

ELECTRONIC TECHNICIAN

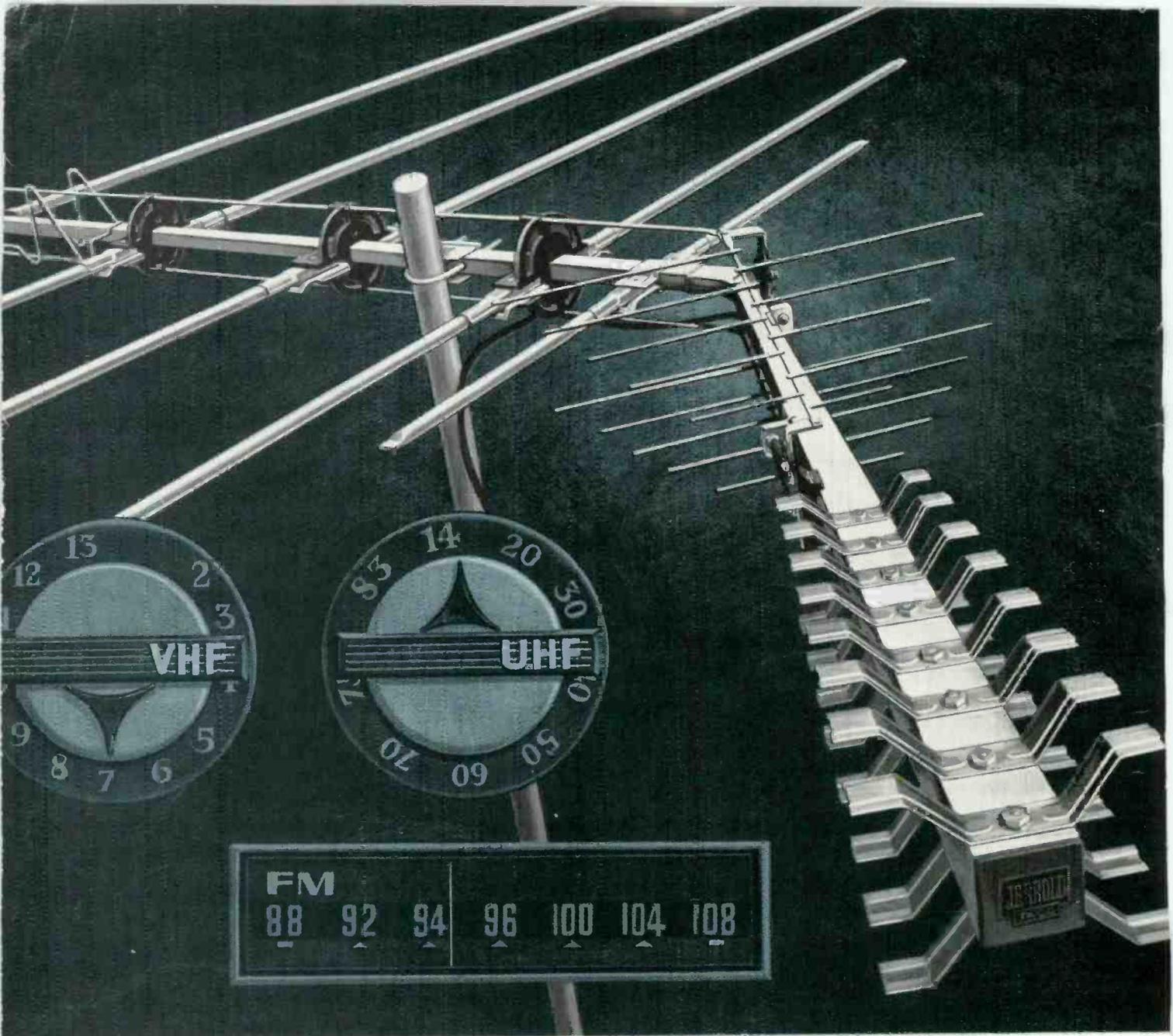
WORLD'S LARGEST ELECTRONIC TRADE CIRCULATION



Understanding Solid-State Hi Fi Amplifiers
Basics of Modern Tape Recorders
Troubleshooting FM / Stereo Equipment



SEPTEMBER 1966



NOW...FIRST ALL-CHANNEL ANTENNA WITH INDIVIDUAL UHF and VHF ORIENTATION, 75- OR 300-OHM OUTPUT

**New JERROLD
Coloraxial**

PathfinderTM

Here's the antenna to answer every VHF, UHF, and FM reception need from metropolitan to deep-fringe areas... Jerrold's new Coloraxial PATHFINDER.

The new PATHFINDER (Series PAB and PXB) is a unique combination—a cascaded-periodic VHF antenna plus an advanced-design UHF section, all in one pre-assembled unit. Both 75-ohm Coloraxial and 300-ohm models for every taste and budget. And look at the prices—as low as \$21.95!

VHF and UHF sections may be individually oriented for maximum directivity. While you get all the flexibility of separate VHF

and UHF antennas, PATHFINDER eliminates the splitters (with their inherent losses) needed to couple separate antennas with a common downlead.

