000cps. The filter output goes to R217 which sets the transmitter deviation. R217's arm feeds V202B's (phase modulator) grid. Once set, deviation can't exceed the amount determined by R217 (normally ±5kc).

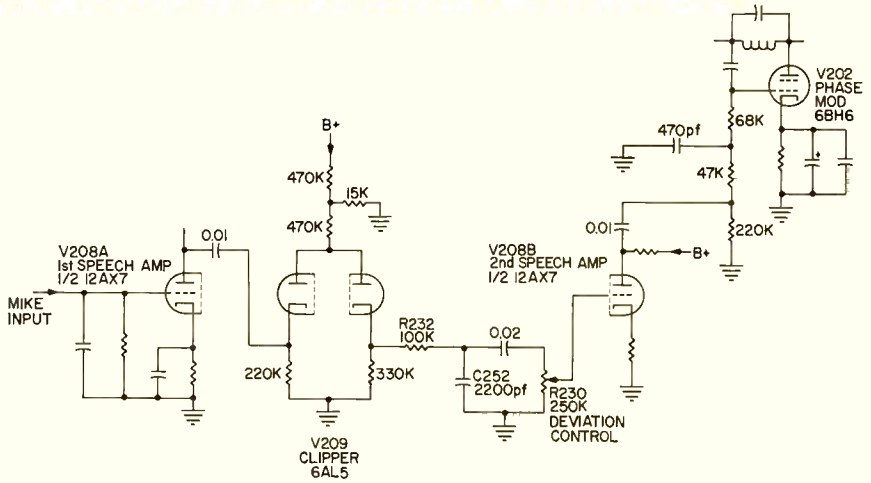


Fig. 2—COMCO's ADL circuit used in the 580/582 series.

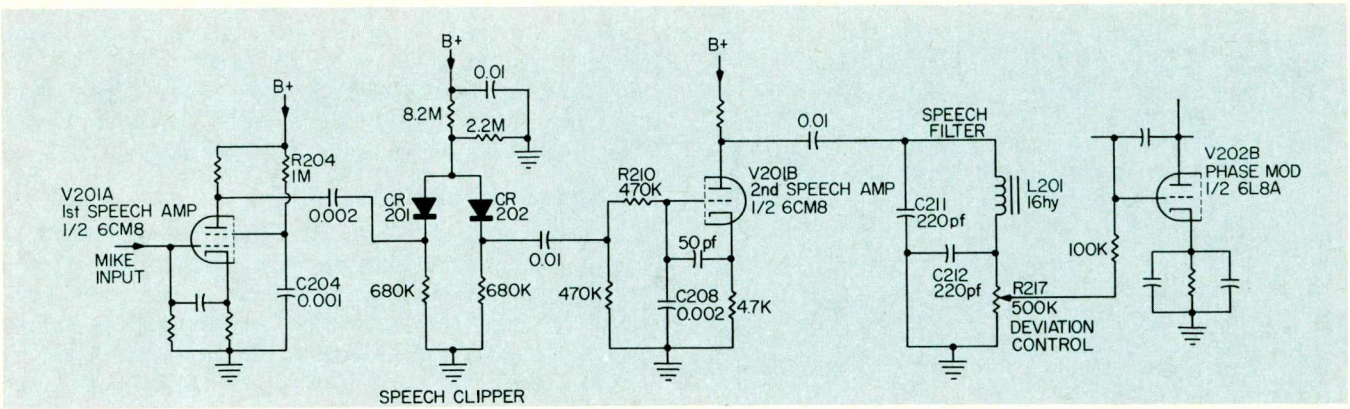


Fig. 1—ADL circuit of Aerotron 7N20/SLT.

Another typical VHF/FM transceiver group for base station, mobile, portable and aircraft work has a power of 25 to 50w for both high and low bands. These units employ ADL similar to the previous sets and the circuity is shown in Fig. 2. The input speech amplifier gain- and clip-level are also fixed. The highs are rolled off by R232 and C252, following the clipper and maximum deviation is set by R230—usually ±5kc.

A second speech amplifier follows the deviation control, driving the grid of V202, the phase modulator. The integrator (R232/C252) and the interstage coupling capacitors shape frequency to the desired 300/-3000cps band. This circuit is basic to all transceivers in this group.

A third group of VHF/FM mobile high-band transceivers have power ratings of 10, 30 and 35w. The ADL circuit, almost identical to the preceding two, is shown in Fig. 3. Semiconductor diodes are used in the clipper stage; audio gain- and clip-level are fixed so deviation doesn't exceed the set value regardless of the input level. R168 and C187 form the integrator, rolling off the highs. L121 and C191 form a low-pass filter in V114B's plate circuit, which, together with the integrator and the interstage coupling capacitors, restrict response to a 300/2500cps range.

Automatic Load Control

It is desirable to maintain the highest possible power output in a single-sideband (SSB) transmitter. Since this is directly produced by the speech signal it would seem that a peak clipper would do the job. Because of phase shift in intermediate RF amplifiers, however, power amplifier RF envelope peaks do not always correspond to audio peaks. Additionally, certain factors (tube aging, frequency changing, etc.) cause the SSB exciter output to vary, thus varying the power amplifier drive. And overdriving the power amplifier causes severe distortion in the transmitted signal.

Automatic load control (ALC) minimizes distortion and maintains a nearly-constant, high drive level on the power amplifier. A simplified ALC circuit is shown in Fig. 4. It will be recognized as a form of compressor, similar to receiver AGC and consists of a feedback loop from output to a preceding RF stage. The power amplifier RF output is developed across capacitive voltage divider C1/C2; C2's portion is rectified by

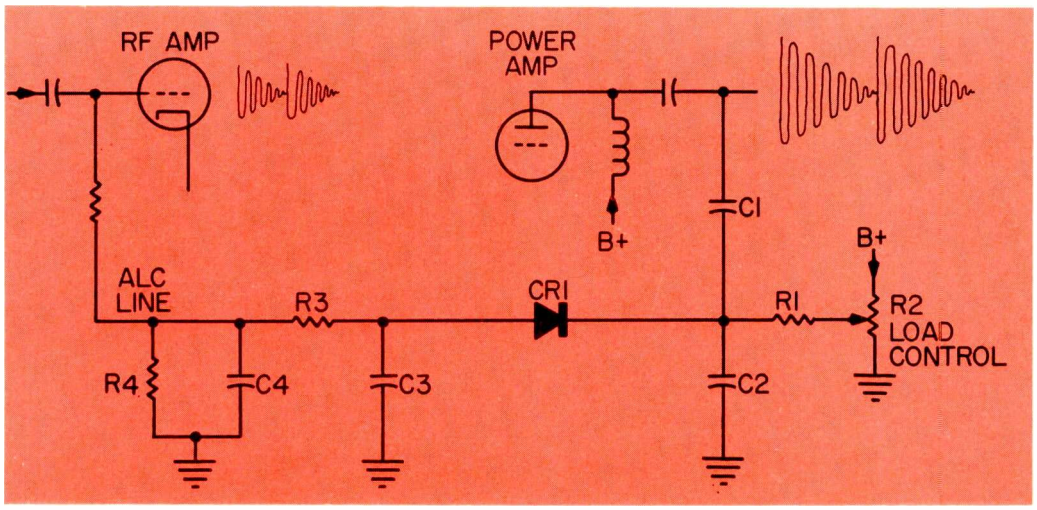


Fig. 4—Basic ALC circuit.

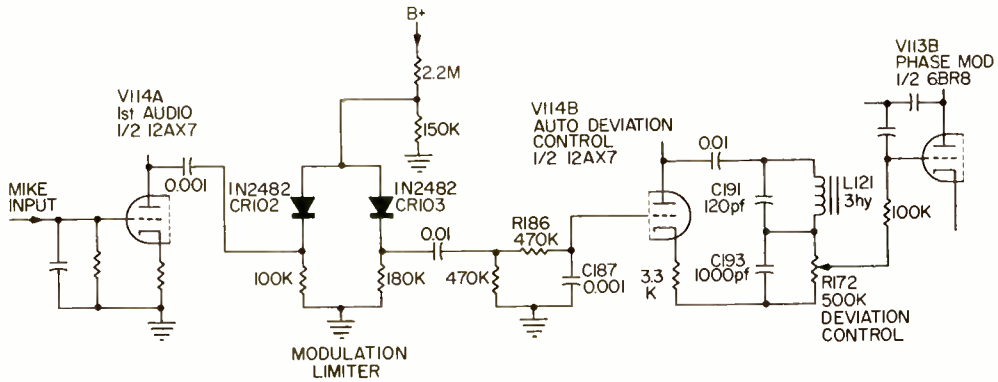


Fig. 3—ADL circuit of the Outercom FM50A.

CR1, producing a negative dc voltage which is filtered by C3 and R3. The charge/discharge time constants are governed by R3, R4, C3 and C4 and the resultant dc is applied to the RF amplifier grid—a remote-cutoff tube—which is ahead of the power amplifier. CR1 is biased by setting R2, the load control. This prevents action until the envelope peaks exceed a predetermined value. At that time, dc applied through the ALC line to the RF amplifier causes a reduction in envelope peaks, thus limiting RF output peaks.

A 150-w commercial SSB transceiver, with a frequency range from 2.5 to 15Mc, employs a single-loop, manually-adjustable ALC circuit (Fig. 5). RF from the power amplifier grid is rectified by V207A, and R265 sets bias on this rectifier to provide gain-correcting voltage only on speech peaks which might otherwise overdrive the power amplifier. The ALC line provides bias on a 6BA6 remote-cutoff stage operating at 455kc—which is used in both receiver and transmitter sections as an IF.

A forthcoming article will cover other limiting circuits, including combined RF/ALC and AF/AGC types. ■

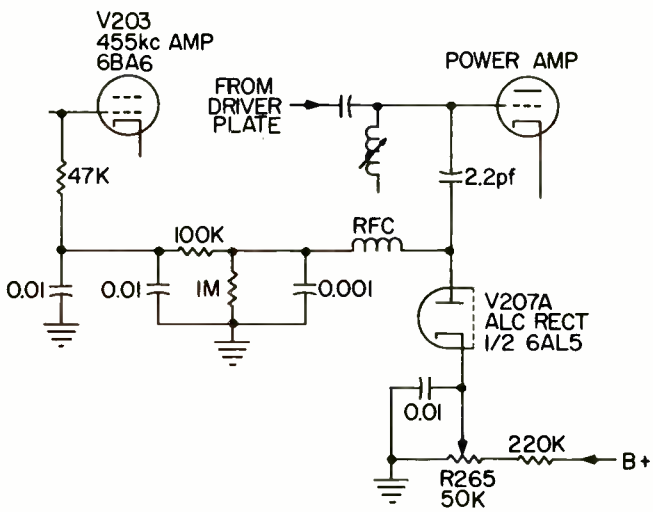


Fig. 5—Aerotron 9S150 ALC circuit.

Give Your 2-Way

Keep the receiver sensitivity at or near the

by Joe Jatis

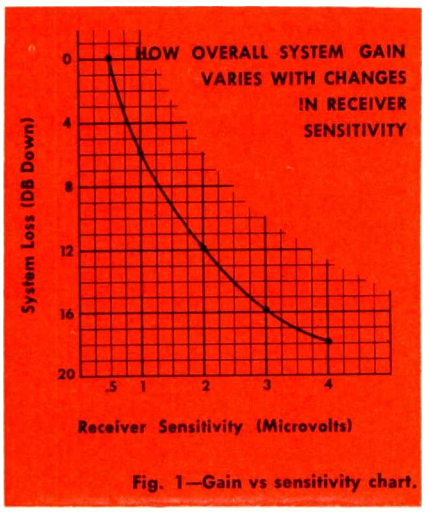


Fig. 1—Gain vs sensitivity chart.

■ A previous article (ELECTRONIC TECHNICIAN January, 1965, page 48) covered the importance of on-frequency operation and proper transmitter deviation. Two other important factors, receiver sensitivity and noise suppression, will be considered here.

Receiver Sensitivity

Receiver sensitivity is commonly expressed in terms of the signal strength required to produce 20db of noise quieting. The figure 20db is used as an Electronics Industries Assn., (EIA) standard for comparison purposes and is generally accepted as a desirable noise reduction for good audio reception.

Receiver sensitivity is a good indication of a receiver's ability to detect signals. In general, the lower the microvolt sensitivity, the better the performance. Keeping the receiver sensitivity at or near the guaranteed specifications level is good maintenance practice and should be part of the radio maintenance program.

The curve plotted in the accompanying diagram (Fig. 1) shows how system gain varies with changes in receiver sensitivity. The figure of 0.5μv is used as a reference point and is plotted as the zero db level for convenience in reading the chart.

From the viewpoint of over-all system performance, the factor of receiver sensitivity is coupled with another important characteristic of radio operation called the "ambient noise level."

Ambient Noise

Ambient noise is an inherent characteristic in all radio operations. It is measured in terms of microvolts of noise, the same as received signals are measured in microvolts of signal strength. For good radio 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 receiver sensitivity.

It can be seen, therefore, that the factors of receiver sensitivity, ambient noise level and signal level are all interrelated. To give your customers the most from their two-way radio systems these factors must be considered together. Notice that ambient noise and signal level will vary from place to place throughout the operating area of a two-way system. Receiver sensitivity, on the other hand, is independent of geography but does vary somewhat from receiver to receiver and varies with time in any given receiver.

Ambient noises from sources other than mobile ignition systems is generally high in cities and low in rural areas. Thus, in giving your customers the most from their systems, it is desirable to make measurements of ambient noise levels at various typical points throughout the operating area. Generally speaking, if the ambient noise is particularly high throughout the entire area, an increase in signal level will be required to override the noise. Usually, however, an operating area includes points of high noise level and points of low noise level. In the typical radio system the ambient noise level is low enough over a wide enough area to justify full attention to keeping receiver sensitivity near the specified value.

Ambient noise originates from a wide variety of sources, both natural and man-made. These sources include a mobile vehicle's electrical system, RF radiated by other transmitters, power lines, electric signs, etc. Ambient noise can be controlled to some extent when it originates within the vehicle. Service manuals include many suggestions for suppressing noise caused by the generator, ignition system, electrical gages, etc. Where the noise level is high, a noise suppression program may be of great benefit.

Various methods have been devised for eliminating ignition noise. Most of these systems, however, have had one serious drawback:

Customers A Break!

guaranteed specifications level for best results

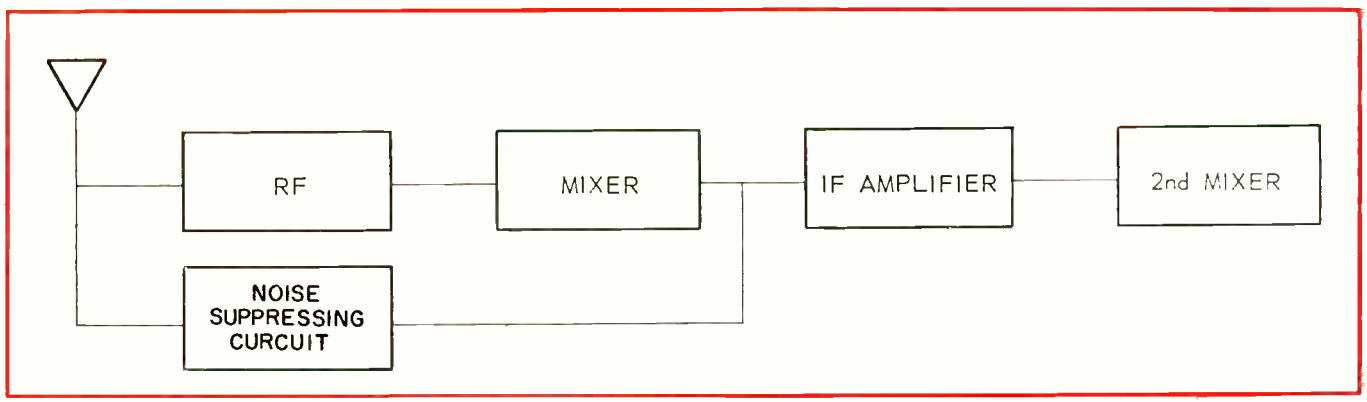


Fig 2—Effective noise suppression is obtained by placing a high speed blanking circuit as near the antenna as possible.

they reduce the ignition noise generated within individual vehicles only. They have no effect on outside interference.

To effectively eliminate noise, a special approach is necessary. To understand why this is so, a basic knowledge of the nature of ignition "noise" is necessary.

Ignition Noise

When a spark plug fires, it produces a short burst of RF energy. Since this RF energy contains components that extend throughout the frequency spectrum, some interference will enter the receiver, regardless of the specific frequency to which the radio is tuned. A plot of interference amplitude vs frequency gets higher, however. Interference is highest in the 25-50Mc band. It is much less bothersome in the 150-174Mc and 450-470Mc bands.

Ignition noise pulses have an extremely short duration when they enter the receiver antenna. But, as these pulses pass through the receiver, they are progressively broadened by the tuned circuits. Therefore, effective noise suppression must take place as close to the antenna as possible. Additionally, the suppressor circuit must be fast-acting, so the receiver is cut off only for a few microseconds during noise pulses, and then immediately opened to the incoming modulated signal. This all important high speed characteristic is the key to an effective noise suppression system.

Noise pulses, together with the desired RF signal, enter the receiver through the antenna. The signal and the noise are delayed while the suppressing action begins. Simultaneously the interference travels through the noise suppressing module (See Fig. 2).

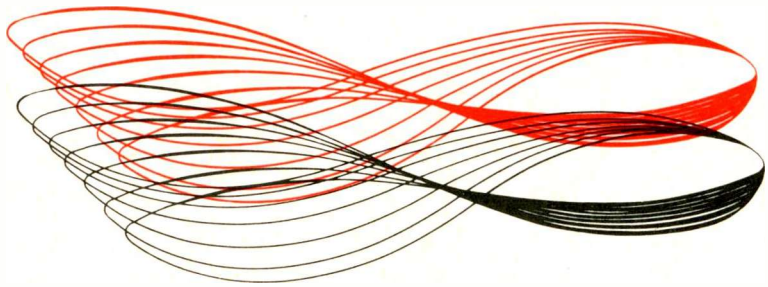
Here noise pulses are detected, acted upon and used to bias a part of the receiver to cutoff at the precise time the noise pulses in the normal signal path attempt to enter this stage.

Its high speed response enables the circuit to effectively blank out tens of thousands of noise pulses per second with no effect on the radio message being received. In an area of heavy mobile traffic, for example, the circuit is able to eliminate the interference from scores of vehicles in the immediate vicinity—even when traffic is moving at 50 and 60 miles per hour.

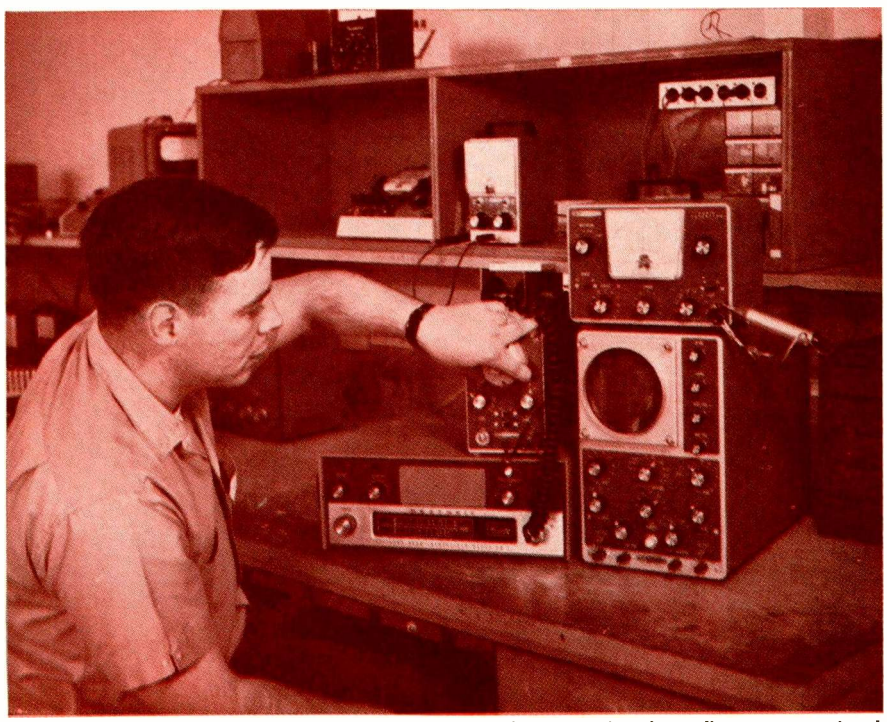
Checking Receiver Sensitivity

Most service manuals include full details for checking receiver sensitivity. This is done by injecting an unmodulated signal into the receiver and the signal strength is increased until a drop of 20db occurs in the speaker noise level. This requires a signal generator which has a calibrated output control that indicates the signal strength for any given control setting. Thus, a sensitivity rating of 1μv means that a 1μv signal reduces noise by 20db and would provide

Continued on page 99



Modify your old narrow band scope



Typical bench set up using the audio generator, signal tracer and modified scope. *Photo and diagrams Courtesy Heath Co.*

■ You can check out the complete modulation system of CB transceivers without disassembling the transceiver. This can be done with standard test equipment now used in most TV-radio service shops.