Take advantage of the growing UHF and FM stereo markets by selling this all-purpose high-gain antenna. Rugged square-boom construction and Golden Armor corrosion-resistant finish assure long life. Flat response across entire band (channels 2-83), low VSWR, excellent front-to-back ratio make PATHFINDER a "natural" for easy sales and satisfied customers. Talk to your Jerrold distributor today, or write for complete information. *Jerrold Electronics Corporation, Distributor Sales Division, 401 Walnut St., Philadelphia, Pa. 19105.*

JERROLD

... for more details circle 132 on postcard

ELECTRONIC TECHNICIAN

TEKFAX

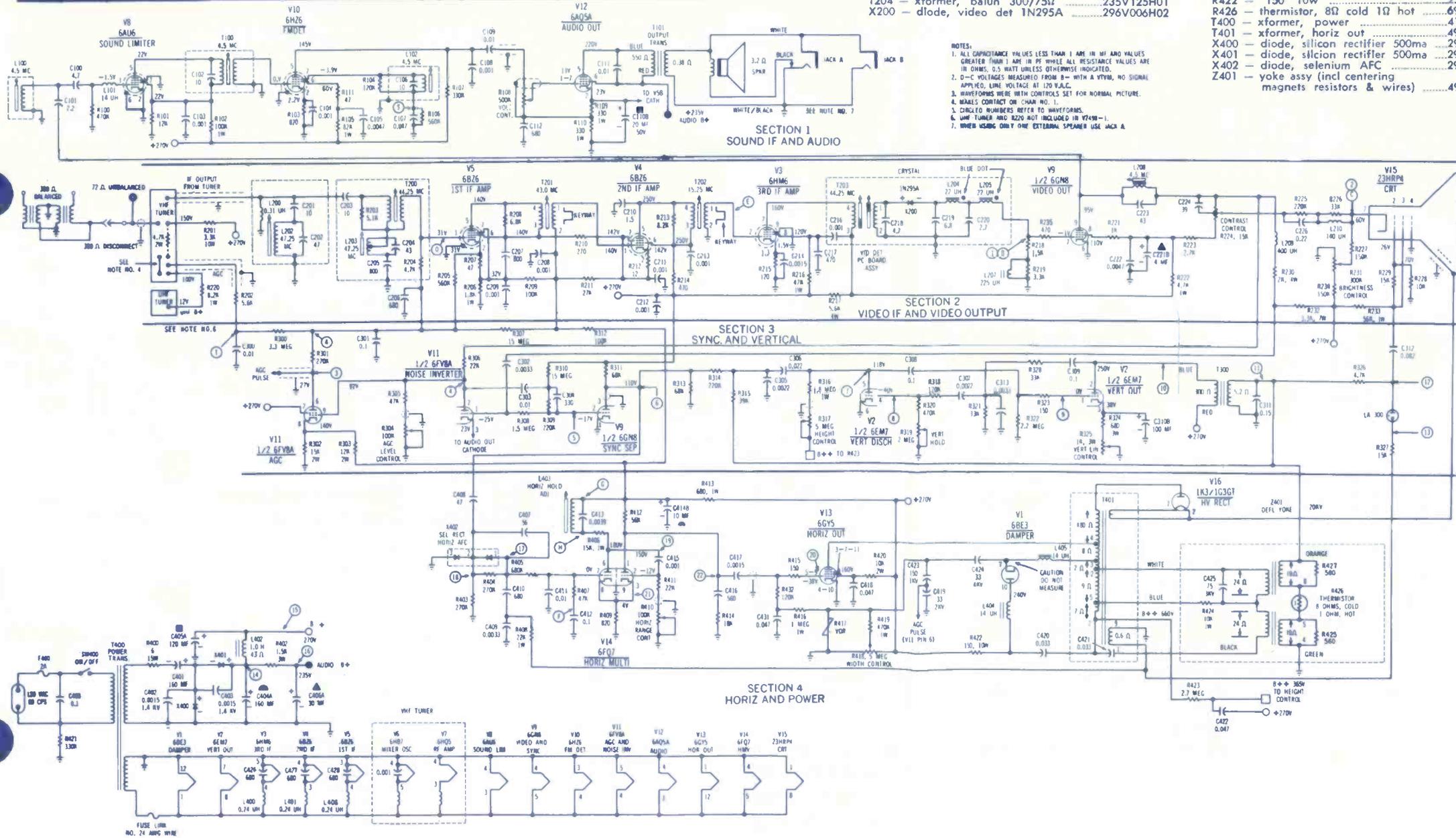
COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS
AND TECHNICAL INFORMATION FOR 7 NEW SETS

GROUP
169

Manufacturer	Schematic No.	Model	Manufacturer	Schematic No.	Model
CANADIAN GENERAL ELECTRIC	1030	TV Chassis M618	SYLVANIA	1035	TV Chassis A06, A07 Series
EMERSON	1033	TV Chassis 120837, 839, 840, 841, 842, 843, 846, 847, 848	WESTINGHOUSE	1029	TV Chassis V-2498 Series
MOTOROLA	1031	TV Chassis TS594	ZENITH	1034	TV Chassis 13X15
RCA VICTOR	1032	Color TV Chassis CTC20			

Symbol	Description	Westinghouse Part No.
C102	10pf 500v N750 cer	215V611A00
C110B	20uf 50v elect (incl C221B, C310B, C414B)	218V054H29
L100	coil, adj 4.5MHz limiter grid	230V083H01
L101	coil, 14uh RF choke	230V130H02
R108	control, vol 500K incl R231 SW400	270V166H04
T100	xformer, 4.5MHz FM det grid	235V046H01
T101	xformer, audio output 3.2Ω	430V154H01
C201	10pf 500v NPO 5% cer	215V131A00
C202	47pf 500v NPO 5% cer	215V134A70
C203	10pf 500v NPO cer	215V300H76
C204	43pf 500v NPO 5% cer	215V134A30
C218	4.7pf 500v N750 cer	215V300H56
C220	2.7pf 500v NPO cer	215V122A79
C221B	4uf 350v elect (incl C110B, C310B, C414B)	218V054H29
L200	coil, .31uh RF choke	230V065H04
L202	coil, adj 47.25MHz trap	230V076H02
L203	coil, adj 47.25MHz trap tapped	230V076H01
L204	coil, reactor 22uh	230V142H01
L205	coil, reactor 22uh	230V142H01
L207	coil, peaking 225uh	230V141H05
L208	coil, adj 4.5MHz	230V030H09
L209	coil, peaking 400uh	230V141H07
L210	coil, peaking 140uh	230V141H06
R201	3.3K 10w	251V014H48
R203	5.1K 5%	259V003H28
R217	5.6K 4w	251V014H45
R218	1.5K 5%	250V211A52
R224	control, contrast 15K	270V159H12
R230	2K 4w	251V014H37
R231	control, brightness 300K incl R108, SW400	270V166H04
R232	3.3K 7w	251V014H38
T200	xformer, adj 44.25MHz IF input	235V049H01
T201	xformer, adj 43.0MHz 1st IF	235V048H01
T202	xformer, adj 45.25MHz 2nd IF	235V048H04
T203	xformer, adj 44.25MHz 3rd IF	235V116H01
T204	xformer, balun 300/75Ω	235V125H01
X200	diode, video det 1N295A	296V006H02

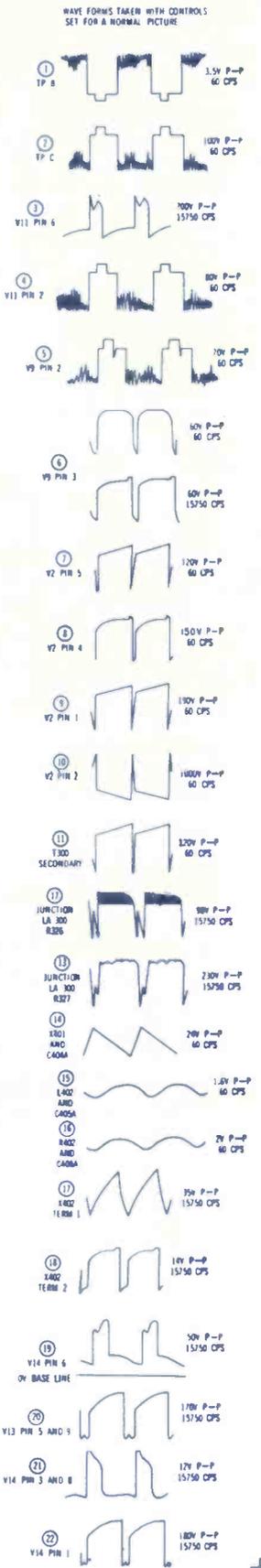
C310B	100uf 50v elect (incl C110B, C221B, C414B)	218V054H29
LA300	lamp neon horiz blanking, RL7-2-27-1A	756V517H01
R304	control, AGC level 100K part of quadruple control Assy (incl R317, R410, R418)	270V162H01
R317	control, height 5M part of quadruple control Assy (incl R304, R410, R418)	270V162H01
R319	control, vert hold 2M	270V159H01
R324	680, 3w	251V014H51
R325	control, vert lin 1K 3w	270V138H02
T300	xformer, vert output	430V039H09
C401	160uf 200v 1.5A elect	218V025H65
C402	.0015uf 1.4kv GMV cer	215V160A03
C403	.0015uf 1.4kv GMV cer	215V160A03
C404A	160uf 350v elect	218V053H20
C405B	120uf 350v elect	218V053H20
C406A	30uf 350v elect	215V125A60
C407	56pf 500v NPO cer	215V124A70
C408	47pf 500v NPO cer	215V318H10
C419	33pf 2kv cer 10%	215V391A51
C423	150pf 1kv cer 10%	215V318H10
C424	33pf 4kv cer 10%	215V318H10
F400	fuse 2A, 125v slo-blo	758V001H09
L400	coil, .24uh	230V065H06
L401	coil, .25uh	230V065H06
L402	choke, filter 1.0hy	430V121H02
L403	coil, adj horiz hold incl: extension shaft	230V144H01
R400	6Ω 15w candohm	251V028H12
R402	1.5K 3w WW	259V009H01
R409	820 5%	250V218A21
R410	control horiz range 100K part of quadruple control Assy (incl R304, R317, R418)	270V162H01
R417	VDR	259V015H01
R418	control, width 5M part of quadruple control Assy (incl R304, R317, R410)	270V162H01
R422	150 10w	251V014H50
R426	thermistor, 8Ω cold 1Ω hot	690V011H08
T400	xformer, power	410V069C01
T401	xformer, horiz out	493V018H01
X400	diode, silicon rectifier 500ma	295V006H03
X401	diode, silicon rectifier 500ma	295V006H03
X402	diode, selenium AFC	296V004H01
Z401	yoke Assy (incl centering magnets resistors & wires)	490V017C03