You can perform complete modulation checks, including the microphone, microphone preamp, audio amp and the modulator output stage. A general purpose scope can be easily rearranged to provide a visual indication of the RF signal at the transceiver output. Your audio generator can give a stable frequency, variable level audio signal that can be fed into a signal tracer to produce an audible tone at its speaker. By placing the microphone in front of the speaker, and depressing the microphone switch, you can tone-modulate the transceiver's RF output. The tone amplitude can be controlled by the signal tracer's audio gain control.

Scope Alteration

Because of the limited frequency response of vertical amplifiers in many older scopes, they require a small modification to perform this work. This modification bypasses the vertical amplifier stages and connects the CB RF signal directly to the CRT's vertical deflection plates. These changes will not interfere with nomal operation of your scope.

This simple modification is an overall approach and will suffice for most older general purpose scopes and of course is not necessary on modern wide-band scopes.

Remove the scope cabinet so you can cut a small hole in the

Checking CB Modulation

by Clarence Lee Thomas

to troubleshoot this 2-way equipment

rear for a slide switch and two banana jacks.

Install a bracket for mounting the slide switch and banana jacks near the CRT base. It must be mounted close to the CRT base so the leads can be kept short.

Connect a 1M resistor from the center of each switch section to one end as shown in Fig. 1 (also see the schematic in Fig. 2). Disconnect the parallel choke-resistor combination or separate resistors and chokes, as the case may be in your particular scope, from both vertical deflection plates, pins 6 and 7, and connect them to the end lugs of the switch with the 1M resistors.

Connect a 0.001μf capacitor from each lug on the other end of the switch to the banana jacks. Connect a short piece of hookup wire from the center lug of each switch section to the vertical deflection plates (pins 6 and 7) of the CRT.

This completes the scope modification. Re-install the cabinet so the hole in the rear lines up with the switch and banana jacks.

The next step is to construct a 50Ω RF input cable and a pickup loop to sample a portion of the transceiver's output signal. This cable can be made from a section of RG58 shielded cable. Install a plug on one end, to be connected to the CB transceiver output. Phono plugs and auto-radio type plugs are the most common types used here.

The other end of this input cable (center conductor) is connected

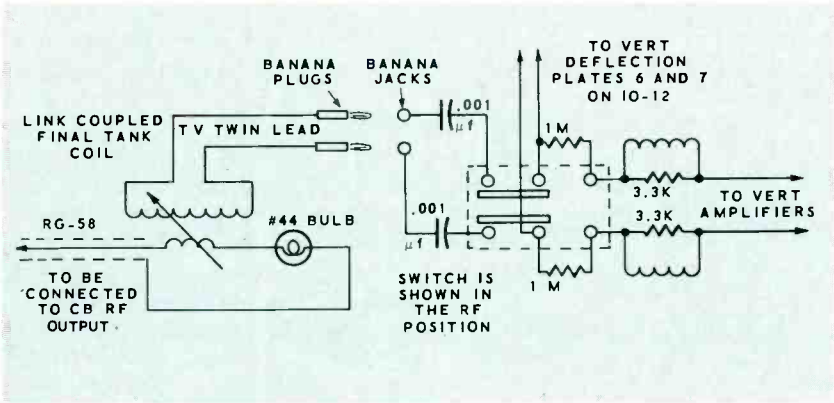


Fig. 2—Complete diagram of modification.

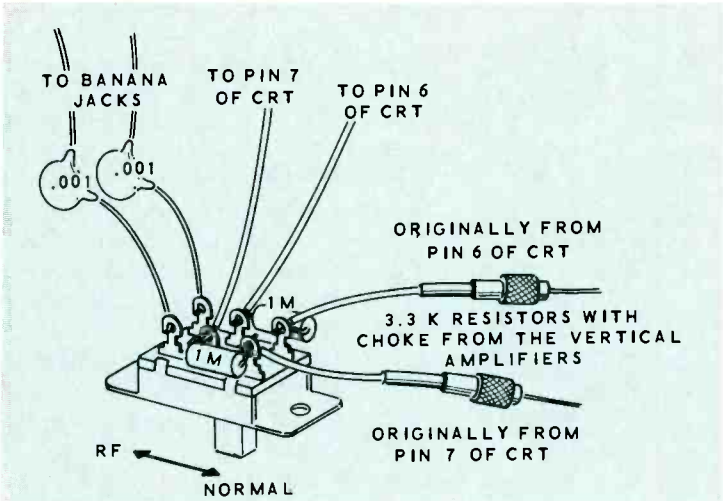
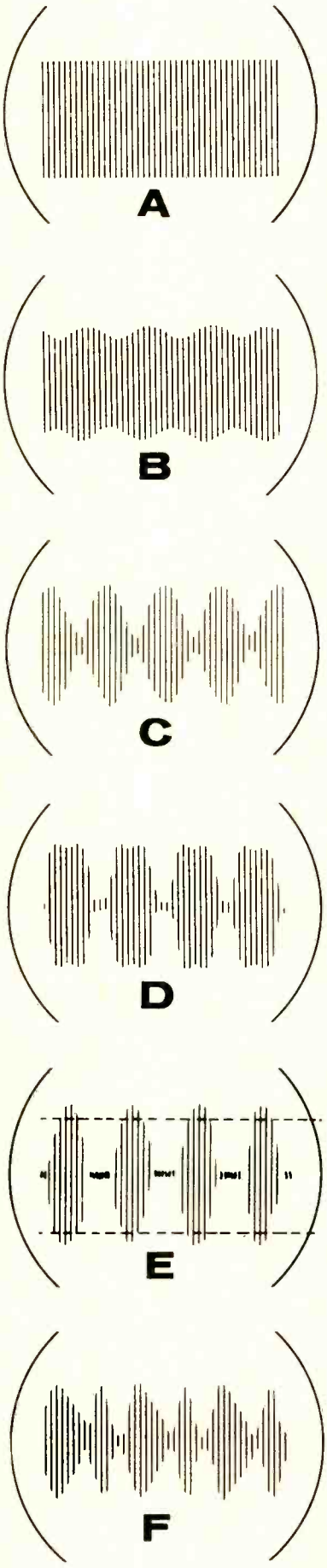


Fig. 1—Diagram for making component connections to slide switch.



to the end of the secondary winding (winding with the least number of turns) of a small link coupled "amateur type" doubler or CB transmitter final tank coil. The other end of the secondary winding is connected to the insulated end of a bayonet-type lamp socket. The other side of the socket is then connected to the shield on the RG58 coax. To the primary winding (the side with the most turns), connect a length of TV twin lead. At the end of this twin lead install banana plugs to both conductors. These banana plugs will then be plugged into the banana jacks you added to your scope. Now install a number 44 lamp in the bayonet socket. You are now ready to begin work.

Doing The Job

While becoming familiar with this equipment and procedure, it would probably be best to use a properly operating CB transceiver.

Switch on your scope, audio oscillator, signal tracer and CB transceiver and let them warm up. Place the audio oscillator and signal tracer on standby. Set the audio oscillator at lkc.

Connect the 50Ω input cable to the CB transceiver output, and connect the other end to your scope and flip the switch on the rear of the scope to the RF position. Turn the scope's vertical gain control fully counter-clock-wise (CCW). Adjust the vertical and horizontal position controls for a straight line centered on the scope face. Adjust the intensity and focus controls for a bright and sharp horizontal line.

Depress the microphone switch. The bulb should light. You should also get an RF indication on the scope similar to that shown in Fig. 3A.

Activate the audio oscillator and feed a signal into the signal tracer input. Adjust the gain on the signal tracer with one hand while holding the microphone in front of the speaker with the other. Adjust the scope to show about four to ten complete cycles of the modulation envelope (Fig. 3C).

By gradually turning the audio gain on the tracer up until flattening appears, the clipping point may be seen. Also the percentage of modulation may be determined (Fig. 3C, D, E, and F).

Set the modulation level on the scope to between 40 and 70 percent by adjusting the audio gain control on the signal tracer. The envelope pattern should be sinusoidal. If it isn't, then you should suspect that the modulating circuits are causing distortion. This distortion may be caused by a bad microphone, weak or gassy tubes, open by-pass capacitors, or any number of components in the audio stages.

Kill the audio oscillator signal to the signal-tracer input. Depress the microphone switch and talk into the microphone. You can now see the average voice modulation level on the scope. If the CB unit has a compression amplifier, the amplifier gain may be adjusted to give the desired average modulation level (70 to 85 percent).

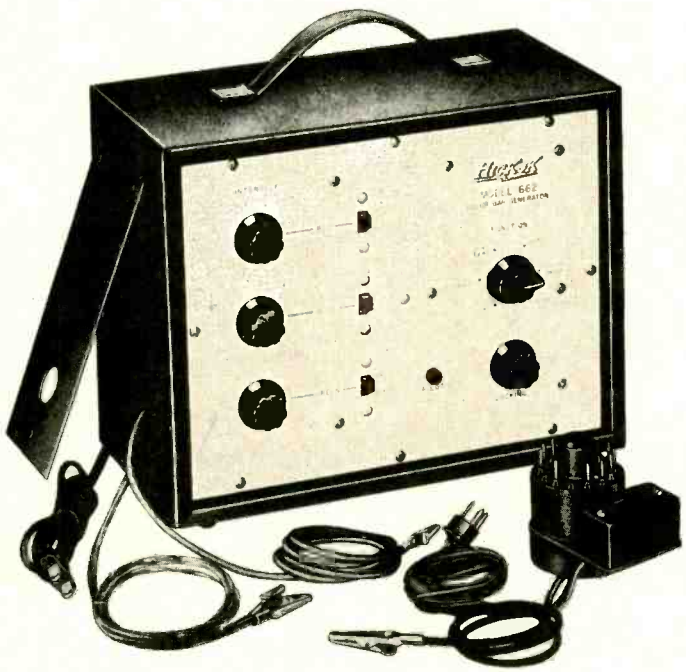
With no tone input, or voice modulation, the scope pattern should look like the unmodulated RF pattern shown in Fig. 3A. If some modulation does appear (Fig. 3B) then the RF signal is probably being modulated by hum, vibrator hash, microphonic tubes, or an oscillation in the audio stages or microphone preamp stage. Quite often on sets using electronic switching the trouble can be traced to dirty microphone switch contacts or a defective microphone cord.

Remember, with the added scope switch in the normal position (See Fig. 2) the scope is restored to its original operating condition. ■

Fig. 3 (A)—Pure CW carrier, no modulation, hash or hum present. (B)—CW with no tone input. The ripples indicate vibrator hash or hum modulating the RF. (C)—Tone modulated AM nearly 100 percent modulated, excellent waveform. (D)—Tone modulated AM. Overdriven modulator incapable of 100 percent modulation. May also result from deliberately 'clipped' audio not properly filtered. (E)—Tone modulated AM. Modulator output more than ample. Modulation in excess of 100 percent in both directions. (E)—Tone modulated AM. Severe distortion in audio modulator system.

Hickok Model 662 Color Generator

Functions, controls, signals and circuit description



Hickok Model 662 Color Generator

■ This instrument generates a single horizontal color reference bar at the exact color burst frequency of 3.579545Mc (crystal controlled). In addition to this color signal, horizontal and vertical bars, dots and a crosshatch pattern are available at the output of the generator.

An important feature of the unit is the gun killer incorporated in the generator. The gun killer is connected so a variety of tests can be performed on the CRT including cutoff and leakage tests of each gun and relative emission tests on each gun. The individual R-Y, B-Y and G-Y signals can also be viewed on the picture tube.

The dot, bar and crosshatch signals are fed directly to the CRT of the set under test. These signals are based on a 500 dot system with a 5:4 ratio. The generator is designed for use on sets employing a 21 in. round CRT but as the CRT assembly plugs in, an available adaptor can be connected for rectangular type tubes.

Circuit Functions

The 15,750cps pulse for synchronizing the generator is obtained by capacitive coupling to one of the leads to the deflection yoke of the receiver. This is done by twisting the pickup lead from the unit around the yoke lead.

The bar and dot signals are developed by two oscillators, one operating at 441kc and the other at 630cps. These oscillators are locked to the incoming retrace pulse from the TV set.

The incoming retrace pulse is applied to V1A, which is connected as a diode clipper. Because the effective coupling capacitance to the TV receiver yoke lead is small in value, R1 is placed in series with the coupling lead to prevent severe differentiation of the incoming pulse. The clipped, positive-going retrace pulse is applied to the grid of sync splitter, V1B. The sync splitter clips and amplifies this pulse, producing a negative-going pulse at the plate and a positive going pulse at the cathode. The negative pulse from the plate is used to trigger the unijunction transistor, Q1, through network R16, C8.

The unijunction transistor, Q1, functions as a 630cps relaxation os-

cillator. Capacitor C7, connected between the emitter and ground charges through resistors R13 and R14. When the voltage across C7 reaches approximately 60 percent of the voltage at B2, the transistor fires. Capacitor C7 discharges to ground through the emitter-base 1 junction. The current through base 2-base 1 increases sharply, producing a negative-going pulse across the base 2 load resistor R15. The width of this pulse can be adjusted by R17, which is in series with base 1 and ground and thus affects the discharge time of the capacitor. When the capacitor has discharged the transistor switches off and the cycle is then repeated. The frequency of oscillation is determined mainly by the RC combination of C7, R13 and R14. The locking control R14, is used to adjust the frequency to 630cps, which is 1/25 of 15,750cps. The oscillator is locked to the incoming sync pulse from the plate of the sync splitter V1B.

The negative-going pulse from base 2 of Q1 is coupled to V3B where it is clipped and amplified. The positive-going pulse from the plate of V3B is then coupled to inverter, V4A. The inverter, V4A, inverts, amplifies and clips the pulse.

The horizontal bar pulse is approximately 40v in amplitude. From V4A it is then coupled to the cathode of the color CRT through switch S1 and the CRT adapter assembly.

The sync pulse from the cathode of V1B drives the ringing coil, 11, which is tuned to 441kc. This produces damped 441kc oscillations which are reinforced and amplified by V4B.

The amplified pulses at the plate of V4B are sharpened by the peaking circuits consisting of R25, R29, C20 and L2 and L3. They are then coupled through C21, S1 and CRT adapter assembly to the cathode of the color CRT.

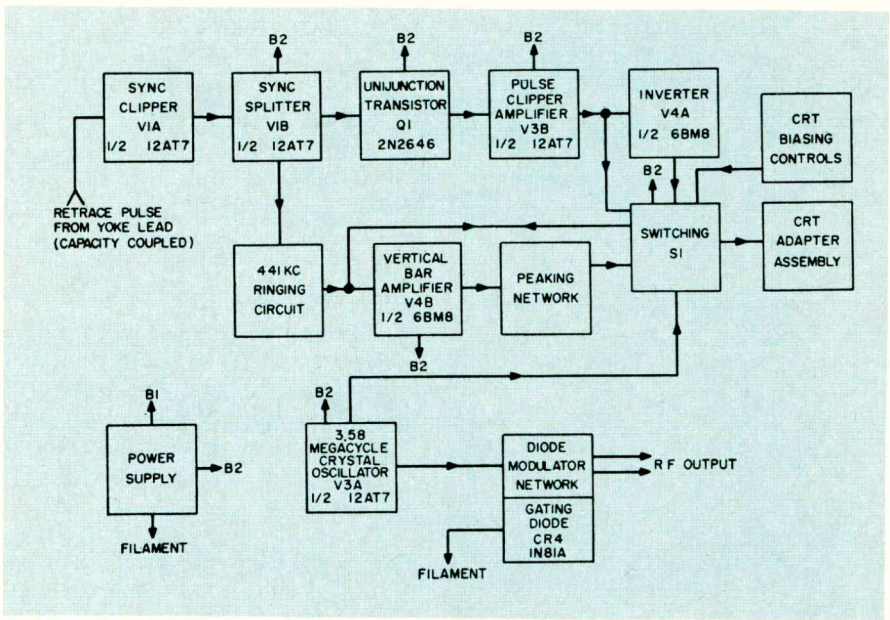
Since the 441kc ringing oscillator is synced to the 15,750cps retrace pulse, the vertical bar pulses are locked so as to produce a stationary pattern on the television screen.

The vertical bar oscillator amplifier operates as before except that its grid leak resistor, R26, is returned to the grid of inverter, V4A, through switch S1. The positive-going 630cps pulse from the plate of V3B is coupled to this grid through C10. The grid and cathode of V4A form a diode, clamping the tip of the positive-going pulse to ground level. Capacitor C10 charges through this diode developing a negative bias at the grid of V4A which cuts off V4B through B26 except during the 630cps pulses. The output of V4B therefore consists of bursts of 441kc pulses. These bursts occur at a rate of 630cps. The bursts are coupled to the cathodes of the color CRT as before and produce a stationary pattern of dots on the face of the CRT.

The 630cps pulses and the 441kc pulses are mixed in network R29, L3, R21, and C11. The mixed pulses are coupled to the cathode of the color CRT as before, producing simultaneous horizontal and vertical bars, or a crosshatch pat-

Color Generator...

Block diagram Model 662 Generator



tern on the face of the CRT. To eliminate bright dots at the intersection of the horizontal and vertical bars, a portion of the negative-going horizontal bar pulse is coupled through switch S1 and attenuator R30-R31 to grid leak resistor, R26, thus cutting off the vertical bar pulse amplifier, V4B, during the horizontal bar pulse time.

The frequency of the crystal oscillator, V3A, is controlled by crystal CR2, which is adjusted to operate at 3.579545Mc. A portion of the output of the oscillator is coupled through C28 to diode CR3.

The RF cable is connected to the television antenna. The TV station carrier signal received by the antenna is coupled into CR3 where it is modulated by the 3.579545Mc signal from the crystal oscillator The resultant signal is connected to the antenna terminals of the TV receiver and is interpreted by the TV receiver as a standard TV signal modulated with a 3.579545Mc color sub-carrier. This color sub-carrier modulation passes through the TV receiver RF, IF circuits and is then detected and amplified by the TV receiver color circuits. Since this subcarrier signal acts as both a "burst" and a color signal, the receiver will interpret this as a color signal at burst phase and will produce a yellowish green color on the face of the CRT, when the color circuits are properly phased.

The 60cps ac from the filament supply is rectified by CR4 to produce a positive pulse. This positive pulse is then applied to the cathode of CR3 through network R39, R40. CR3 is therefore gated off for one-half of each of the 60cps. Since the vertical field rate in the TV receiver is 60cps, the color signal will appear during one-half of the vertical field.