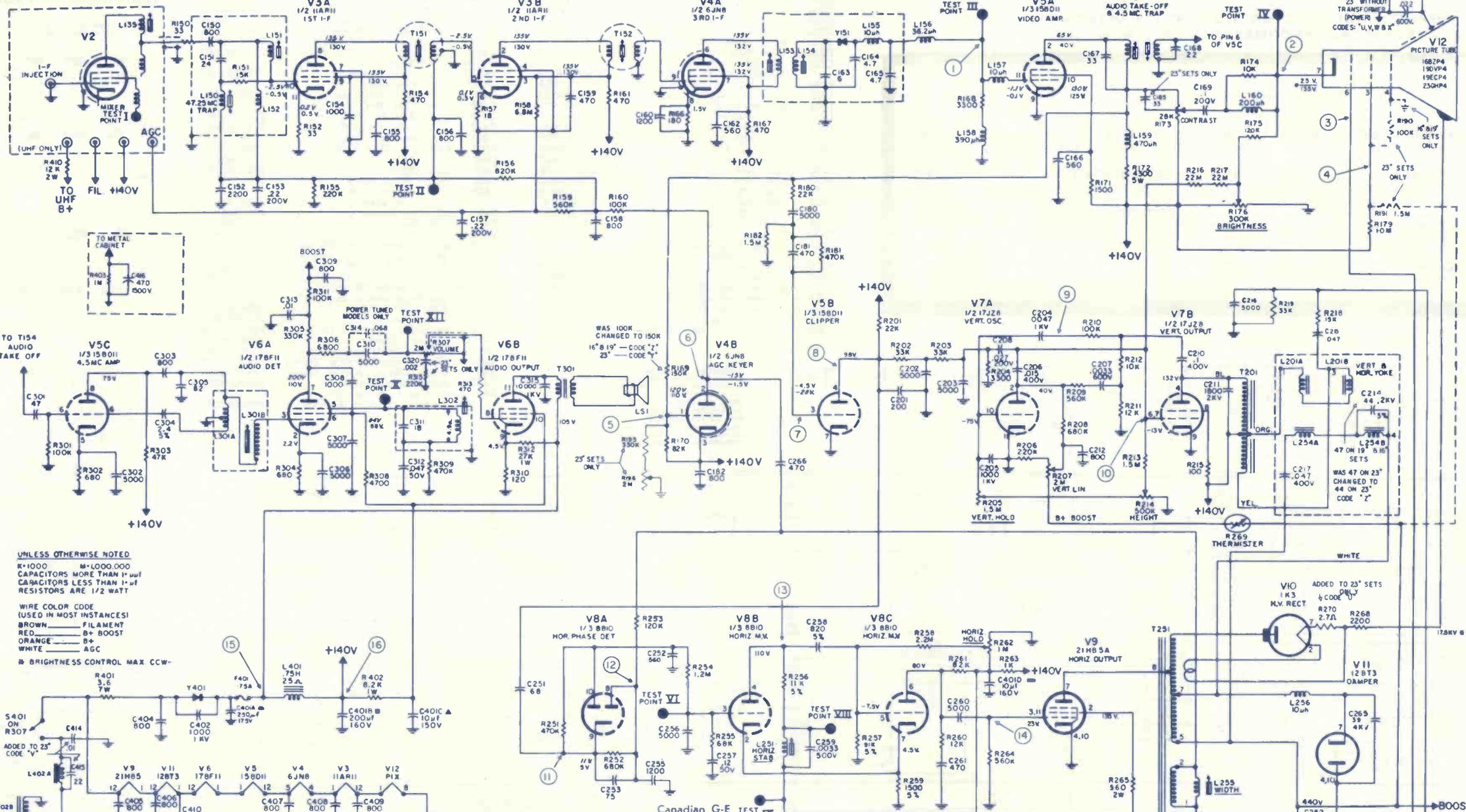
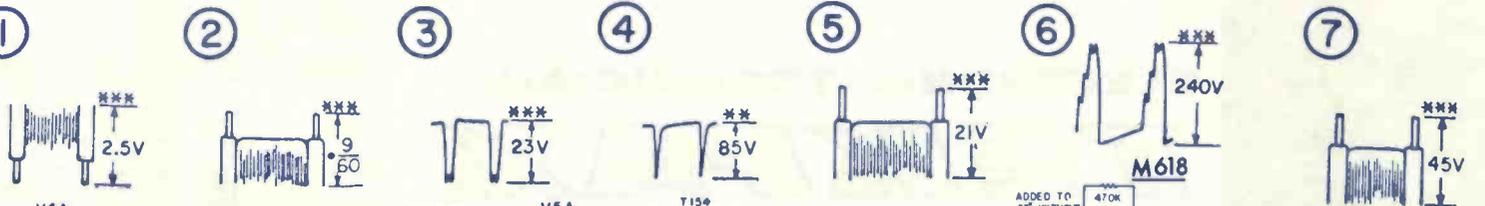


NOTES:
1. ALL CAPACITANCE VALUES LESS THAN 1 ARE IN PF AND VALUES GREATER THAN 1 ARE IN μF UNLESS OTHERWISE INDICATED.
2. D-C VOLTAGES MEASURED FROM B- WITH A VTVM, NO SIGNAL APPLIED, LINE VOLTAGE AT 120 V.A.C.
3. WAVEFORMS WERE TAKEN WITH CONTROLS SET FOR NORMAL PICTURE.
4. WAVEFORMS TAKEN FROM B- WITH A VTVM, NO SIGNAL APPLIED, LINE VOLTAGE AT 120 V.A.C.
5. CIRCLED NUMBERS REFER TO WAVEFORMS.
6. VHF TUNER AND R220 NOT INCLUDED IN V2498-1.
7. WHEN USING ONLY ONE EXTERNAL SPEAKER USE JACK A.

1029
WESTINGHOUSE
TV Chassis V-2498 Series

September • 1966





UNLESS OTHERWISE NOTED
 K=1000 M=1,000,000
 CAPACITORS MORE THAN 1 μ f
 CAPACITORS LESS THAN 1 μ f
 RESISTORS ARE 1/2 WATT

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

* BRIGHTNESS CONTROL MAX. CCW

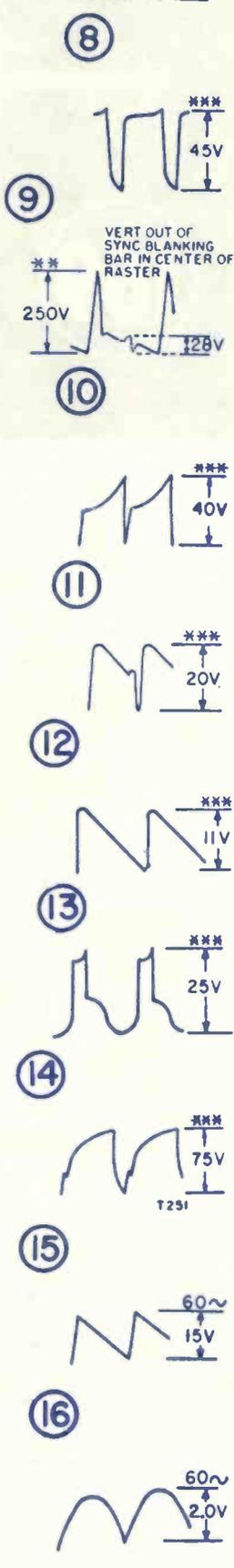
Symbol	Description	Canadian G-E Part No.
C307	310 - 5000pf GMV 500v	R1973
C181	266 - 470pf 20% 500v	R6729
C205	1000pf 20% 1000v	R6746
C211	1800pf 20% 2000v	R4112
C258	mica 820pf 5% 500v	R7003
C401A, B	elect 250 μ f 175v/200 μ f 160v	R6735
L150	coil, 47.25MHz link	R6735
L302	coil, quad	R7001
T151	x-former, 1st IF	R6999
T152	x-former, 2nd IF	R6739
T154	x-former, audio take-off and trap	R7000
T201	x-former, vert output	R7004
T251	x-former, horiz output 16" & 19" sets only	R7092
T251	x-former, horiz output 23" sets only	R7085
T301	x-former, audio output 16" & 19" sets only	R7005
T301	x-former, audio output 23" sets only	R7084
	yoke, deflection, models 95T51	
	95T52, 95T53 only	R7294
	yoke, deflection 23" sets only	R7118
	yoke, deflection all other models	R7050
R176	control, brightness 300K	R7191
R173	control, contrast 25K	R7189
R205	control, vert hold 1.5M	R7190
R307	control, vol 2M	
S401	switch, ac power	R7192
T401	x-former, power	R7317
T401	x-former, power	R7173

** SCOPE SYNCED AT 1/2 VERTICAL FREQUENCY.
 *** SCOPE SYNCED AT 1/2 HORIZONTAL FREQUENCY.

● VARIES WITH CONTROL SETTING.

WAVE SHAPES TAKEN WITH A NOISE FREE SIGNAL PRODUCING -2.5 to -3.5 volts AGC AT THE VHF TUNER. FINE TUNING CONTROL ADJUSTED FOR MAXIMUM AGC. ALL OTHER CONTROLS ADJUSTED FOR NORMAL OPERATION.

- NOTES:
- ALL VOLTAGE MEASUREMENTS MADE WITH A VACUUM TUBE VOLTMETER WITH RESPECT TO CHASSIS GROUND, WITH RECEIVER CONTROLS SET FOR NORMAL OPERATION.
 - WITH LINE VOLTAGE MAINTAINED AT 120 V. AC, MEASUREMENTS MAY DEVIATE \pm 10%.
 - VOLTAGES SHOWN IN BOLD MADE WITH THE SELECTOR KNOB SWITCHED TO A CHANNEL WITH NO SIGNAL AND THE ANTENNA TERMINALS SHORTED.
 - WHEN VOLTAGE IN ITALICS IS NOT SHOWN, VOLTAGE IN BOLD IS THE SAME FOR EITHER ON SIGNAL OR OFF SIGNAL. ON SIGNAL VOLTAGES SHOWN IN ITALICS TAKEN WITH A NOISE FREE SIGNAL PRODUCING -2.5 to -3.5 volts AGC AT VHF TUNER. FINE TUNING CONTROL ADJUSTED FOR MAXIMUM AGC.
- ALL OTHER CONTROLS ARE ADJUSTED FOR NORMAL OPERATION.
 * BRIGHTNESS CONTROL AT MAX. CCW.



GENERAL INFORMATION

The receivers in this manual employ a horizontally mounted chassis containing an 11-transistor etched board sub-chassis on which are mounted the small-signal circuits. These include the video and audio IF amplifiers, video amplifiers, sync, AGC and noise gate circuits.

The chassis also has 8 tubes employed in the sweep and audio output circuits and the VHF tuner. The UHF tuner is transistorized. The diode complement consists of 10 diodes and 2 silicon power rectifiers on the chassis plus 1 diode in the UHF tuner.