The CRT bias controls provide a means by which the intensity of the red, blue, and green screens can be independently controlled. The operation of these controls is as follows:

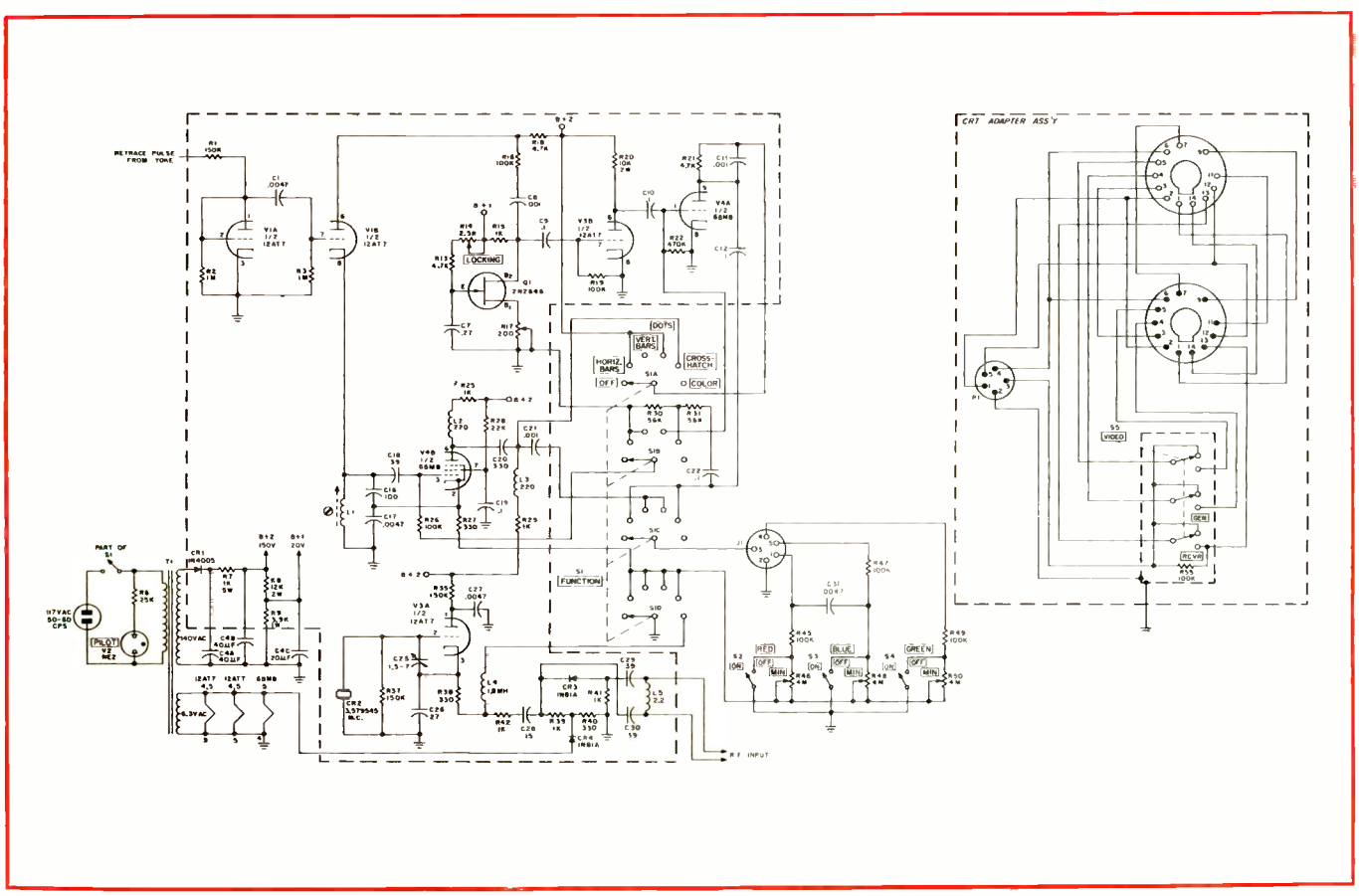
The grid of the red gun in the CRT is connected through limiting resistor R45 to variable resistor R46 and switch S2. As the resistance of R46 is reduced, a portion of the positive bias normally present on the CRT grid is shunted to ground through R45 and R46. This makes the grid more negative with respect to the cathode, thus reducing the brightness of the red screen. When switch S2 is closed the red gun grid is grounded through R45 and this "kills" the operation of the red gun completely. The blue and green CRT biasing controls function in the same manner.

The CRT adapter assembly provides a method of connecting either receiver or generator video information to the picture tube.

Pins 4, 5, and 13 of the adapter plugs are connected to switch S5. In the GEN position of the switch, the cathodes of the CRT are connected directly to the TV receiver.

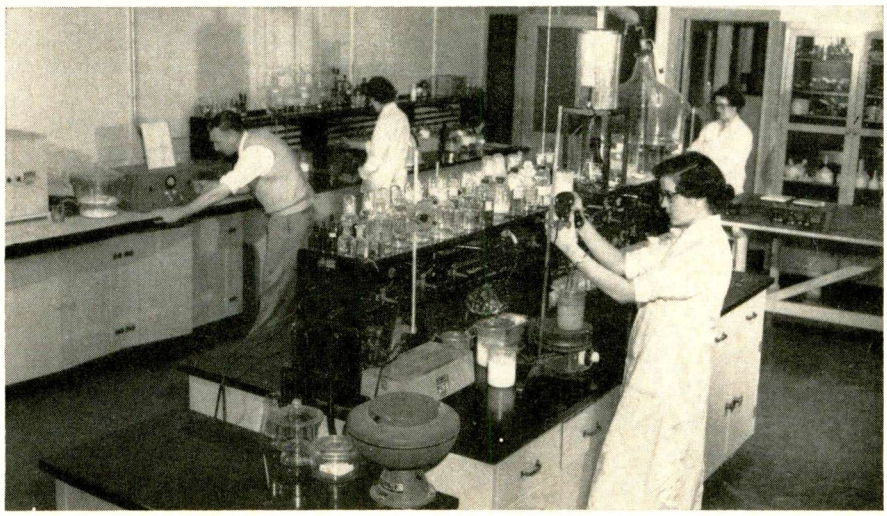
Resistor R55 is placed in series with pin 3 of connector P2 and Pin 13 of the adapter plug. It provides a dc bias path for the CRT cathodes when S5 is in the GEN position. ■

Schematic of Hickok 662



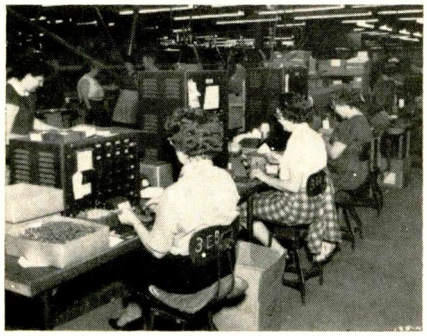
CERAMICS--
THE NEW SHAPE OF CAPACITANCE

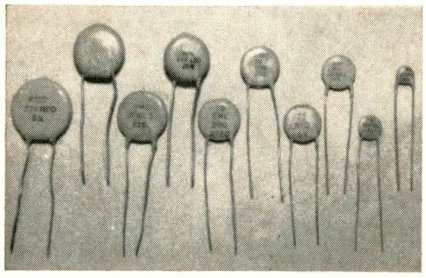
by C. G. Cunningham, P. E.



Ceramic capacitors begin in the chemical laboratory. All ceramic capacitor manufacturers maintain complete laboratories to formulate the ceramic compounds that determine the final capacitor characteristics.

Testing ceramic tubulars.





RMC ceramic capacitors

■ Semiconductor and other sensational new component developments have obscured the revolution taking place in some other electronic component areas. One important example is the ceramic capacitor. Sure, most of us knew they were around, but the breadth of their application and versatility has been an almost unnoticed subtle change.

The very appearance of electronics has changed and ceramic capacitors are greatly responsible. Not only has printed circuitry moved the bottom of the chassis to the top, but the most obvious component, the "paper" capacitor, appears to be diminishing. In its place are small discs and tube-shaped ceramic capacitors. And this is only the beginning.

Already, according to one authority, more ceramic capacitors are now being used in consumer products than any other kind.

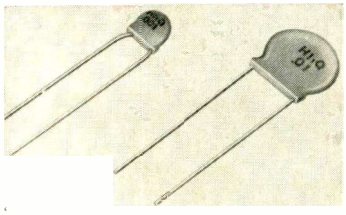
Capacitor Basics

The function of a capacitor—to store electricity—remains the same regardless of how it's made. And, just to confuse matters, all capacitors have the same basic design. They are all variations of two conducting plates separated by insulating material—the dielectric. Different designs result from the following phenomonea governing the behavior of capacitors:

1. Capacitance increases as the area of the plates increases.
2. Capacitance decreases as the distance between the plates increases.
3. Capacitance increases as the constant of the dielectric material increases.

All capacitors, except ceramics, usually apply the first two factors to achieve different components. The plates were long, thin sheets and the whole thing was rolled up to make the familiar tubular capacitor. The electrolytic capacitor obtained its high capacitance by putting the plates extremely close together. This was possible because of the high strength of the oxide film that

The next generation of electronics technicians will shake their heads in tolerant amusement at the brute force methods used to obtain today's 'standard' components



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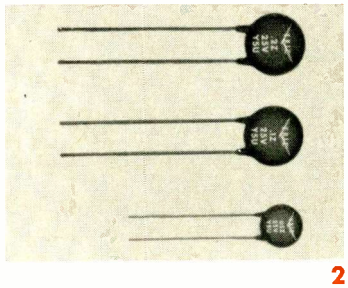

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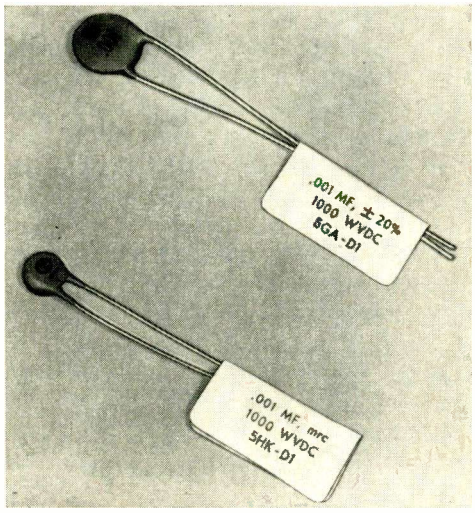

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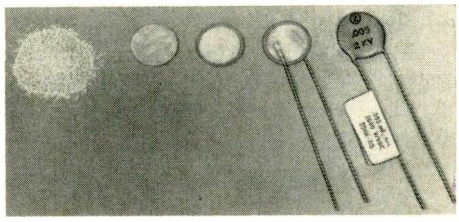
1. Aerovox ceramics.
2. Ceramics by Erie Technological Products.
3. Two capacitors with the same rating. The one at top has a lower dielectric constant ceramic. The component at the top is a general use component with a 20 percent tolerance. The smaller capacitor has a minimum rated capacity (MRC).
4. Steps in manufacturing a ceramic capacitor. Ceramic powder is sintered into discs, electrodes are silvered onto opposite sides and leads are soldered on. The entire assembly is then coated with a tough insulating covering.



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was formed on the plates electrically.

Many rating factors apply to a capacitor besides capacitance and voltage. These relate to losses, accuracy and stability. They all depend chiefly on the characteristics of the dielectric.

Various dielectrics have a number of surprising characteristics. For instance, the losses in the dielectric may be higher at dc than at high frequencies or vice-versa. They sometimes exhibit hysterisis—usually associated with iron cores. They are beset with numerous instabilities and most of them change characteristics. For example, change with temperature. They often show a temperature hysterisis by failing to return to the same value after heating and then cooling. The strangest characteristic, common to all solid dielectrics, is dielectric absorption. This is the tendency of the dielectric to absorb some energy in a manner that prevents quick release. This is observed when the voltage across an open circuit capacitor begins to build up from no apparent source.

The Nature of Ceramics

Ceramic capacitors depend on the third factor that affects capacitance—dielectric constant. Dielectric constant is a characteristic of the atomic structure of the insulating material. It is the ability of this structure to store energy. Ceramics can be made that have dielectric constants more than 1000 times greater than the best previously used materials. Additionally, they have great insulating strength and, thus, can stand high voltages. The result, a capacitor as much as 1000 times smaller than the same component made another way.

Hence, an important characteristic of a ceramic dielectric is its dielectric constant. This can range from 10 to 10,000. At present, certain widely different characteristics seem to go with a given dielectric constant range. High dielectric constant material, for example, displays the greatest hysterisis effect. Hence, when the dielectric constant is selected many other general characteristics are set.

Know Your Ceramic Types

Ceramic dielectrics are made in three different ranges: low, medium and high. From these, four different capacitor classes are made.

Capacitors having the lowest dielectric-constant ceramic also have extremely low losses and excellent stability. They perform well at HF and at high temperatures. Capacitance change with temperature is small. Insulation resistance is extremely high and units are usually rated at 1000vdc plus ac peak, the dc unit is usually rated at 1000vdc plus ac peak—the dc working voltage (wvdc). They are available from 3 pf to 0.01μf with a tolerance of 10 percent.

If ceramic material having a slightly higher dielectric constant is used, an extremely useful component results. It has all the advantages of a lower dielectric constant material plus a known rate of capaci-

tance change with temperature. This temperature coefficient can be either positive, negative, or zero. This means the capacitance increases, decreases, or remains the same when the temperature is raised. These components are indispensable for stabilizing tune circuits—local oscillators in TV and FM receiver, for example. The voltage rating is usually 1000wvdc and the capacitor is available from 1pf to 700 pf with a tolerance of 5 percent.

Capacitors ranging from 1.5 pf to 0.15μf are obtained if ceramic with fairly high dielectric constants —from 200 to 2000—are used. Components of this type are useful for many purposes: coupling, bypassing, filtering, decoupling and many others They are not satisfactory, however, for tuned circuits, timing applications or frequency compensation. This is because the capacitance of these units changes greatly with temperature and exhibits other rather large instabilities. For many applications, including those previously mentioned, this is not important and a capacitor that remains within 20 percent of its nominal value is perfectly adequate. These general-application capacitors are rated from 300 to 6000wvdc. Tolerance on the rated capacitance is 20 percent for a given range of temperatures. It is important not to exceed this temperature range because a few degrees beyond the range may result in a capacitance change of 100 percent or more.

Extremely high dielectric constant values—3000 to 10,000—yield a high-capacitance component in a small package. Because of its many instabilities and high losses it is suitable only for non-critical applications—filtering, bypassing and in some cases coupling—for example.

Because of the great temperature sensitivity of this ceramic type, components made from it are usually rated in terms of guaranteed minimum value (GMV) or minimum rated capacity (MRC). That is, the capacitance never goes below rated value, but may go much above it.

Capacitors of this type show hysterisis much like an iron core. For this reason, they are not suitable for large ac signals because of distortion and losses from hysterisis. This group also shows changes in capacitance with applied dc bias and other peculiarities. Despite these disadvantages it has wide application in non-critical circuits. Its insulation resistance is very high and it is available from 0.001μf to 0.1μf at 1000wvdc.

Composite ceramic components are also available. These range from a "universal" capacitor that can be used to yield 12 different capacitance values and multiple section units with a common ground point, to printed circuit resistor/capacitor combinations useful for TV vertical integrators and other applications.

Application Notes

Ceramic, with its high insulating strength, is an ideal material for high voltage applications. For this reason it is substituting for mica and other types in transmitter applications. They have practically

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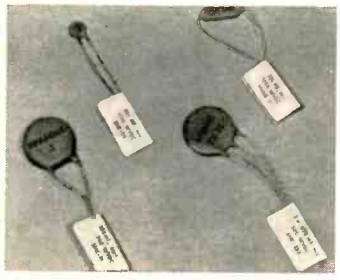

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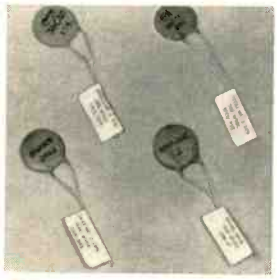

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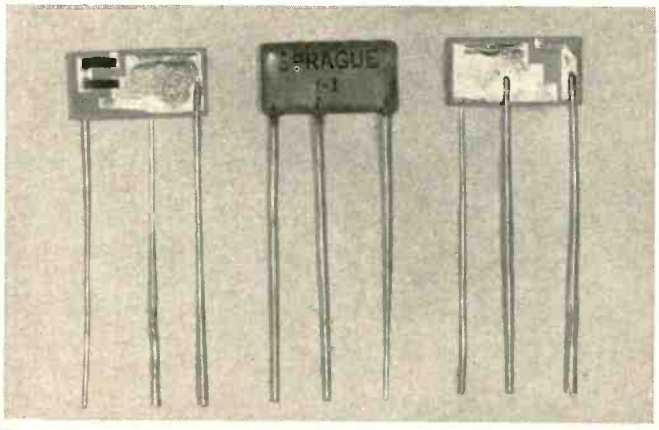

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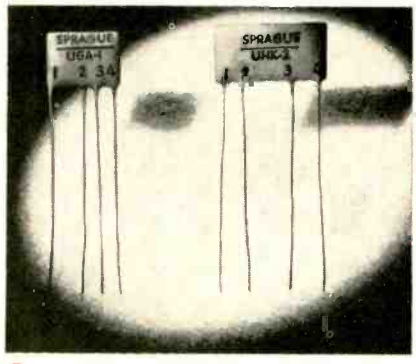


5

1. High dielectric constant capacitors pack a lot of capacitance in a small package. Unit at lower right is a dual with common electrode. All are minimum rated capacitance. (MRC). By Sprague.

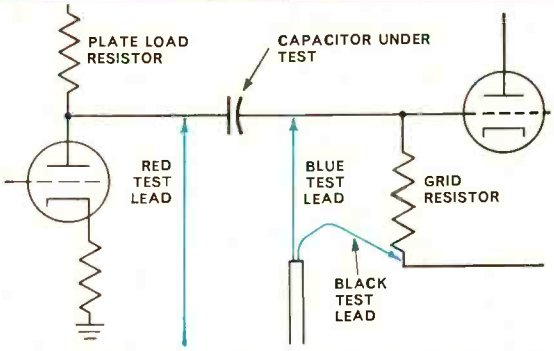
2. Four capacitors with the same physical size but different values of capacitance. Other characteristics are different, too. The components at the top are for temperature compensation. The one at the lower left is for general applications, including coupling. The 0.1μf is for non-critical uses as in filtering and bypassing.

3. Composite circuits are produced on ceramic bodies. This is a complete RC network for a TV vertical integrator.

4. Ceramic capacitor by Arco Electronics.

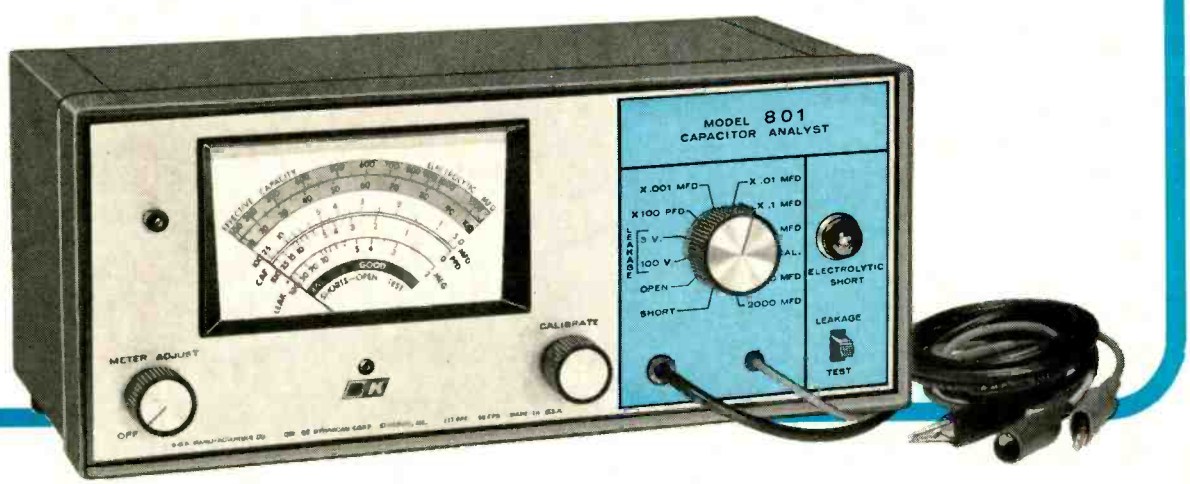
5. A 'universal' capacitor. Twelve different values are obtained by different lead connections: By Sprague.

locate defective capacitors in-circuit



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

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



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

Leakage can be determined in-circuit. The unique B & K 3-lead method permits a degree of accuracy not possible with any 2-lead tester. For normal circuits defective capacitors can be located immediately.