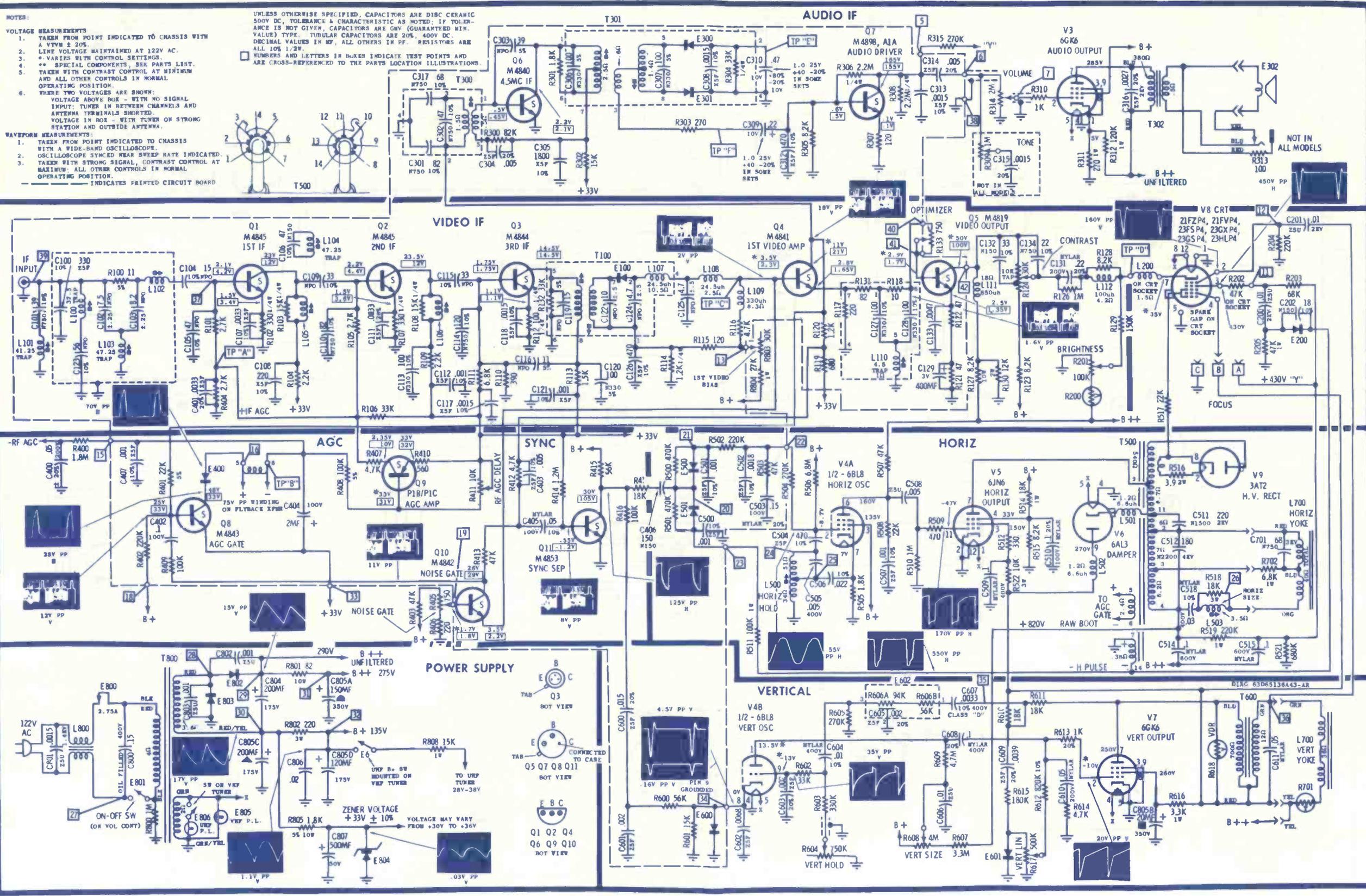
ELECTRICAL SPECIFICATIONS

Power Rating: 145 watts
Source: 120 volts, 60 cycle AC INTERMEDIATE FREQUENCIES
IF: Video 45.75Mc
Sound 41.25Mc
Sound IF: 4.5Mc

COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR 7 NEW SETS

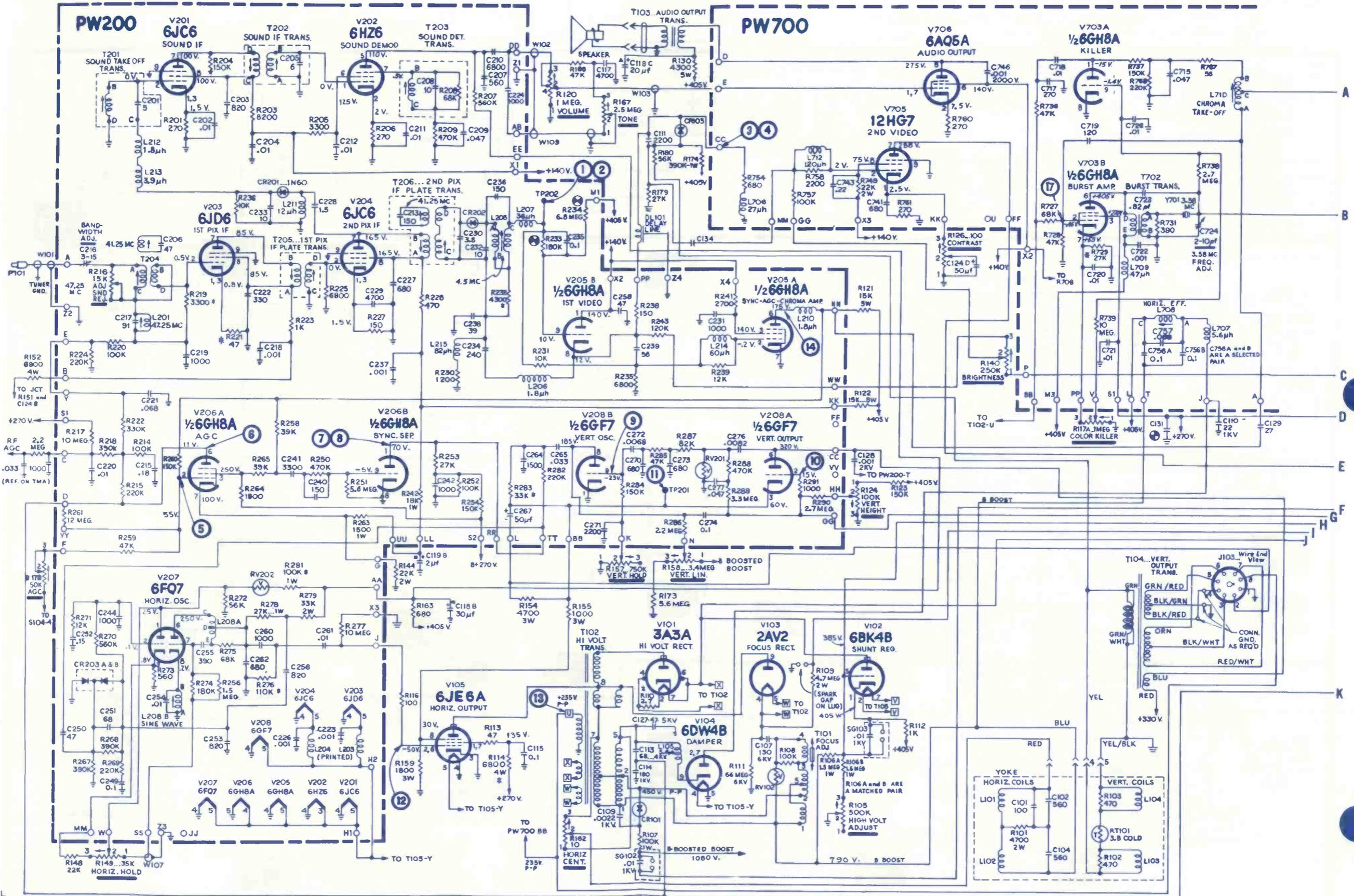
- NOTES:
VOLTAGE MEASUREMENTS
1. TAKEN FROM POINT INDICATED TO CHASSIS WITH A VTVM ± 2%.
2. LINE VOLTAGE MAINTAINED AT 122V AC.
3. VARIES WITH CONTROL SETTINGS.
4. ** SPECIAL COMPONENTS, SEE PARTS LIST.
5. TAKEN WITH CONTRAST CONTROL AT MINIMUM AND ALL OTHER CONTROLS IN NORMAL OPERATING POSITION.
6. WHERE TWO VOLTAGES ARE SHOWN: VOLTAGE ABOVE BOX - WITH NO SIGNAL INPUT; TUNER IN BETWEEN CHANNELS AND ANTENNA TERMINALS SHORTED. VOLTAGE IN BOX - WITH TUNER ON STRONG STATION AND OUTSIDE ANTENNA.
WAVEFORM MEASUREMENTS:
1. TAKEN FROM POINT INDICATED TO CHASSIS WITH A WIDE-BAND OSCILLOSCOPE.
2. OSCILLOSCOPE SYNCED NEAR SWEEP RATE INDICATED.
3. TAKEN WITH STRONG SIGNAL, CONTRAST CONTROL AT MAXIMUM; ALL OTHER CONTROLS IN NORMAL OPERATING POSITION.
- INDICATES PRINTED CIRCUIT BOARD

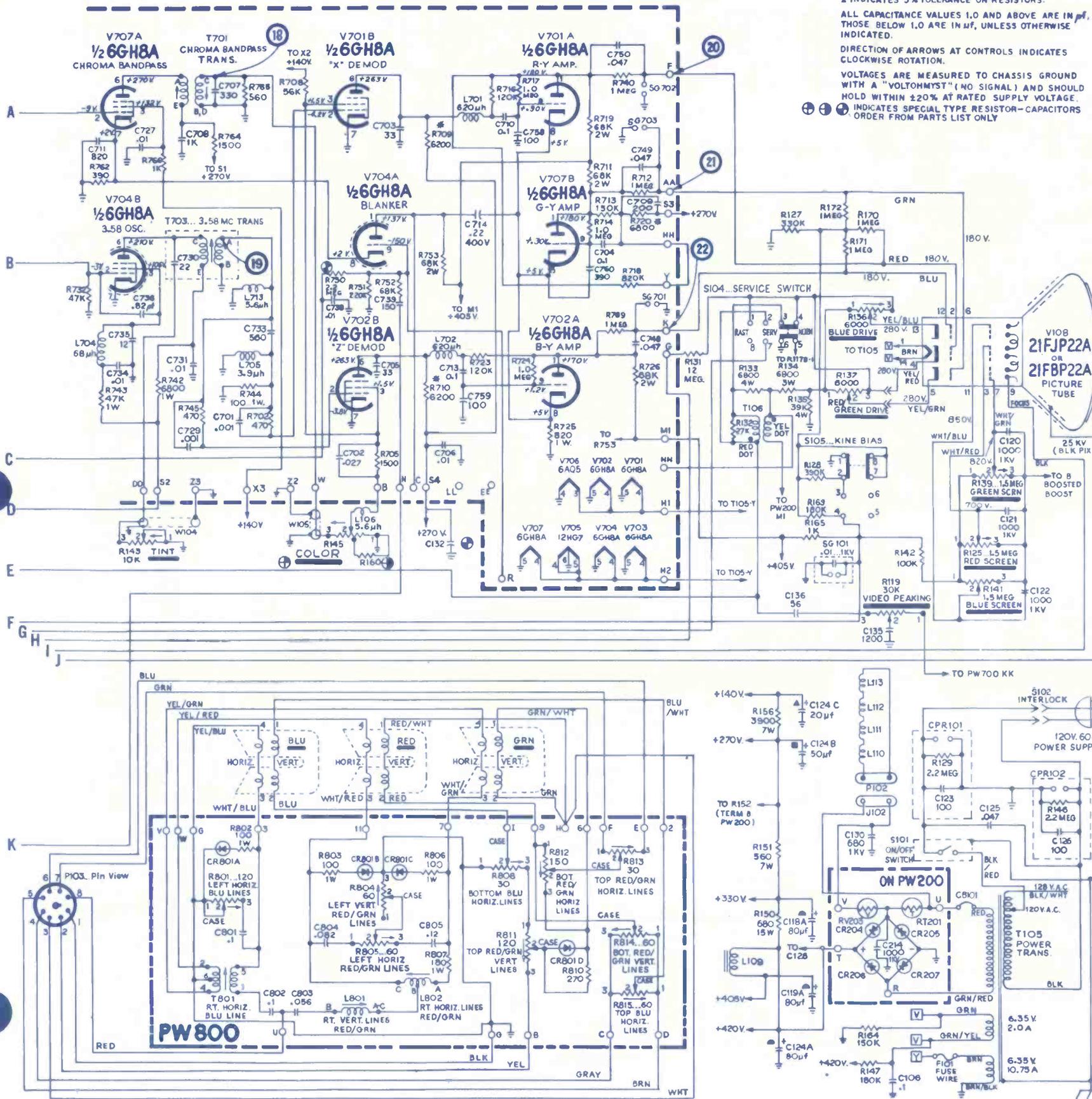
UNLESS OTHERWISE SPECIFIED, CAPACITORS ARE DISC CERAMIC 500V DC, TOLERANCE & CHARACTERISTIC AS NOTED; IF TOLERANCE IS NOT GIVEN, CAPACITORS ARE GRV (GUARANTEED MIN. VALUE) TYPE. TUBULAR CAPACITORS ARE 20%, 400V DC. DECIMAL VALUES IN MΩ, ALL OTHERS IN Ω. RESISTORS ARE ALL 1/2W.