Open capacitors with values as low as 25 pF are easily located with the sensitive high-frequency-signal and resonant-¼-wave-transmission-line method.

Electrolytic capacitors are tested with a circuit that accurately measures their effective capacitance. Their inherent characteristics of variable equivalent series resistance and internal parallel resistance are automatically accounted for. Only one capacitor lead need be disconnected. The capacitor is charged and then discharged under load. High peak load currents up to 2 amperes ensure testing to in-circuit conditions. Unlike with other testers, capacitor can not be deformed by a reverse polarity voltage. The actual power transferred to a load is measured and the capacitance is read directly from the meter scale for immediate replacement decisions.

All these tests and short tests too are performed with the one set of test leads which is included with the instrument.

Here's the capacitor analyst that really works: B&K Model 801 quickly pays for itself with reduced shop time. Net $109.95

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G-E "CB" Tint and 3.58Mc Alignment

In performing 3.58Mc subcarrier alignment on General Electric "CB" chassis, it is very important that each coil or transformer is tuned to the proper peak as indicated on the meter connected to Test Point 701.

As the core in each coil or transformer is adjusted, two definite peaks (dips for T704) will be seen on the meter. Tune the coils and transformers as follows:

1. For T702 crystal filter and L705 crystal tuning, turn the core counterclockwise to the top of the shield can. Now rotate the core clockwise towards the chassis and the meter indication will increase to the first peak. If the clockwise rotation of the core is continued, the meter indication will drop slightly and then increase to a second peak. The first peak is the correct tuning point.
2. For T703, the R-Y transformer, turn the core clockwise towards the circuit board and the bottom of the shield can. Now rotate the core counterclockwise until the meter indicates the first peak which is the correct one. Again, further adjustment in the same direction will indicate a second peak which is the incorrect one.
3. For T704, the B-Y transformer, rotate the core clockwise to the bottom of the shield can. Now rotate the core counterclockwise until a point of minimum voltage (dip) is indicated on the meter. If the counter clockwise rotation of the core is continued, the meter indication will rise slightly and then decrease to a second dip. The first dip from the bottom of the shield can is the correct tuning point.

In multi-channel areas a condition may exist, because of transmission difficulties, where the 3.58Mc burst phase of a particular station has been shifted sufficiently so that normal flesh tones are not attained. This would occur, of course, with the TINT control places at the end of its range for the nearest approach to correct fleshtones.

Using a hypothetical example of a three-channel area, the following conditions might exist.

One channel — Flesh tones at center of TINT control range. **Second channel** — Flesh tones ± 10 deg from center. **Third channel** — TINT control at end of range and flesh tones not attained. (flesh tones either green or magenta).

The cure for this condition would be to correctly tune in the third channel and preset the TINT control about ten deg in from the end of the control range which is nearest to flesh tones (turning toward the center of the range). Leave the TINT control in this position and realign the 3.58 Mc subcarrier channel using the offending station signal as a signal source. After realignment it should be possible to get correct flesh tones within the range of the TINT control for all of the above channels. Similar adjustments can be made if you have multi-channel peculiarities in your area.

The TINT control in the 21 in. and 25 in. "CB" Chassis was changed from a capacitor (C125) to a potentiometer (R165) beginning with chassis stamped "EN106." C720 (24pf) was also deleted at this time. (See Fig. 1.)

A special semiconductor diode (CR710) which, when reverse biased, acts like a capacitor. If the reverse bias applied to the diode is changed, the capacity of the diode will change. CR710 has a capacity range of approximately 5pf to 25pf when the applied reverse bias is changed from +90v to +2v. The capacitance is low when the voltage is high and vice versa. The function of the new TINT control R165 is to produce the change in voltage to vary the capacity of the diode CR710.

A voltage divider between B+270v and ground is formed by R726, R165 and R166, B+ is connected to the cathode of CR710 through R725. CR710 is connected to L705 and the grid of the subcarrier amplifier V702B through the dc blocking capacitor, C717. R725 isolates the grid circuit from the voltage divider to eliminate stray capacity effects.

Adjustment of the TINT control, R165, produces a change in voltage at point T and CR710 which changes the capacity of CR710. CR710 then acting as a variable capacitor, changes the phase of the subcarrier at the grid of V702B.

With the above change it was necessary to readjust the neutralization. C721 was changed to 1.1pf and the connections were reversed at the secondary of the R-Y transformer, T703. Since this reversed the phase of the subcarrier at the R-Y synchronous detectors, it was also necessary to reverse the polarity of the diodes CR705 and CR706.

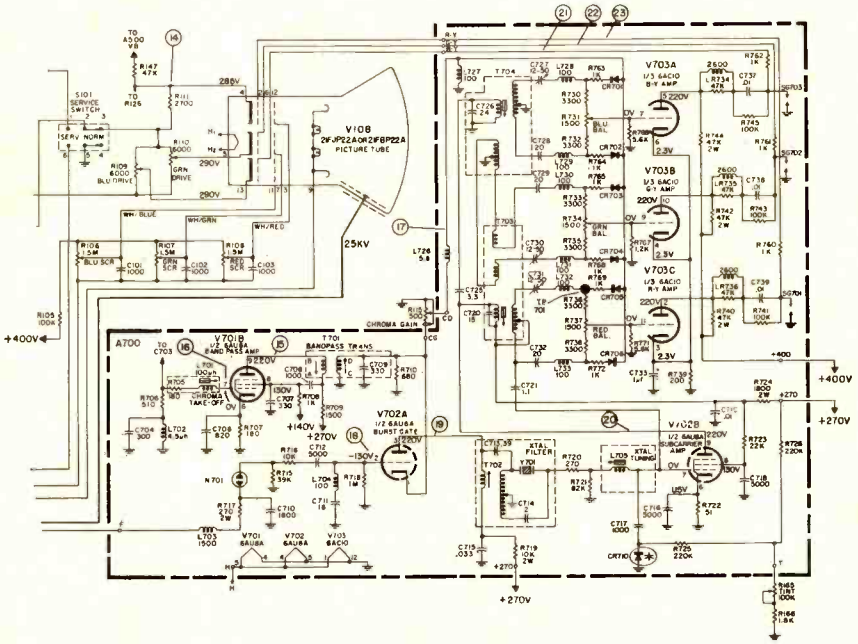

Fig. 1—Chroma circuitry, General Electric "CB" color chassis

B&K MODEL 970 RADIO ANALYST

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SERVICE AM & FM AUTO AND TRANSISTOR RADIOS AT A PROFIT!

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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.

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COLORFAX

Sylvania 22 in. Color CRT

Sylvania Electric Products Inc. announces that it will introduce a 22 in. 90 deg rectangular, color television tube this spring.

To facilitate TV chassis and cabinet design, Merle W. Kremer, a senior vice president of the company in charge of the electronic components group, said that sample quantities of the new tube will be sent to the nation's leading television manufacturers in the second quarter of the year.

All of Sylvania's color picture tubes use the red "rare earth" europium phosphor introduced by the company in June 1964. The phosphor provides increased brightness and truer color rendition and has been in heavy demand since its introduction.

"The 22-in. rectangular tube has been designed to eventually succeed the 21-in., 70-deg round tube that has long been the standard tube in the industry," Mr. Kremer reported. "The 22-in. tube will be six inches shorter, back to front, and will provide 228-square-in. of viewing area."

The new tube will be made available to set manufacturers for approximately $120.

"During 1966, Sylvania will produce rectangular tubes in 19-, 22-, and 25-in. sizes and the 21-in. round tube," Mr. Kremer said. "A 15-in. rectangular tube will be shown early this year and will be in production late in 1966 or early in 1967, depending on demand from set manufacturers," Mr. Kremer added.

Elmer H. Wavering, president of Motorola, Inc., is shown with a 21 in. rectangular color CRT. The new addition to Motorola's color CRT line is being tested in a Helmholst Chamber where the effects of magnetic fields in various parts of the earth can be simulated.

10 facts you should know about color-bar generators

If you are going to buy a color-bar generator *—or even if you already own one*—here are several facts you should know.

While other types of test instruments may lack one or more features, they may still be useful in skilled hands—*provided* the user is aware of their shortcomings and *provided* he has other means of determining what he must know.

This is not true of a color-bar generator.

A color-bar generator should allow you to walk away from an adjusted receiver knowing that the owner can turn it on and receive color broadcasts in full-fidelity color and sound.

Not all color-bar generators can give you this assurance.

Let's talk facts.

FACT NO. 1: ***A gated-rainbow type generator is accepted as the standard of the service industry***

You do not need fully saturated NTSC colors to achieve perfect adjustment any more than you need an FCC-type broadcast signal for tuner and if-amplifier alignment. The gated-rainbow type signals are used by virtually all TV manufacturers in establishing service procedures for their sets.

Gated rainbow color-bar pattern

Urgent service needs for a trustworthy color-signal source were met years ago when RCA introduced the *gated-rainbow* system.

Today, this basic system is used in nearly all service-type color-bar generators. The waveforms and procedures in nearly all color-TV service notes are based on this system.

FACT NO. 2: ***All gated-rainbow type generators are not alike***

In spite of their basic circuit similarities, available models differ in their features, accuracy, and ultimate usefulness. Some of these differences are critical.

FACT NO. 3: ***The offset subcarrier oscillator must be controlled within a few cycles of its true frequency***

This oscillator controls the phase angles (hues) of the color-bar pattern. It is the *heart* of the color-bar generator.

The subcarrier oscillator should be within ±20 cps of its fundamental frequency of 3.563795 megacycles. *In the crystal-controlled RCA WR-64B Color-Bar / Dot / Crosshatch Generator, this deviation is kept well within the ±20 cps limit.*

FACT NO. 4: ***Provision must be included to prevent the subcarrier oscillator from drifting off frequency***

The subcarrier oscillator must not only be accurate when the instrument is *new*—it must *stay* accurate. Top-quality components minimize undesirable frequency changes.

Check, for instance, the trimmer capacitor used in the 3.56-Mc subcarrier oscillator. *You'll find a piston-type ceramic capacitor—not a flat mica type—in the RCA WR-64B.*

FACT NO. 5: ***The generator must have an rf-sound carrier to assure proper setting of the fine-tuning control***

Unless your color-bar generator has this essential feature, it may produce a perfect color-bar pattern on the receiver, *but at the wrong setting of the receiver fine-tuning control. In such cases, the receiver may not correctly reproduce a color program.*

The WR-64B has this necessary feature. With it, you can accurately set the fine-tuning control *before* making color adjustments. *In the WR-64B the rf-sound carrier is also crystal-controlled.*

FACT NO. 6: ***The rf picture carrier must be exactly on frequency to assure that the color subcarrier is correctly placed in the receiver bandpass***

Drift, faulty adjustment, or aging of components in the rf oscillator section can move the generator picture carrier off frequency. This shift, in turn, will also move the color subcarrier signal away from its correct position in the receiver bandpass. In some receivers, this shift will affect accuracy of color-circuit adjustments.

A separate crystal-controlled oscillator is used in the WR-64B to keep the picture exactly on frequency.

FACT NO. 7: ***The axes of the output color-bar pulses should lie on the zero axis—and not on elevated brightness pedestals***

Elevated pulses necessitate use of an oscilloscope for accurate setting of receiver phasing. A generator having zero-axis color-bar pulses, such as the WR-64B, does not require use of an oscilloscope for checking phasing in the customer's home.

FACT NO. 8: ***The generator should not require frequent adjustment of internal counter circuits***

All color-bar generators contain circuits which develop vertical and horizontal sync, and dot-and-bar-pattern signals, by dividing or counting down from a higher frequency: usually 189 Kc. If one of these circuits is unstable, the patterns can jitter, ripple, jump sync or contain the wrong number of dots or bars.

Conventional R-C circuits are used in the counters of most generators. *But the RCA WR-64B uses inherently stable iron-core inductors in its counters,* thereby assuring long-term counter-circuit stability.

FACT NO. 9: ***The proper way to check receiver color performance is to feed the generator signal into the antenna terminals***

Color performance depends on overall receiver condition—not on that of a single section alone. A color-test signal fed directly into the video amplifier—rather than through the antenna terminals—will not provide a proper check of the complete receiver. *The only method you should use in adjusting the receiver, therefore, is the rf-signal-input method*—the method provided by the RCA WR-64B.

FACT NO. 10: ***There is no "best" dot size or bar width for convergence adjustments***

Generator dot size or bar width has no significance for convergence adjustments.

Veteran technicians, however, have found that very small dots or thin bars are difficult to use under average lighting conditions. If receiver brightness is turned up to overcome this handicap, blooming will result. Proper convergence cannot be achieved under this abnormal condition.

The dot and bar size of the WR-64B is small enough to permit exact, speedy adjustment, and large enough to be useful under average lighting conditions.

These are ten specific facts you should know about color-bar generators. They add up to this

FACT: ***The new RCA WR-64B has all the features you need for complete color-circuit adjustment***

It's the *one* color-bar generator that meets all servicing requirements—from the company that pioneered and developed the color-TV system now in universal use: RCA!

Order it today from your local Authorized RCA Test Equipment Distributor.

$189.50* *Optional distributor resale price. May be slightly higher in Alaska, Hawaii and the West. Prices subject to change without notice.

RCA ELECTRONIC COMPONENTS AND DEVICES,
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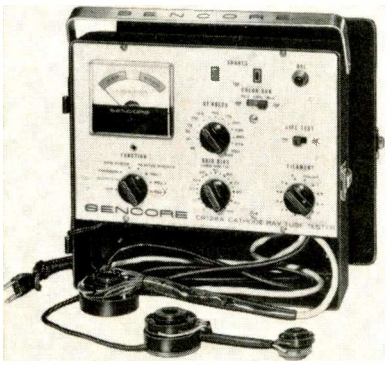
NEW PRODUCTS

FOR MORE INFORMATION CIRCLE NEW PRODUCT NUMBERS ON POSTCARD INSIDE LAST COVER.

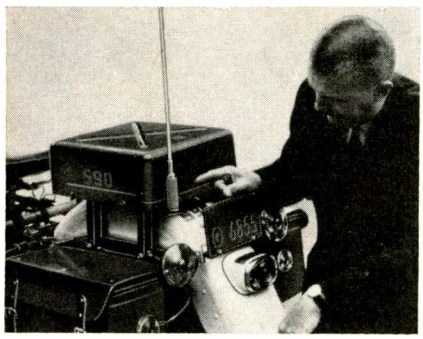
CRT Tester 200

A CRT tester with a variable G2 control is announced. The tester has two permanently attached cables including sockets for all types of CRTs. The CR128A checks CRTs for emission, shorts and leakage between elements. It weighs 10 lb and measures 10 x 9 x 3½ in. and sells for $74.95. Sencore.



Emergency Identification 201

A line of mobile communications antennas made with brilliant fluorescent "International Emergency Orange" material is introduced. The antennas are used on police radio equipped motorcycles and other vehicles. The citizens band versions are used by CB clubs with emergency groups such as REACT teams. Antenna Specialists.

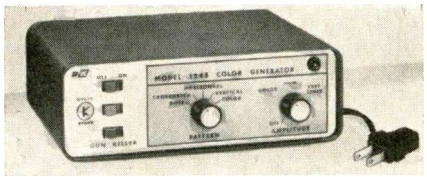


CB Radio 202

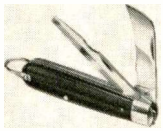
An all solid-state citizens band two-way radio, with 12 crystal-controlled channels and an all-silicon transistor complement is introduced. This CB transceiver, designated Mark 10, weighs less than four and one-half lb and occupies a space of slightly more than one cubic ft. In addition to operating as a two-way CB radio, the unit may be used as a public address (PA) system with 3w audio-power output and includes a jack for external speaker connections. The unit requires a 12vdc power supply with either positive or negative ground. RCA.

Color Generator 203

A portable transistorized color generator which provides crystal-controlled keyed rainbow color bar display, and dot, crosshatch, horizontal line and vertical line patterns as well as gun killer controls is announced. Dots are one line high and only 0.2μsec wide. The model 1245 measures 2-7/8 x 8-1/2 x 8-7/8 in., weighs 3 lb and sells for $134.95 net. B&K.



Hook Blade Knife 204



A pocket knife with a "modified hook" blade, instead of the conventional "spear" blade is introduced. The knife also has a screwdriver blade. It is claimed that the new blade is scientifically shaped so that it is highly effective for general cutting. In addition, the modified hook is just right for ripping, cutting close to a line, or slitting the outer covering of cable. Holub.

Underwater Phone 205

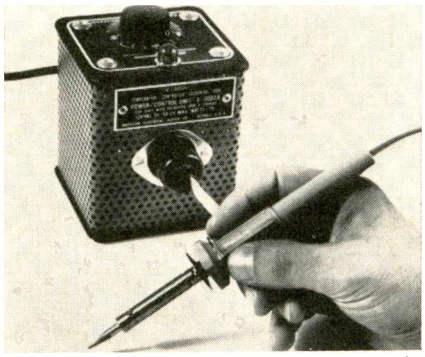
A device for underwater communications between skin divers is introduced. Normal speech sounds are carried through the water for 50 ft. or more and can be heard by other divers without special receivers or listening equipment.

Extending the range of the equipment beyond the normal operating radius is an automatic tone alarm.

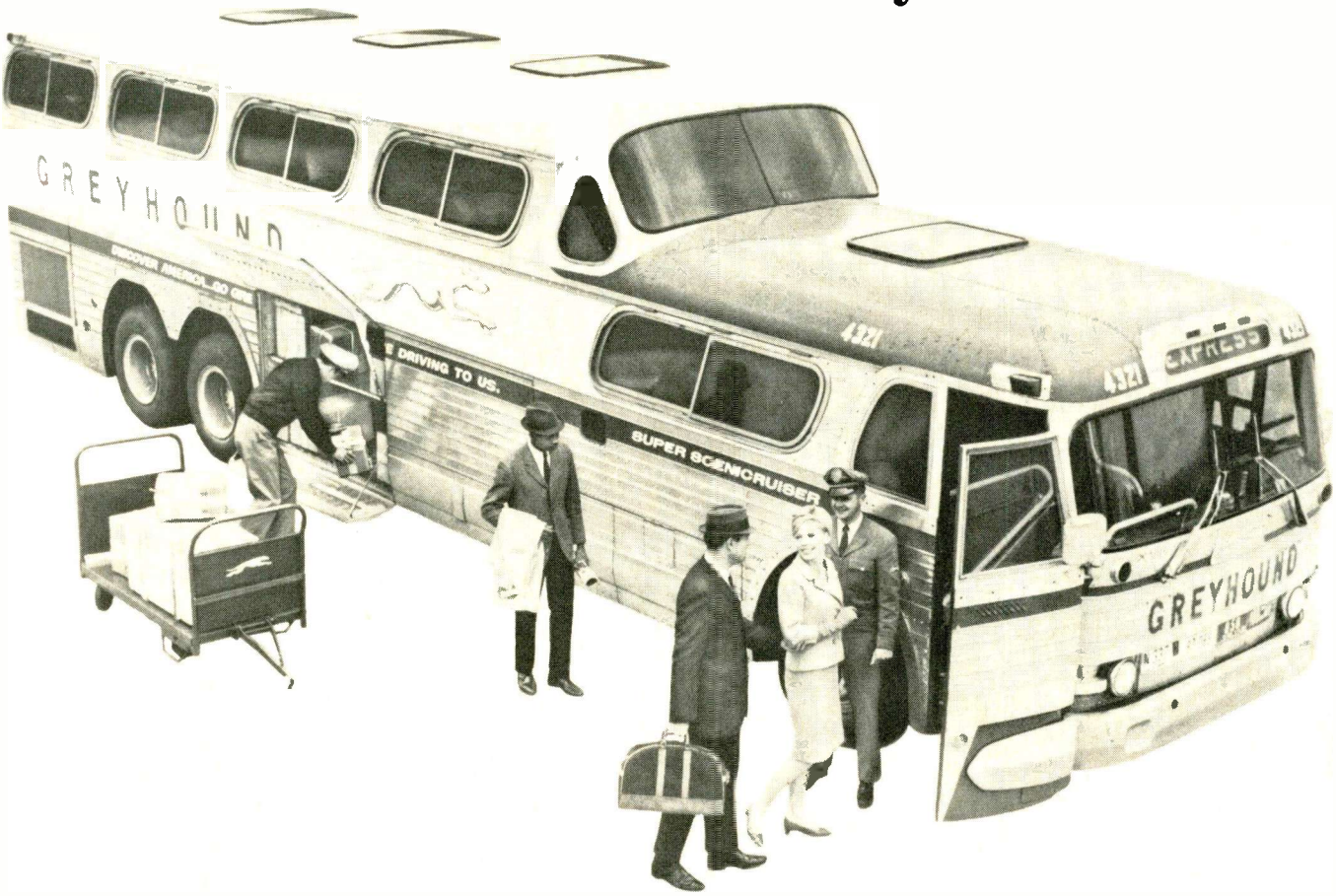
The system consists of two parts: a face mask including a microphone and a sound diffuser to eliminate bubble sounds and a plastic case containing the amplifier circuitry, dry cell battery, and speaker. The microphone assembly fits inside an ordinary diving mask while the speaker case is worn on the weight belt. The complete system weighs 25 oz in the water. Raytheon.

Soldering System 206

A production soldering system which includes a power-control unit which regulates soldering-iron tip temperatures, and a miniature soldering iron which utilizes regular tips is announced. The power-control unit's range of 350-750° tip temperatures is set by a direct-reading dial. American Beauty.



A million miles a day!



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NEW PRODUCTS

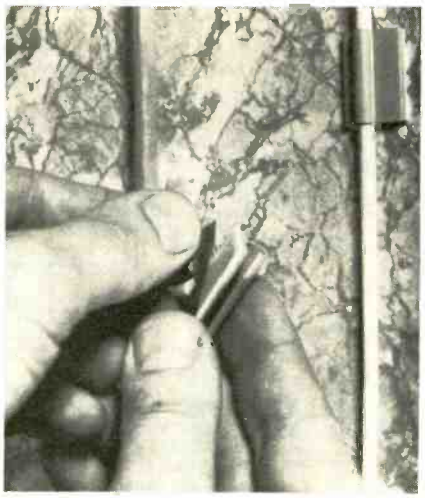
Fuseholder 207

A line of waterproof fuseholders which can be used on circuits of 600v or less is introduced. The fuseholders can be used for street or highway lighting standards, yard lights, mobile power supply units, marine equipment,

sub-surface junction boxes supplying lighting or equipment circuits, portable outdoor or construction equipment or any circuit operating in exposed locations. Bussmann.

Cable Clamps 208

An adhesive cable clip for holding electronic cable in place is introduced. The cable clips are constructed of polyvinylchloride with a foam adhesive backing. They are available in four sizes to handle bundles or jacketed cable from ⅛ to ½ in. in diameter. The clamps are for use in communi-



cations systems wiring to hold JKT or coaxial cables, and in electronic systems. 3M.

Microphone 209

A transistorized base station microphone with adjustable output level is introduced. According to the manufacturer, the microphone makes it

possible to increase the range and signal strength of any transceiver. A volume control on the microphone allows the operator to dial the output level. Turner.

Audio Transformers 210

An audio transformer measuring 5/16 x 3/16 and weighing 1/20 of an

oz is announced. The transformer is metal encased, hermetically sealed. United.

...for more details circle 38 on postcard

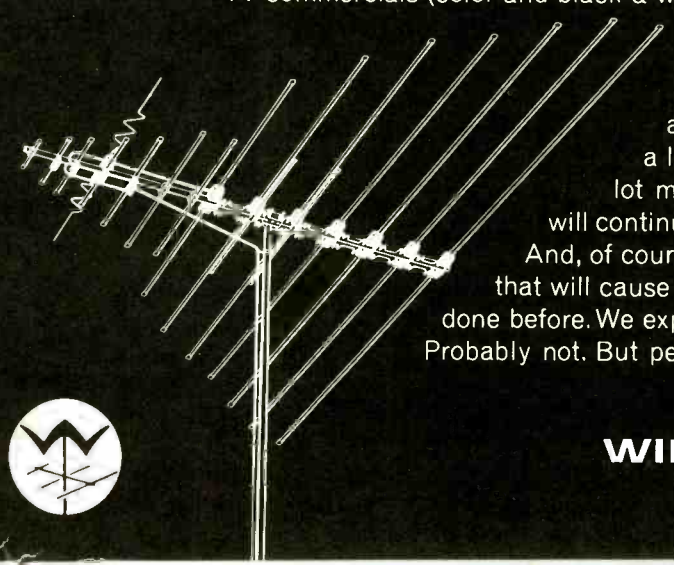
...for more details circle 61 on postcard →

Most companies would be satisfied to double sales.

Not Winegard

True, Winegard sales doubled in '65. So did the number of Winegard employees. We added some 60,000 sq. feet of production space. And we advertised more than ever before—with thousands of TV commercials (color and black & white) and with big, hard selling ads in Life, Parade and Sunset.

But that was last year. And a company doesn't continue to be the leader in its field by being satisfied with what happened last year. That's why Winegard will have even more production, assembly and office space this year. That's why there will be a lot more people working a lot more hours to make and deliver a lot more of the best antennas available. And that's why Winegard will continue to do more advertising than any other antenna manufacturer. And, of course, there will be some new antennas and a few other surprises that will cause more excitement (and sales) than anything Winegard has ever done before. We expect to at least double sales again in 1966. Will we be satisfied? Probably not. But people who buy Winegard products will be. And so will people who sell and install them. We hope that includes you.



WINEGARD ANTENNA SYSTEMS

WINEGARD CO. • 3000 Kirkwood • Burlington, Iowa 52602

NEW PRODUCTS

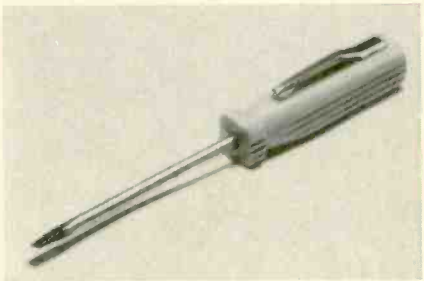
Cartridge Display 211

A phono cartridge counter display/dispenser finished in three colors with gold metal trim is announced. The

unit is being offered to dealers through a promotion. The display/dispenser measures 15¼ x 13½ x 8½ in. Sonotone.

Screwdriver 212

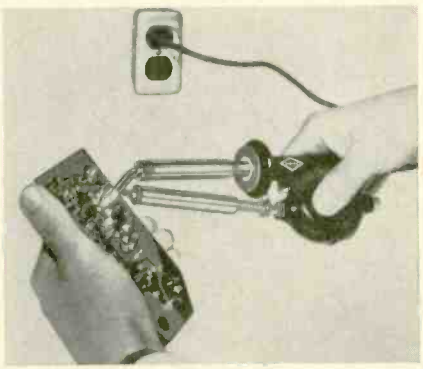
This 3 15/16 in. long pocket screwdriver has a pocket clip, plastic



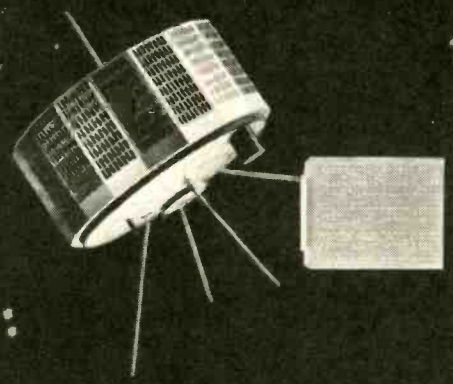
handle and a ⅛ in. hardened steel blade. Moody.

Desoldering/Resoldering Iron 213

A pencil-style iron for removing and replacing miniature components in printed circuit boards and conventional wiring is announced. Known as the Model 300, it is only 8 in.



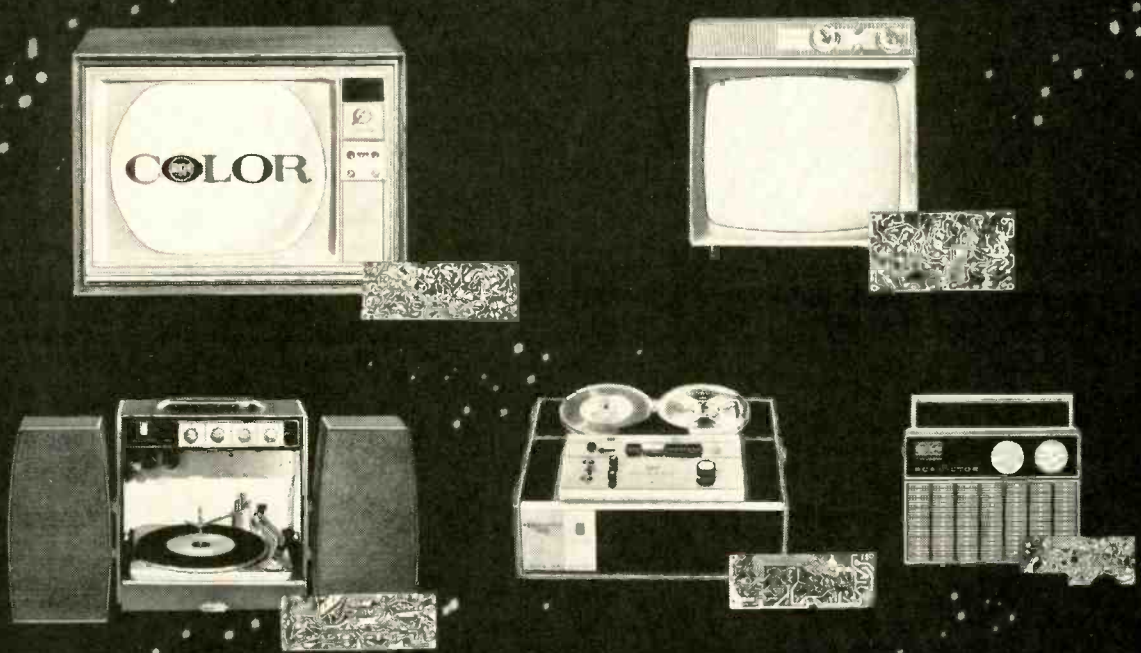
long and weighs 3½ oz. Rated at 40w and 115 vac, it delivers a 720° F tip temperature, according to the announcement. List $13.49. Enterprise.



Tiros uses Solid RCA Circuits

The entire RCA Victor line uses RCA Solid Copper Circuits Why?

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



SHOWN AT TOP: SOLID RCA CIRCUIT DESIGNED FOR NASA'S TIROS

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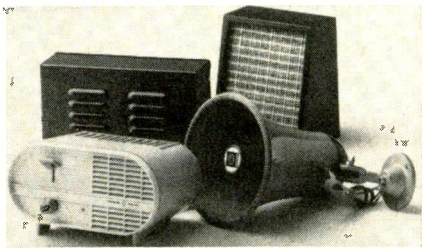
NEW PRODUCTS

Wireless Paging System 214

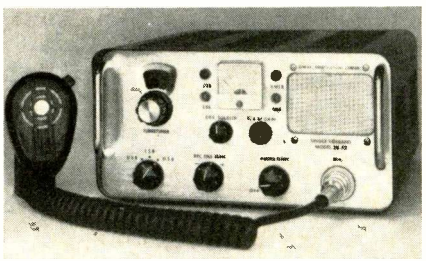
A two-way paging and talkback system that plugs into ac outlets is introduced. The system permits one



(or more) persons to originate the call—the paged party can reply by speaking in the direction of the speaker. Fanon.

SSB Transceiver 215

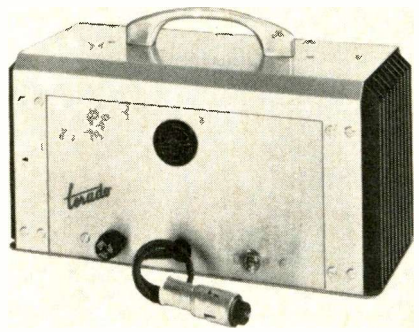
A transceiver for use on the high frequency band (2 to 30Mc) is announced. The SB72 uses 13 tubes in-



cluding compactrons and nuvistors. It has a built-in power supply for 12 or 115v operation. The unit is an upper sideband, lower sideband or double sideband transceiver. General.

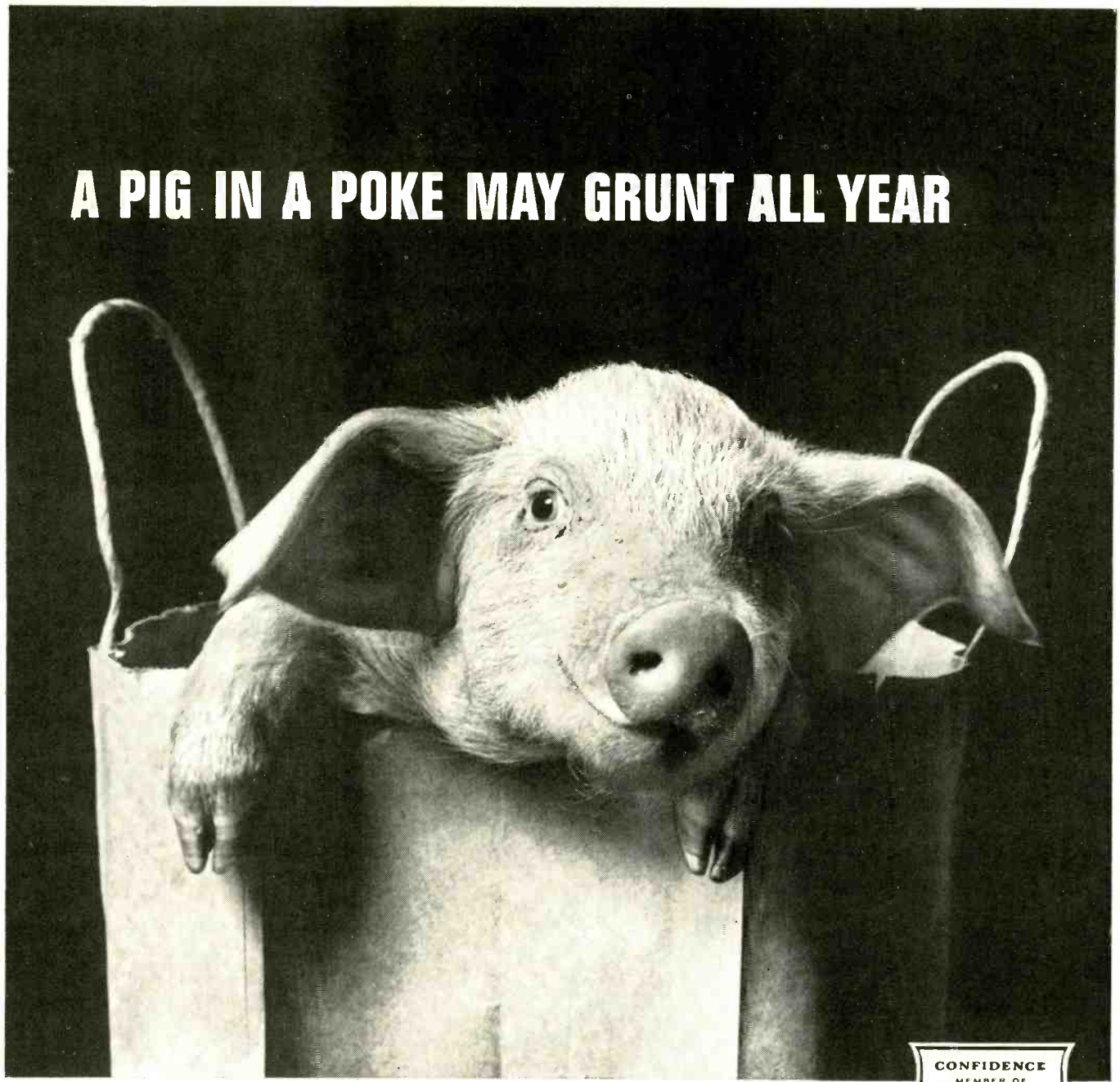
Inverter 216

A solid state transistor power inverter is introduced. This unit changes the regular storage battery current of a car or boat to 117v filtered ac. Ca-



pacity is 125 to 150w. The inverter can be used to power amplifiers, radio, portable TV, lights, can openers, mixers, electric shavers, electric drills, soldering irons and other electrical equipment. Terado.

A PIG IN A POKE MAY GRUNT ALL YEAR



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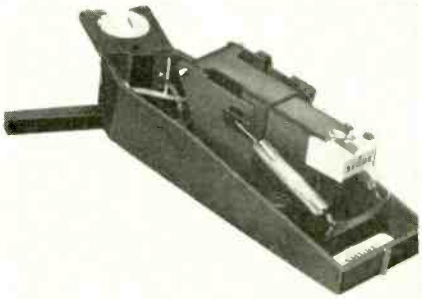
NEW PRODUCTS

CB Transceiver 217

A 5w unit with pre-aligned "plug-in" circuits is introduced. This 24 transistor unit has a typical RF power output of 3.7w with 85% upward minimum modulation, the manufacturer says. A base station console is available for use with transceiver. Texas Communications.

Cartridge Assembly 218

A cartridge assembly designed for the newest Garrard automatic turntables is announced. The Model M80E cartridge assembly features a retractile suspension system and an elliptically shaped diamond stylus and is said to provide bounce-proof and scratch-proof operation. The assembly plugs into the tone arm of the Garrard Lab 80 and Type A70 automatic turntables. Shure.

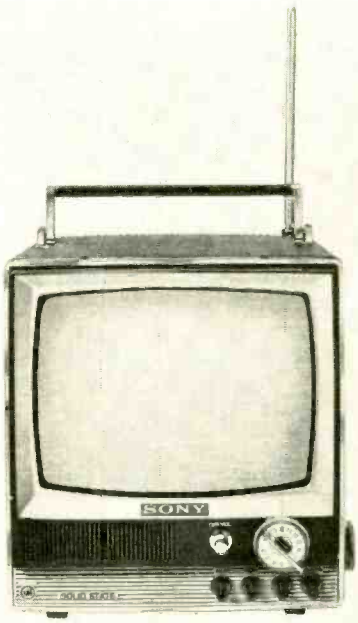


Multitester 219

Ten push buttons select operating mode and range on this VOM. It has a 30,000Ω/v sensitivity and has a 1vdc full scale range. Olson.

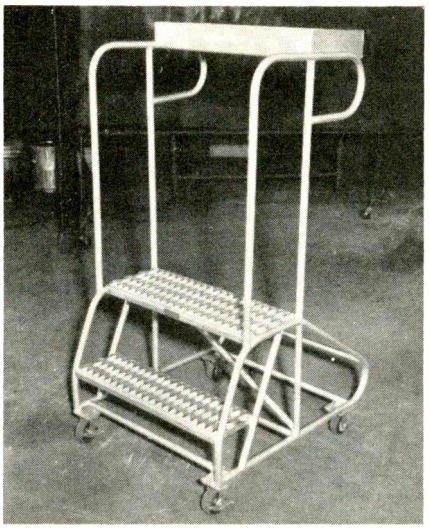
Solid State TV Set 220

A 9 in. TV portable weighing 10 lb is announced. The solid state unit 951-UW uses epitaxial passivated transistors. It operates on rechargeable battery, ac or auto/boat 12v power. Sony.



Tool-Tray Ladder 221

A ladder with an overhanging tool-tray is introduced. The tray, 24 x 3 in., is welded to the top and back of



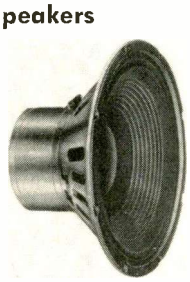
the ladder frame in a cantilevered arrangement. The ladder rolls on four 3 in., side-braking, swivel casters that are mounted to the frame. Ballymore.

Tape Recorder 222

A custom 4-track tape recorder is announced. It is said the unit provides finest recording and playback performance of 7½ and 3¾ ips tapes, plus "sound-with-sound" feature that per-

mits additions to previously recorded programs. The unit records FM/stereo, FM, AM or phono by using console and tape recorder controls, according to the maker. Zenith.

Speakers 223



Two speakers for high power application and adaptable for musical instruments, music systems and Hi Fi music systems and other similar applications are announced. Both contain a 3½ lb Alnico V magnet, 3 in. dia. voice coil, built-in heat sink, and rear vent for air relief. Oxford.

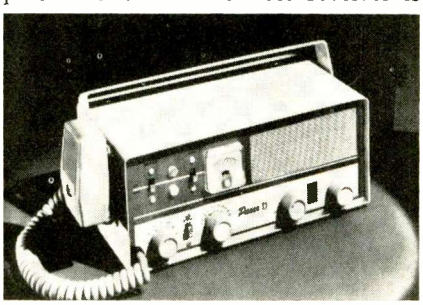
NEW PRODUCTS

Solder Tube Dispenser 224

A transparent plastic tube dispenser containing 13½ ft of coiled 60/40 rosin core solder wire, 0.050 in. dia is introduced. This solder tube dispenser can be used by TV-radio technicians. Alpha.

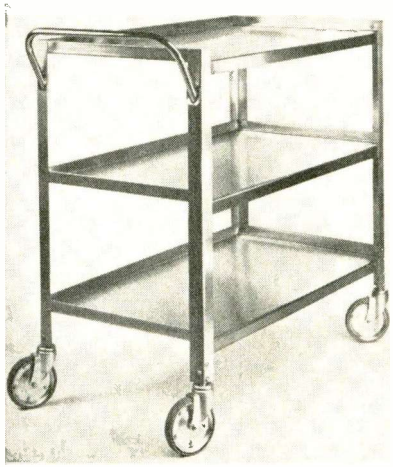
Transceiver 225

A CB transceiver with 11 channel crystal control transmit and receive, plus a 23 channel tunable receiver is introduced. The transmitter's frequency range is 26.965 to 27.225Mc (channels 1 to 23). It has push to talk switching. Audio output is 3.5w and sensitivity is 0.5μv. Power supply is either 117vac, 60cps half-wave voltage-doubler or 12vdc. Metrotek.



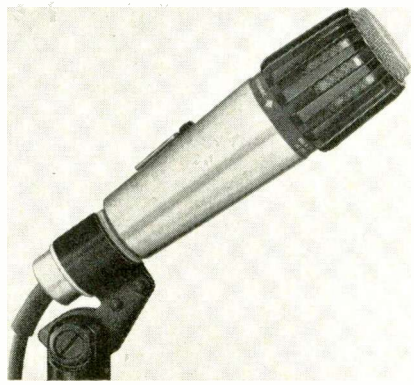
Utility Cart 226

A line of utility carts in two or three-shelf models is introduced. Each cart is equipped with 5 in. replaceable rubber tired and ball bearing casters. The three-shelf models have a capacity of 350 lb, an over-all length of 40 in., over-all width of 21½ in. and an over-all height of 36 in. Clearance between shelves is 11⅝ in. Colson.



Microphone 227

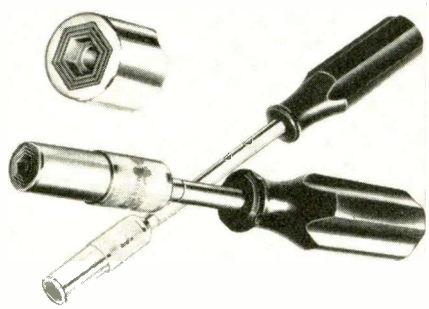
A dynamic cardioid microphone with uni-directional pickup characteristics is introduced. The Model 580SA



is a high impedance unit to be used with any high gain, high impedance amplifier while the Model 580SB is a low impedance unit to be used with any low impedance amplifier. Where long cable lengths are required, the Model 580SB should be used. Shure.

Socket Wrench 228

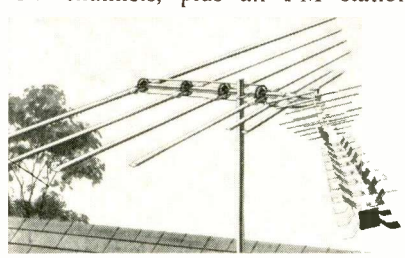
Concentric, spring-loaded hexagons in the socket of this wrench adapt to



the size of the nut as you push the wrench on the nut. It fits nuts in the ¼" to 7/16" range. Meredith:

All Channel Antennas 229

A line of all-channel antennas is announced. The pathfinder series covers all eighty-two UHF and VHF TV channels, plus all FM stations,



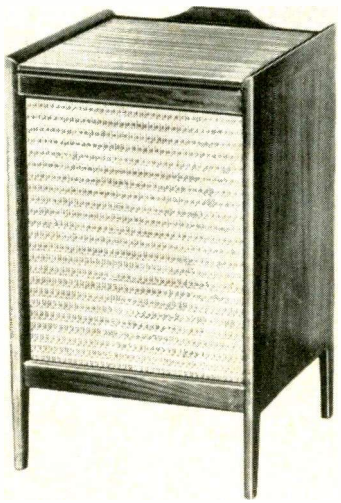
according to the manufacturer. The antennas are available with outputs for both 300Ω twinlead and 75Ω coaxial cable. Jerrold.

Automatic Telephone 230

It is said an answering and recording device features no installation and very low cost while maintaining high quality throughout. High fidelity tape recorders transmit voice recordings and record messages left by caller, according to the manufacturer. Minatronics.

Speaker System Kit 231

A 3-way speaker sytem kit is introduced. Model AS15 contains a 12 in. woofer with a 1½ in. voice coil, two 2 in. mid-range speakers and ultra-high frequency tweeter. Heath.

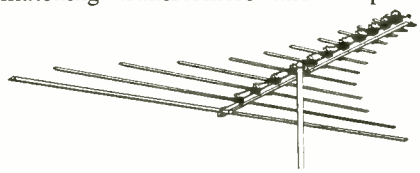


CB Transceiver 232

A tube type CB transceiver with six crystal-controlled channels plus full-channel receiver tuning with spotting switch and "S" meter is announced. Weighing 14 lb, the CB-9 measures only 12 x 7 x 5 in. It is furnished ready to operate either base or mobile, including power cords and mobile mounting bracket. Hallicrafters.

Antenna 233

A line of all-channel color antennas is introduced. Five models are available for all television areas, from local to far-fringe, with list prices ranging from $18.95 to $59.95. A series of matching transformers and couplers is also available for use with coax cables and/or multi-set installations. GC Electronics.



Crystal Filter 234

A crystal filter for two-way radio base station receivers operating on frequencies in the 25 to 50Mc and 136 to 174Mc band is introduced. The crystal filter measures 3 x 1 x 11/16 in. Installation is accomplished with an "in line" connection between receiver and antenna relay. Motorola.

NEW PRODUCTS

Cartridge Caddy **235**

A compartmentalized box designed to hold up to four cartridges and six

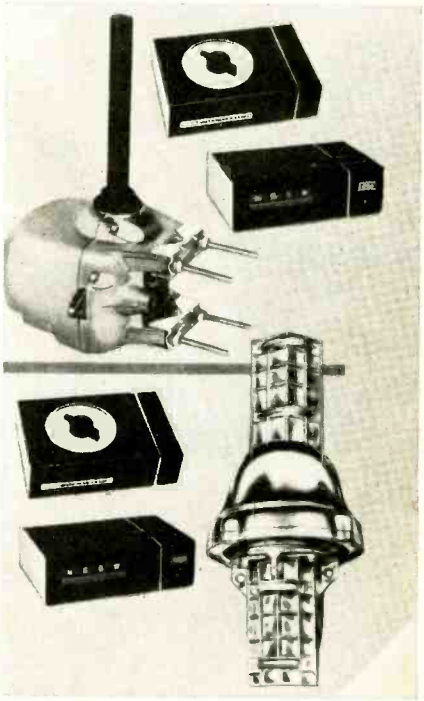
extra styli or three cartridges and six extra styli, with room for pressure gages, brushes or other items is announced. The cartridge caddy is finished in black simulated leather with gold leaf tooling. It is 12 x 5¼ x 2½ in. and lined with plastic foam. Shure.

Frequency Meter **236**

A solid state frequency and deviation measurement instrument is announced. The CE1 has direct reading offered on all bands: 20-80Mc, 120-180Mc, 420-480Mc, and 920-980Mc. Three directly calibrated frequency and three directly calibrated deviation ranges are included. The self-contained, portable instrument measures 10 3/4 x 10 5/16 x 16-1/2 in. Cushman Electronics.

Antenna Rotor **237**

A line of automatic manually controlled rotors is announced. The two basic rotor mechanisms are contained



in the line, a heavy duty 'in-line" support with a "Bell" casting and a unit designed for single stack, non-cross-braced antennas for metropolitan and suburban use. It features a self contained ¾ in. dia steel stub mast on which the antenna is directly mounted. The rotor exceeds the accuracy and strength for maximum performance, the report said. CDE.

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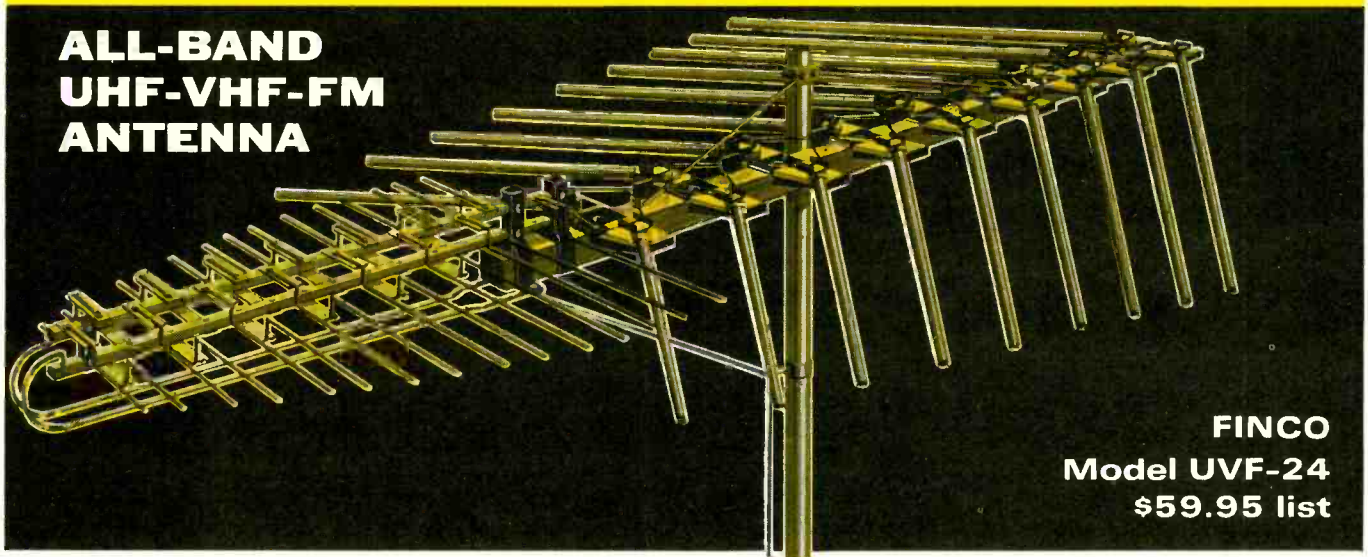
FINCO COLOR-VE-LOG ANTENNAS FOR UHF, VHF, FM RECEPTION

ALL-BAND UHF-VHF-FM ANTENNA

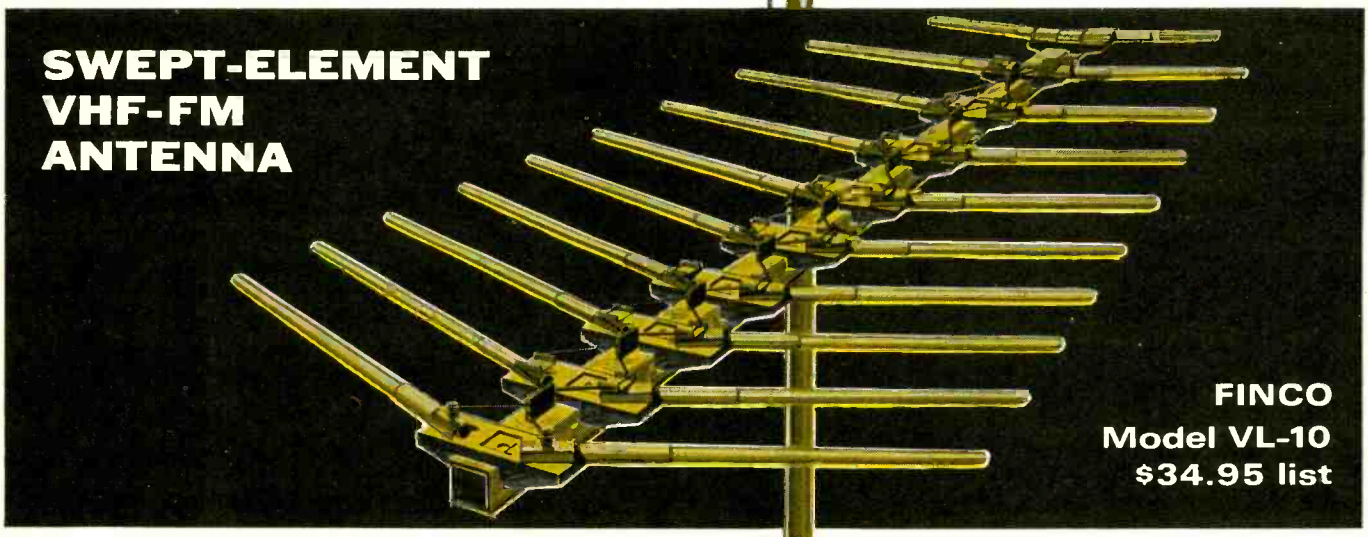


FINCO Model UVF-24 $59.95 list

The one antenna that does the work of 3! Gives startlingly clear black and white pictures and beautiful color on **both** UHF and VHF television channels — plus the finest in stereophonic and monophonic sound reproduction.

FINCO Model UVF-18—$42.50 list
FINCO Model UVF-16—$30.50 list
FINCO Model UVF-10—$18.50 list

SWEPT-ELEMENT VHF-FM ANTENNA



FINCO Model VL-10 $34.95 list

FINCO's Color-Ve-Log challenges all competition! Its swept-element design assures the finest in brilliant color and sharply defined black and white television reception — as well as superb FM monaural and stereo quality.

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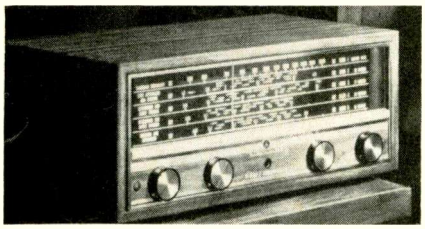
NEW PRODUCTS

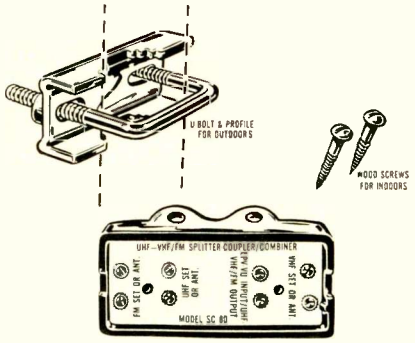
Broadcast Receiver **238**

A short wave receiver covering the foreign broadcast spectrum is announced. The receiver provides coverage of the 5.9-6.25 MC (49 meters); 9.45-9.8Mc (31 meters); 11.65-12.05 Mc (25 meters); and 15.05-15.55 Mc bands. These bands are in addition to the standard broadcast band of 550-1600kc. Sizes 13½ by 5⅞ by 8¾ in. Hallicrafters.



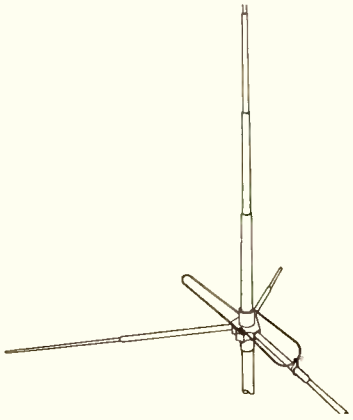
Three-Way Splitter **239**

A signal-divider network for distributing separate VHF, UHF and FM signals from a single antenna system is announced. This device can conversely serve as an outdoor combiner when separate VHF, UHF and FM antennas must be used. Eliminates multiple downleads. JFD.



Amateur Antenna **240**

A ⅝ wave vertical base station antenna for 6-meter amateur radio use is introduced. Maximum input recommended for this antenna is 1000w. SWR of 1.5:1 or better is claimed. Gain is 3.4db over ¼ wave ground plane and 5.9db compared to isotropic source. A coax female connector is incorporated into the radial support assembly. Mosley.



BOOK REVIEWS

MOBILE and MARINE STATION LICENSE MANUAL. *By Leo G. Sands. Published by Howard W. Sams & Co.*, 320 pages, soft cover. $6.95.

This book can be used as a guide for applicants who wish to obtain radio station licenses in the marine and land mobile radio services, as well as for operators of such radio stations. Basic laws applicable to these services are reviewed. Radio operating procedures are covered in detail and convenient check lists are included.

The various types of radio systems that can be licensed are also discussed, and their limitations and applications are explained. The book provides the correct interpretation of FCC rules and regulations concerning this type of station.

A Toast To the Designers

by Willy Le Coq

'I've poked my head in chassis for years trying to find . . .'

■ For ten years I've been storing it up. I've wrestled with TV chassis and every mistake in them and I've found every mistake that can be made — although not all in one chassis — and I'm fed up. Not mad enough to join 'em, mind you, but angry enough to resolve one thing: if ever I meet a man who introduces himself as a designer . . . well, depending on how big he is . . .

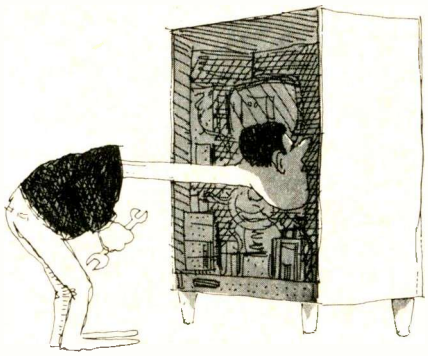
But let me tell you how I'll blast him if he *is* bigger than I am.

All Gold and Virgin Plastic . . .

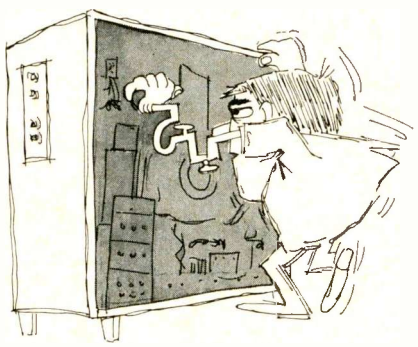
There's this nice small portable, see. It looks like a little jewel, all gold and virgin plastic and little yellowstone knobs. The owner tells me it's a gift for his anniversary. The screen on this bauble is ablaze with light but sans picture, see. And the owner says they can't do that to him. So I'm looking for the RF section. I know there's a tuner in it somewhere, but RF tubes? No. There are three IF tubes all right and a video 6AW8. But where's the blasted 6BQ7? Ah! It don't have one? I've poked my head inside chassis for years trying to find the tube (and socket holes) behind that discriminator can — but this set is too small to get my head into, I tell you.

There's the neck of the CRT, all bundled up in wiring and little nasty resistors — two sheets of printed wiring all messed into a dandy cobweb, but no doggone tuner-tubes anywhere. Now I know they're in there somewhere. Inside the CRT, maybe? No, they didn't go that far yet, I reason. *Underneath* the CRT, of course — peeking their little spouty-tops out.

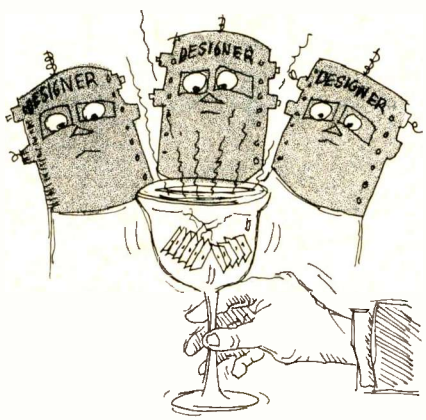
Behind the wiring and the chassis



'. . . Stick your head in . . .'



'. . . They've developed a special tool . . .'



'. . . One golden, super-gridded glass of selenium poison!'

and the printed circuits, in the far corner, way down there on the very bottom they were. You would think the front would be removable — like the top of a can. But you don't know these boys. They must have almost forgotten to include the tuner —then stuffed it on the bottom of the "can" and I guarantee you the front doesn't come off.

You remove the chassis, that's what. Then you remove the CRT. And the tuner stays down there, see, screwed to the bottom. And the leads aren't long enough to move the chassis out of the way. So you *cut* 'em.

But . . . Oh! . . the tubes are pointed away from you, so you have to dismount the tuner, turn it over and if you have deep ridges on your fingers you can just squeeze the tube tops and with three or four tries they may (or may not) lift out of their long, stiff shields. Easy, wasn't it?

Now most of your hour is gone, eh? But let me give you a tip right here. Replace *both* tubes. You can't try the set until everything is back in place. That takes care of the next hour. If you pick the wrong tube, you'll have to repeat the whole thing. And by that time (like one technician I heard about) you may be keyed-up to the point where you'll smash the stupid little jewel flat on the floor like pizza-pie, anniversary-gift or not.

Pick A Console Job

But never mind the compacts and tinyvisions. Pick an honest to goodness console model with plenty of room to "put" things. There's the CRT all nicely by itself in the middle, the tuner fastened (and I mean *fastened*) in the upper left corner of the cabinet — the chassis nestled cozily bottomwise in the center. Let's not worry about the speaker, it's on the back cover, right, and exactly above the CRT neck. If you don't hold it up . . . bang . . . one neckless CRT. (That was the year this company needed to sell more CRTs.) If you're not careful now and accidentally tug on the HV lead, the CRT may fall on your fingers.

But the tuner is another matter. They've developed a special tool to bolt that down. And tight. Can't reach in with any of the tools you ever heard of. Don't swear, the cus-

tomer is sitting next to you to see how good a technician you are. You tell him you need something from the truck and run to kick the tires, ram the floorboards with your head or whatever you do when you're in bad shape. Take ten tranquilizers and go back refreshed and ready for battle.

No More Sardine Cans

Instead of the sardine cans, they're now making the smaller jobs out of plastic. You know, front and back, nice soft plastic, the center-strip metal — welded so it clings to the chassis like molasses. Now here's a job that calls for a small head, one you can poke in between the high-voltage cage and the 15-watt input resistor, to see what made the hole in the plastic front under the viewing screen. Ah! you got it! It's the globar resistor. It has dissolved the lugs it was mounted on (at one time) and now dangles against the plastic bottom. What do you do with the hole? That's easy. Do what the designers do with the holes they make and later discover they have no use for. You get some fancy gold strip with such names as "Super-Duper Chassis," "Aristocrat of the Silver Screen," or perhaps "Air-ventilated Picture Screen" and stick it over the hole with glue — not too tight so it will fall off within a few months — and there you are.

You would think, since we're on the matter of holes, you might find one, say, where the tuner-oscillator slugs are behind, don't you? Ah! Not so. You must search for the slugs with a spying glass, my friend, *after* you remove the tuner. That figures!

Printed Circuits

Now getting down to printed circuits (which one must). Here's something you can get your teeth into. Much easier to service. You simply peel the whole thing off and sell the man a new set. They don't develop intermittents half as much as some people say. You simply button up sagging and on-off sections with pieces of card-board, which was intended to be done all along. You can plug IFs, tune sockets, anything at all that moves like thin ice up and down with the heat to give you the finest sheet of intermittents imaginable, with tube tops, neatly folded and stuck in —

around and under like nobody's business. If you have to unsolder stuff, I admit, that's a little harder — a good yank or two will generally make the thing say "snap," however. This is the time to tell him you think it will cost too much to fix it. Gives the designers a chance to design another day.

Circuit Tracing

Now let's get to methods of tracing circuit wiring. You have the schematic with you at all times, haven't you? Well, it don't say much about *where* things are hung in the chassis anyhow. I'm having a portable this time (the country is full of 'em) and I'm tracing B+, see. The line that supplies the contrast control circuit, because that's where we lost the picture. Now. It comes from, say, the 260v line somewhere out of a filter. Good. Now the wire runs into a hole on the chassis and away underneath . . . behind . . . the CRT. So I figure the supply resistor sits there all blackened up and wide open, see. But . . . eh . . . I have to remove the CRT to get at it, of course. That done . . . ah . . . you'd never guess it. The wire runs to a neat little lug there, but nothing else is connected to the lug. No sir. From the lug with nothing connected it runs back through another hole and ends up not two inches from where it started, all nice and easily accesible, to a little metal cover with three resistors inside, including the one I wanted. Could you ask for anything neater?

Knobs and Shafts

I've recently read of a world exposition where a technical writer ran into a set made in an "iron-bar" country and he complained that the knobs fell off at a touch Well sir, let me tell you about *our* knobs. We have two kinds — the ones made of plastic that melt around the shaft, so you will no doubt conclude that they have been glued on (go ahead with your screwdriver, its going to break in half no matter what you use) and the kind that . . . eh . . . falls off. I'm sure there is no other word for it.

You see, shafts are made with the idea in mind that there should be a choice between too short or too long. So what's wrong with that? We have always had choices, nobody's ever happy unless he has a choice. And we have plenty of choices, let me tell you. Shafts too long, too short, too brittle (we've all seen fine-tuner shafts made of pressed paper and plastic snap off). And then there's the kind that look and feel like plastic drinking straws and are. Trying to get them aligned to go through their holes in the back cover is like setting up eggs on end without cracking 'em. They can go around corners and neither horses nor men could keep them from splitting open at the ends where they're supposed to fit on controls.

But there's one thing the designers have not neglected. That's the back cover. It is generally held on the set with enough screws to assemble a half-ton truck. Sixty-four screws is my own record and anyone who has seen anywhere from eight to thirty-four to sixty-four, half red robinson and half green robinson with one or two flat-slotted or criss-crossed . . . knows enough to slip two-thirds of 'em in his pocket so he can make the job possible next time.

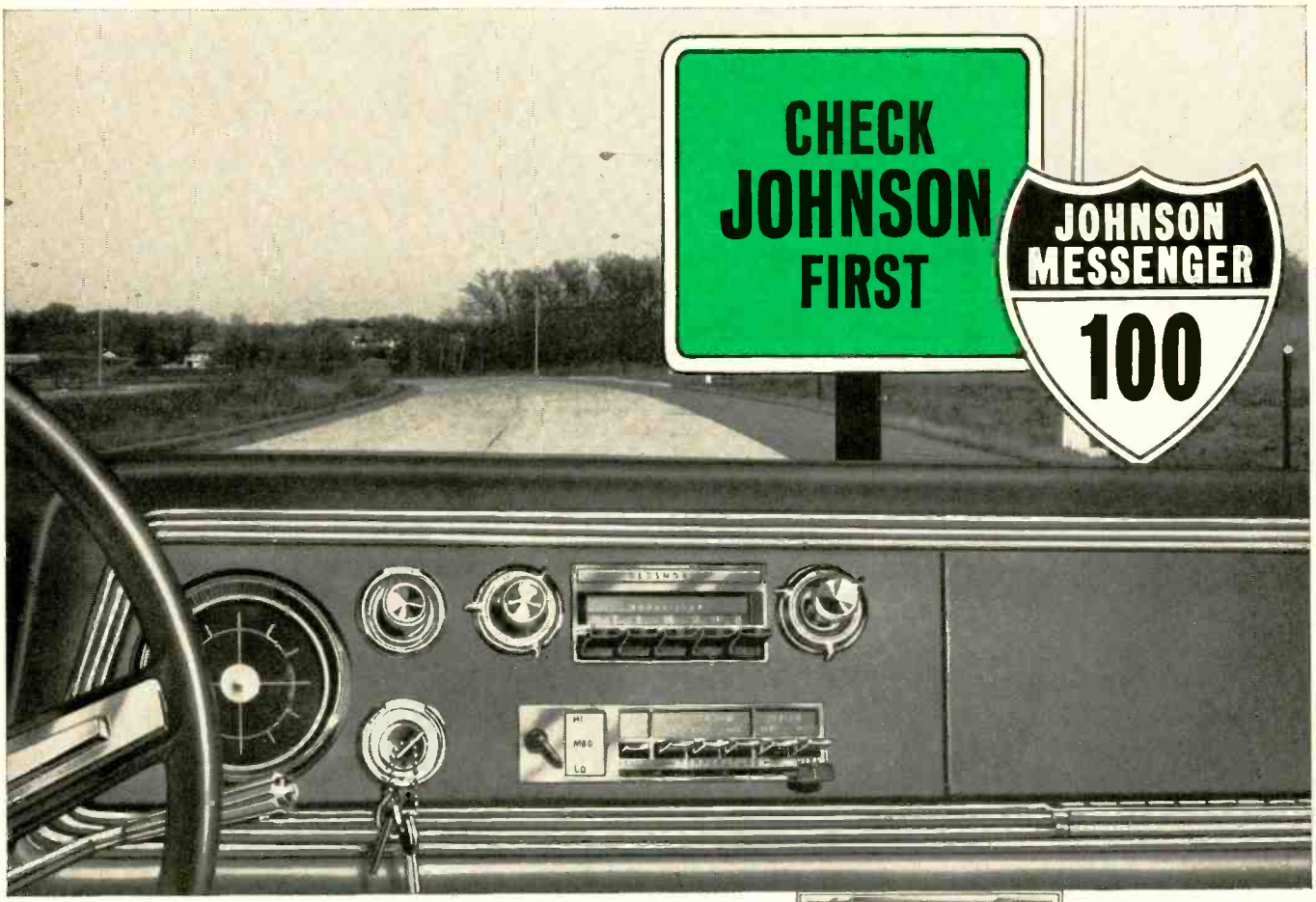
There's not one thing they have overlooked. Therefore I'm going to salute the men who make it all so interesting and possible. To the designers, the men who gave us handfuls of unneeded and unpaid for work, the breed that works behind closed doors and has no name, only a bodyguard or two out in the lobby of their workshops . . . to them and their likes . . . one golden supergridded glass of selenium poison! ■

. . . MARKETING PROGRAM

Continued from page 26

relative importance of each campaign. Let's shed more light on this last idea.

Suppose you have decided to allocate 3 percent of your gross sales per month to advertising. Let's also suppose in a certain month, you are faced with the problem of increasing your antenna installation business, while promoting a recently introduced 24-hour service plan. These two factors become your monthly advertising objectives. You must now pause and decide whether both are equally important (in terms of each one's profit poten-



MESSENGER "100"

new! *Low cost—all solid-state* CITIZENS RADIO TRANSCEIVER

The new Johnson Messenger "100" puts you on the right road to greater profits with a top-quality transceiver for the popular priced market! This compact, 5-channel unit delivers performance and proven reliability no other CB transceiver in its price range can match!

Advanced circuitry! Receiver is both sensitive and selective — unique Johnson speech compression circuit prevents overmodulation and delivers a crisp, clean, penetrating signal with no adjacent channel "splatter" . . . boosts average transmitted power for greater readability at extended ranges. Circuit design provides maximum power output — high performance noise limiting gives user "whisper quiet" operation!

ADVANCED CIRCUITRY FEATURES OF THE "100" INCLUDE:

- *Narrow bandwidth receiver* for excellent selectivity!
- *High receiver sensitivity* for maximum range!
- *Unique speech compression circuit* which prevents overmodulation and helps deliver a clean, crisp signal without adjacent channel "splatter"! *Three types of usage* from *one* unit — Mobile, Base or Portable.

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tial) or whether one is more important than the other. As previously mentioned, this decision should be based on expected profit potential for each factor. Once you have put these objectives into an order of importance, you can then allocate your funds accordingly.

Although this system cannot guarantee desired results, it certainly will come a lot closer than the "sawed-off-shotgun" approach used too often by service-dealers. At least you'll be able to justify your expenditures!

Determination of the actual amount to be spent is not possible. The 3 percent figure cited here was based on the sample budget presented earlier. In that instance, gross sales were $2400 (approximately), $80 was ear-marked to advertising. This comes out to roughly 3 percent. You must decide for yourself whether this figure applies to your own operation. In so doing, bear in mind that advertising is no cure-all. It cannot be counted on to solve your complete business problems. You should also realize that if you advertise too little, you are wasting your money. If you go too heavily into a campaign, you may reach a point of diminishing returns—the extra dollars you invest in the program will not produce extra-profit dollars. Actually, you must experiment. Try one figure for a few months and keep track of extra sales and new customers coming in. Then try another figure. After a few changes, you will find the one figure which best suits your own particular needs.

Image Promoting

Probably the best and least expensive advertising program you can engage in is simply to become an active member of your community. Make new friends and meet new people. Attend community meetings and participate in community activities. The more people you know—the more people who know you—the better your chances for new customers.

It is no longer true that people regard TV-radio service-dealers as "thieves" or "overcharging businessmen." People are becoming more aware that TV-radio service technicians as a group are trained specialists like doctors, for example, and entitled to fair payment. Take advantage of this new image, enhance and build up your business on it.

One very easy way for service-dealers to enhance their images is to create a good impression in the eyes of their customers. This is readily accomplished by having a neat, clean and well organized shop and by keeping neat and well dressed. The old idea that dirty clothing indicates a hard worker just doesn't hold water any more.

We have outlined a modern service-dealer marketing program. It can, and should, help you become a more successful and more respected businessman. Like any other program of this nature, however, it will vary from one particular operation to another. The points mentioned in this summary should serve as the basis or foundation on which an individual business can build a complete and total marketing program. It is a program based on sound marketing and management techniques and it can be geared to your particular business. ■

NEWS OF THE INDUSTRY

Contract Let For New WWV Station

The National Bureau of Standards (U.S. Department of Commerce) signed a contract with Ditzen-Mueller and Associates of Boulder, Colo. for architectural design of a transmitter building for NBS standard broadcast station WWV at the station's new site at Fort Collins, Colo. Construction of the building will begin in early 1966 and will be completed in time for WWV to begin broadcasting from Fort Collins on July 1, 1966.

Sam Schlussel, President of TAME

It is announced that Sam Schlussel has been elected president of the Television Accessory Manufacturers' group known as TAME. Mr. Schlussel succeeds Morton Leslie, who completed his term after serving as president since the organization's inception. Paul Wilson was re-elected vice president, and Morris Finney, treasurer.

Mr. Schlussel is an official of Channel Master Corp. Mr. Leslie is with JFD Electronics Corp., Mr. Wilson with S & A, and Mr. Finney with Finco.

Sylvania Appoints CCTV Agent

Executone of Knoxville, Inc., Knoxville, Tenn., is appointed authorized sales agent of closed circuit TV systems for the commercial electronics division of Sylvania Electric Products Inc.

Executone of Knoxville will assist Sylvania in the marketing of educational and commercial closed circuit television systems in the Knoxville area. In addition, the company will install and service the Sylvania equipment. Mr. Charles Bell is President of Executone of Knoxville, Inc.

National Electronics Week, 1966

Ninety-one companies have signed contracts to exhibit in 1966 National Electronics Week, as of the first cut-off date for preference in space assignments, according to Kenneth C. Prince, General Manager. Over half the available space is already committed, Mr. Prince says.

1966 National Electronics Week will be held in San Francisco from May 30th through June 5th. The all-industry marketing event incorporates trade association meetings and conventions, new business forums, and the only national trade show for electronics merchandisers.

Philco Appointment

Hobart A. Ballou has been appointed general service manager for consumer products at Philco Corp., according to Ray Nugent, general manager of the parts and services department, sales and distribution division.

Mr. Ballou, who has been accessories manager in Philco's Atlanta, Ga., district since December 1, succeeds C. Howard Tomlin, resigned. William D. Fore, now service manager in the Boston (Mass.) District, is moving to Atlanta as accessories manager, Mr. Nugent said.

NEWS OF THE INDUSTRY

Admiral Record Employment in Illinois Plants

Admiral Corp. announces that employment in its Illinois facilities including Chicago headquarters is nearly 8000. The company's Harvard, Ill., electronics center, which produces color TV, black and white TV, stereo instruments and radios, reported 3300 people are currently on the job — an increase of 1700 since early 1964. Employment is expected to total 4000 at Harvard by January. Bus service for employees who live considerable distances from the expanding plant has been increased. Established bus routes include connections to such points as Belvidere, Ill., Janesville, Wis., Beloit, Wis., Rockford and Crystal Lake, Ill., Richmond, Woodstock, and Hebron, Ill. Employment at the company's Galesburg appliance manufacturing subsidiary is 2400, and indications are that a complete third shift will soon be added at this plant. Employment at the McHenry and Bloomington, Ill., divisions are 300 and 150 respectively, while there are approximately 1800 on the payroll in Chicago.

RCA Third Quarter Sales and Earnings

Sales and earnings of the RCA rose to new record levels in the third quarter and first nine months of 1965, Chairman David Sarnoff and President Elmer W. Engstrom report. Profits after taxes in the third quarter of this year rose 22 percent to $22,300,000, as compared with the previous high of $18,200,000 in the same period of 1964. This marked the 18th consecutive quarter in which profits improved over the similar period of the previous year. Earnings in the first nine months of 1965 amounted to $66,200,000, up 18 percent over the previous record of $55,800,000 in the comparable nine months last year.

Sales of products and services in the third quarter rose 17 percent to $506,700,000 from $431,400,000 in the like 1964 period, and were the highest for any three-month period in the company's 46-year history. For the first nine months of 1965 sales amounted to $1,470,600,000, an increase of 10 percent from the $1,330,500,000 recorded in the similar period a year ago.

Earnings per share of common stock in the third quarter were 38 cents, an increase of 27 percent over the third quarter of 1964. In the first nine months per share earnings reached $1.13, up 21 percent from a year earlier.

Zenith Engineer Cited

John Rennick, division chief of advanced development in color television at Zenith Radio Corp., received the 1965 Consumer Electronics Outstanding Achievement Award.

The award is given annually by the Broadcast and Television Receivers, Audio and Electron Devices groups of the Institute of Electrical and Electronics Engineers (IEEE) to the engineer who "has contributed significantly towards the advancement of consumer electronics through engineering achievement."

Rennick, who has been a member of Zenith's engineering staff since March 1935, has worked on color television for over twenty-five years. He is the inventor or co-inventor in 21 U.S. patents and 15 Canadian patents, most of which involve color TV, and almost every color television receiver in use today embodies his developments.

TV Antennas On John Hancock Center

Six Chicago television stations will locate their transmitting antennas on the 100-story John Hancock Center, it is announced.

Louis Sudler, partner, Sudler and Company, rental agent for the tapering $95 million structure being built on North Michigan Ave., identified the stations as:

WGN-TV (Channel 9), WMAQ-TV (5), WBBM-TV (2), WTTW (11) and UHF stations WXXW (20) and WSNS (44).

The stations are expected to begin transmitting from the top of the world's tallest residential-commercial structure in the summer of 1968, Sudler announced.

Although plans are still subject to approval by the Federal Aviation Agency, the Hancock Center TV facility calls for twin transmission towers 2,049 ft above sea level, or 1,499 ft above Michigan Ave., a request the FAA is studying.

Each TV tower on the Hancock Center would rise 344 ft from its roof.

Also proposed as part of its broadcasting facility, John Hancock Center will include a lower 100-ft tall common FM radio antenna located directly between the two TV transmitters. The proposed antenna is designed to serve 15 stations.

Jerrold Announces Record Earnings

The Jerrold Corp. had record sales and earnings for the first half of the current fiscal year announces Milton J. Shapp, president. Consolidated sales for the six months net income of $459,188, equal to 22 cents per share, was $1,294,949, equal to 61 cents per common share, based on an average of 2,128,613 common shares outstanding. No provision is required for Federal income tax because of a tax loss carry over of approximately $3 million from previous periods.

Last year Jerrold reported sales of $12,999,770 and a net loss of $241,440 for the first half. However, after adjustments to reflect the sale of the assets and business of the Pilot Radio Corp. subsidiary last March, sales for the same period a year ago would have shown $11,126,548, with net income of $459,188, equal to 22 cents per share based on an average of 2,114,547 common shares outstanding.

Operating results for the first six months this year compared to those of last year — excluding Pilot — reflect an increase of 39 percent in sales and 182 percent in profits. Mr. Shapp disclosed that orders and contracts on hand as of September 1, 1965 exceeded $8,500,000, compared to an adjusted $7,300,000 at the same time a year ago.

Oak Acquisition

Oak Electro Netics Corp. announces acquisition of N. V. Messa Electronics, Emmen, Holland, through purchase of the remaining 25 percent of the Dutch company's outstanding capital stock. In April, 1965, Oak acquired a 75 percent stock interest in Messa. The Company will be operated as a wholly-owned subsidiary of Oak.

Harry E. Seston, formerly managing director of Oak-Hart Manufacturing (Canada) Ltd., the Canadian subsidiary of Oak in Aurora, Ontario, has been named managing director of Messa.

Messa produces VHF and UHF antennas, couplings, impedance transformers and filters. In May, the company began assembly of Oak Moduline rotary switches — custom-made units assembled from standard parts shipped from the United States.

the 1960s, from $630 million in 1965 to $755 million in 1970.

Although the industrial market will experience high annual growth rates through 1970, the consumer market is now enjoying and will continue to enjoy a relatively high rate of growth in the more immediate future, an expansion EIA attributes primarily to the rapid increase in sales of color television receivers.

Total sales of radios, particularly FM, phonographs, tape recorders, and many of the more recent consumer products, are also expected to contribute significantly to the overall growth of the consumer market.

Distributor Rep. for Cornell Dubilier

Cornell-Dubilier has appointed Covert-Newman Associates as their general line distributor representative in Western Pennsylvania and West Virginia.

Bernard Newman and Jack Covert have been active in both OEM and distributor marketing for many years. Their offices are located at 300 Mount Lebanon Rd., Pittsburgh, Pa.

Ullrich Named CCTV/MATV Product Manager

Walter A. Ullrich has been promoted to the position of product manager of the closed-circuit and master antenna television division of Blonder-Tongue Laboratories, Inc., announces Richard B. Helhoski, director of marketing of the electronics firm. In his new position, Mr. Ullrich will have national responsibility for CCTV and MATV systems, including developmental marketing and the coordination of sales programs.

Forecast Foresees 40% Increase

Business by the U.S. electronic industries is expected to expand 40 percent during the next five years, with all product segments — government, industrial, consumer products and components — sharing in the rise.

That is the outlook set forth in a five-year forecast prepared by the Electronic Industries Association (EIA) and released by Dr. Harper Q. North, EIA president and vice president, research and development, TRW Inc., Redondo Beach, Calif.

EIA foresees, Dr. North said, an increase in total industry business from $17 billion in 1965 to $23.9 billion by the end of 1970. The fast-growing industrial electronics market is expected to pace the expansion, rising 62 percent during the five-year period from $3.87 to $6.26 billion.

During the same period, the government market for electronics is expected to expand 36 percent, from $9.19 billion in 1965 to $12.48 billion in 1970, while the annual consumer electronics market is expected to advance 31 percent from $3.34 billion to $4.38 billion.

Electronic components business in the U.S. is projected to expand 28 percent from $4.30 billion during 1965 to $5.49 billion during 1970, according to the EIA analysis. Annual sales of components for replacement purposes are expected to increase by 20 percent during the balance of

July Mono CRT Sales Up in Units, Down in Dollars

Factory sales of monochrome TV picture tubes in July totaled 573,077 units valued at $9,398,626, up slightly in units (3.7 percent) but down in dollars (4 percent) compared to 552,550 units valued at $9,788,584 in July 1964, the Electronic Industries Association's Marketing Services Department reported today. Identical decreases in units and dollars (22.9 percent) were registered in July's sales figures as compared to 743,335 units and $12,191,-776 for the previous month of June 1965. Sales of mono TV picture tubes for the first seven months of 1965 were down both in units and dollars: 4,907,524 units valued at $81,921,719 in 1965 compared to 5,193,324 units valued at $92,327,538 in 1964, decreases of 5.5 percent in units and 11.3 percent in dollars. Unit sales of receiving tubes in July totaled 26,203,000, down 1.7 percent from 26,-648,000 in July 1964 and down 17.7 percent from 31,842,-000 in the previous month of June 1965. Receiving tube sales for the first seven months of 1965 totaled 214,252,000 up 5.2 percent from 203,718,000 units during the same period of 1964.

Ampex-Orrtronics Agreement

Ampex Corporation, Redwood City, California, and Orrtronics, Inc., of Opelika, Alabama, have concluded an agreement licensing Ampex to manufacture and market home and educational versions of the Orrtronic cartridge stereo tape music system now being sold for use in automobiles. Ampex will provide technical support for the further development of cartridge systems for various markets. Orrtronics will continue to manufacture and market the automobile system.

New Belden Plant

Belden Manufacturing Company, Chicago, announces construction of a new plant near Franklin, N. C.

Twenty-five acres of land have been acquired approximately one and one-half miles south of the town of Franklin, North Carolina. Franklin is a town with a population of approximately 2,500 people, located in Macon County in western North Carolina. The plans are to erect a 45,000 sq ft plant which will initially employ about 100 people when the plant is in full production.

Belden Earnings

Belden Manufacturing Company announces that its earnings for the nine month period ended Spetember 30, 1965, rose to a new high in the company's 63 year history to $2,169,554 or $2.66 a share. Last year for the same period the earnings were $1,572,012 or $1.95 a share.

Sales for the period climbed 24% over the same period a year ago to a new high of $38,338,002. The sales figure last year for nine months was $30,871,985.

Littelfuse Nine Month Profits and Sales

Littelfuse, Inc., net sales and earnings for the nine months ended Sept. 30, 1965, were the highest on record, announces Thomas M. Blake, president. He reported increased earnings of $261,329, or 71 cents per share, for the nine months of 1965 compared with $190,-564, or 52 cents per share for the same period in 1964. Sales rose to an all-time high of $7,202,119 in contrast to last year's $5,243,584.

NEWS OF THE INDUSTRY

Second American Revolution

A "second American revolution" based on technology can remove poverty and hunger in the underdeveloped nations and thwart the communist thrust for world domination, David Sarnoff, Chairman of the Board of the Radio Corporation of America, said.

He spoke at a National Veterans Day dinner in Birmingham, Alabama at which he received the 1965 National Veterans Award, presented annually by nine leading veterans organizations to the person who has distinguished himself most as a veteran during the year.

Charging communism with "defrauding mankind" by distorting the purpose of revolution, General Sarnoff said:

"Today, I believe we have it within our power to demonstrate the strength of our historic American principles with such clarity that the pretensions of communism can be totally exposed and its designs finally thwarted.

"The instrument that we possess is technology — the application of science to human need. It is generating a second American revolution which will have as great an impact as the first upon this nation and the world."

General Sarnoff cited the recently announced Red Chinese strategy of mobilizing the underdeveloped "rural areas of the world" to isolate and crush the industrialized West, and he said:

"Just as communist growth is rooted in frustration, it withers as the causes of frustration are removed. Therefore, to the extent that we apply our technology to the needs of others, we strengthen ourselves. In this way, we can blunt the communist thrust and defeat its objective of encircling and conquering the free world."

The RCA Chairman said that the wise application of technology to the underdeveloped continents can remove the vast distinctions between the rural areas and the cities, extending everywhere "the same opportunities for greater well-being, the same technologies and resources, and the same means of using them."

"In short," he added, "this second American revolution can accomplish all that communism has promised and never delivered, and it can do so by using the implements of technology for constructive purposes."

RCA Opens Direct Telex Link With U.S.S.R.

RCA Communications, Inc. announces the inauguration of telex service between the United States and the Soviet Union. The service was officially opened and placed in commercial operation by an exchange of messages between the Soviet Ministry of Communications and T. H. Mitchell, president of the RCA subsidiary. Mr. Mitchell said, "The opening of telex communications between the U.S.S.R. and the U.S.A. marks another step forward in the many years of close cooperation in telecommunications between the two organizations." He pointed out that RCA has been maintaining direct telegraphic communications with the U.S.S.R. for more than 30 years. At the outset, government agencies and news media are expected to be the first users of the new telex service which provides two-way teletypewriter connections between the two nations. However, the service is also available to more than 70,000 subscribers to AT&T's TWX network, the Western Union domestic network and RCA subscribers in New York, San Francisco and Washington.

NEW PRODUCTS

Coaxial Switches 300

This sixteen page catalog covers a line of coaxial switches. The catalog contains illustrations and mechanical and electrical information on 23 different series of switches. Amphenol.

Electronic Products 301

A 508 page catalog presents high fidelity components, CB and ham radio units, public address and intercom equipment. Test instruments, radios and phonographs, small screen portable TV receivers, tubes, parts, antennas, tools and technical books are also included. Allied.

Spindle Replacement 302

This wall chart shows a complete line of popular 45rpm adapters and center posts which are visually cross-referenced to the record changer. A supplementary catalog lists a line of record changers and phono cartridges. Vidaire.

Electrolytic Capacitors 303

Specifications, dimensional drawings and performance curves of a line of both axial and printed circuit lead capacitors. Centralab.

Semiconductors 304

This 8 page handbook contains replacement guides for 6 categories of semiconductors. Transistors, diodes, silicon rectifiers, selenium rectifiers, selenium dual diodes and color TV rectifier replacements are included. Semitron.

Audio Systems 305

A series of modular amplifiers and accessories for commercial audio installations is described in this eight page catalog. Harman-Kardon.

Stereo Consoles

This booklet features a line of stereo consoles. It contains several articles dealing with the technical and non-technical aspects. Scott.

Two-Way Radio 306

This four page brochure describes and illustrates features and applications of a business/industrial transceiver. E. F. Johnson.

Nickel-Cadmium Batteries 307

This four page brochure discusses applications, maintenance features, packaging arrangements, charging and construction of a line of nickel-cadmium sealed cells. Sonotone.

2-WAY CUSTOMERS . . .

Continued from page 55

adequate audio for good communications. A 2μv sensitivity is less desirable since the receiver requires stronger signals for adequate audio readability.

Checks of receiver sensitivity should be made and recorded periodically.

Loss of receiver sensitivity can generally be traced to low gain in the RF and first IF stages. This is usually caused by tube aging. Most often, a change of tubes in these stages will bring sensitivity back to normal. Tubes should not be changed arbitrarily.

If a change of tubes does not improve sensitivity, re-align the receiver as described in the service manual. If this does not provide acceptable sensitivity, then look for a defective component. Check plate voltages and power supply output and replace defective components to bring voltages up to normal. Check gain in the RF and IF stages. Compare these measurements with the chart in the service

manual to isolate the faulty stage. Check voltages and resistances in the faulty stage to isolate the defective component.

With proper attention to "netting" and deviation, as covered in Part I of this series, plus the problems discussed in this article, you are well on your way toward giving your customers the most from their two-way radio equipment.

The final article in this series will cover two-way mobile power supplies, antennas and checking transmitter output power. ■

CERAMICS . . .

Continued from page 64

infinite shelf life and do not deteriorate under sustained rated-voltage application. They are also being used as the familiar "doorknob" capacitor in TV high-voltage circuits.

Ceramic capacitors are being used more in original-equipment because they are less expensive. And their small size, plus economy, make them a favorite replacement component in electronic servicing too. Care should be exercised, however, to use the proper type when replacing another ceramic type. It should be remembered that the circuit application of the component determines the type of ceramic to use. If the capacitor is used for coupling, for example, it should be replaced with a 20 percent general use ceramic. For that matter, it pays to be careful when replacing a ceramic capacitor with a ceramic capacitor. These are flexible little components and they are sometimes used for special applications. The ceramic capacitor may be in the circuit for temperature compensation and it should naturally be replaced with the same type.

In fact, the versatility and applications-scope of these ceramic discs and tubes almost place them in the category of a new type component. They are certainly the best thing that has happened to capacitors since the Leyden jar.

Technicians of the not too distant future will no doubt consider us slightly eccentric for using rolls of foil and paper for capacitors. They will use ceramic and never give a thought to its beautiful simplicity. ■

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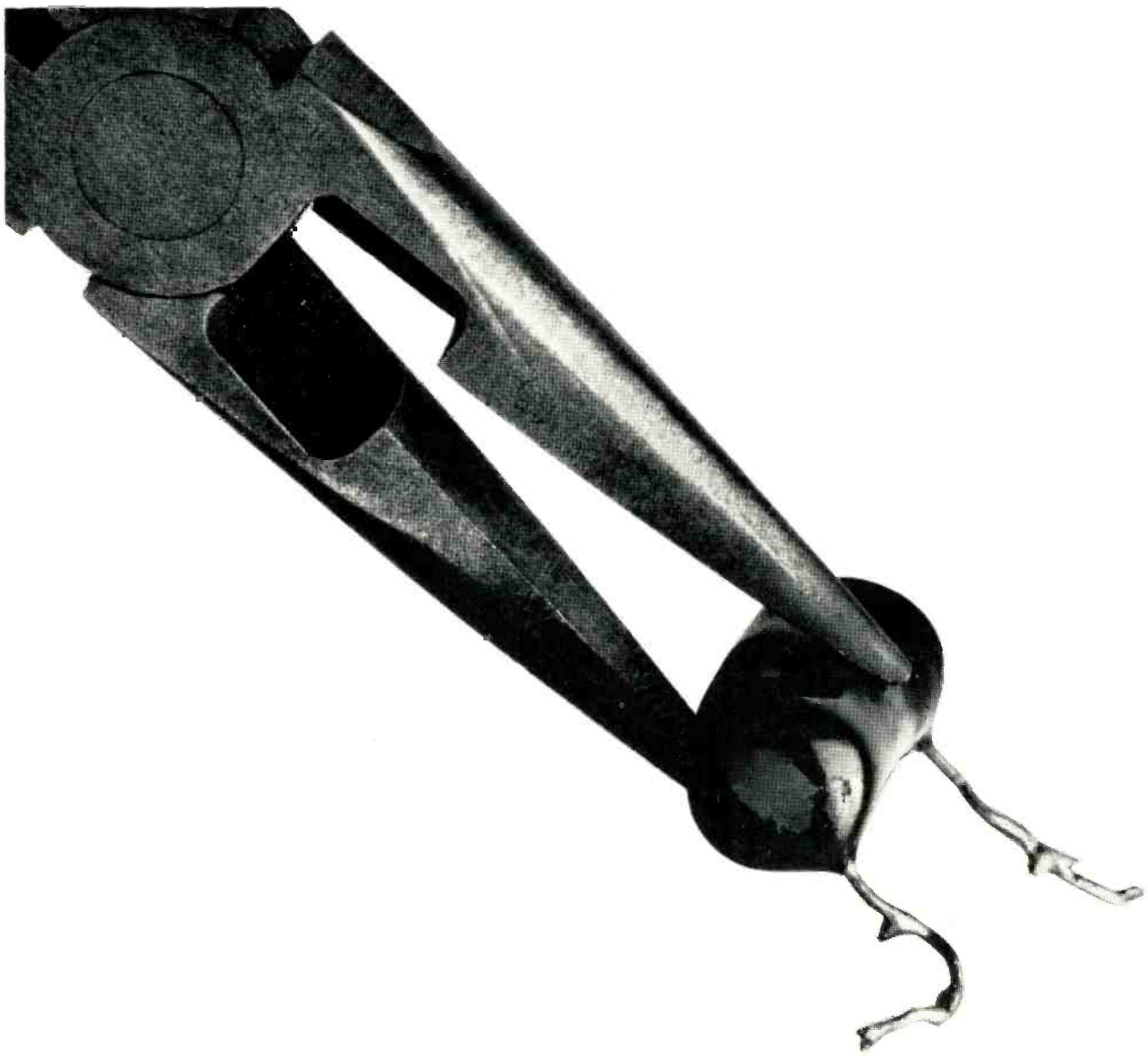

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Elmenco dp capacitors satisfy the requirements of missile manufacturers. And exceed the requirements of all radio and television manufacturers. That's why you should order some from your Arco-Elmenco distributor. They're built to be wired into missiles. And priced to be wired into TV sets.

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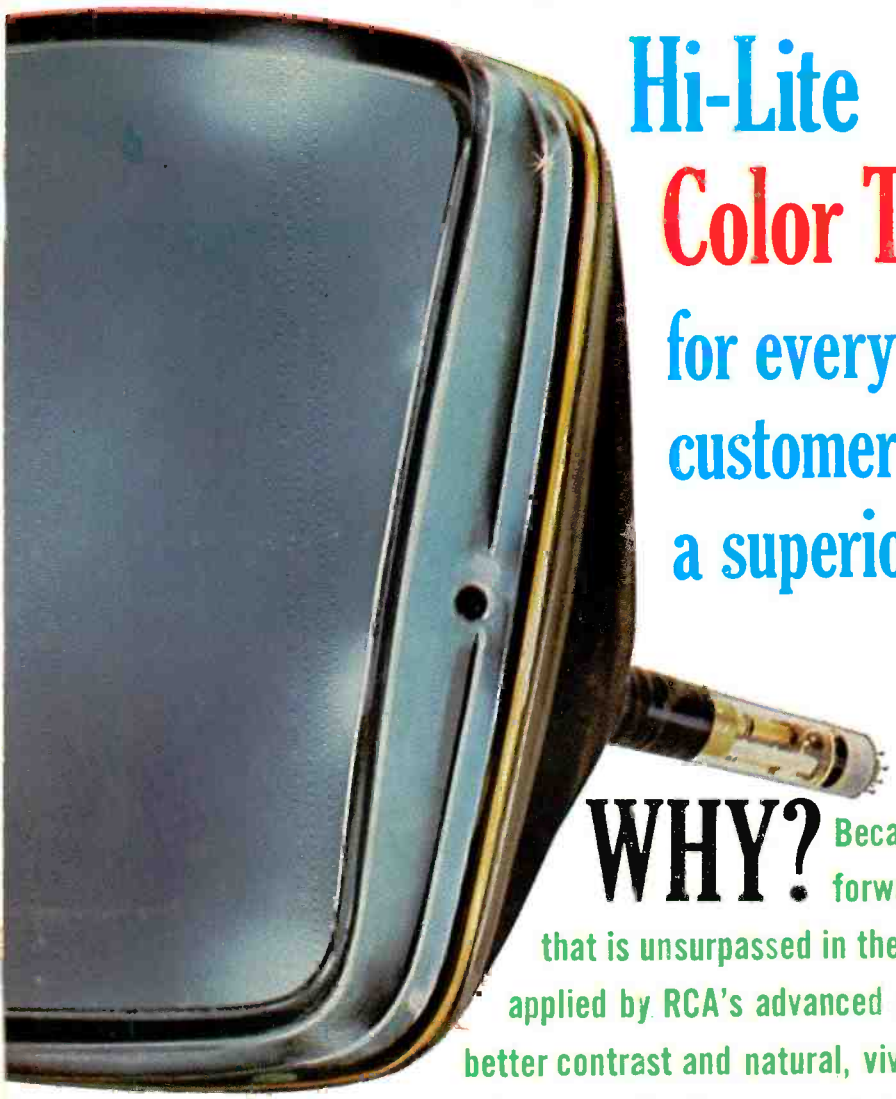

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