September • 1966

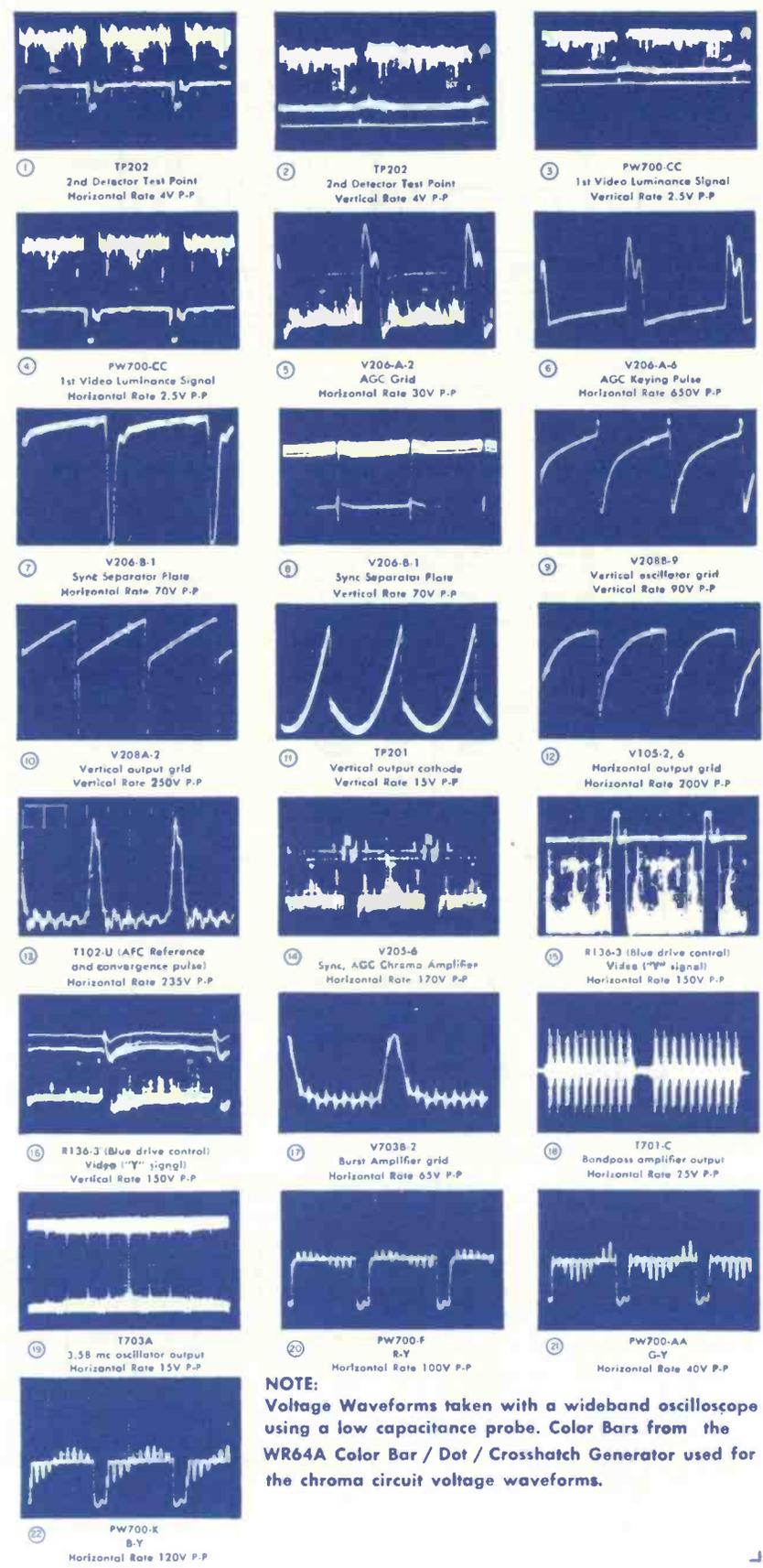
COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS
AND TECHNICAL INFORMATION FOR 7 NEW SETS





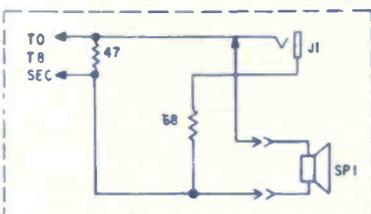
NOTES:
K=1000.
ALL RESISTANCE VALUES ARE IN OHMS.
ALL RESISTORS ARE 1/2 WATT EXCEPT AS NOTED.
X INDICATES 5% TOLERANCE ON RESISTORS.
ALL CAPACITANCE VALUES 1.0 AND ABOVE ARE IN μ F, THOSE BELOW 1.0 ARE IN μ F, UNLESS OTHERWISE INDICATED.
DIRECTION OF ARROWS AT CONTROLS INDICATES CLOCKWISE ROTATION.
VOLTAGES ARE MEASURED TO CHASSIS GROUND WITH A "VOLTMYST" (NO SIGNAL) AND SHOULD HOLD WITHIN $\pm 20\%$ AT RATED SUPPLY VOLTAGE.
⊕ ⊕ ⊕ INDICATES SPECIAL TYPE RESISTOR-CAPACITORS ORDER FROM PARTS LIST ONLY

CTC20C CHASSIS VOLTAGE WAVEFORMS

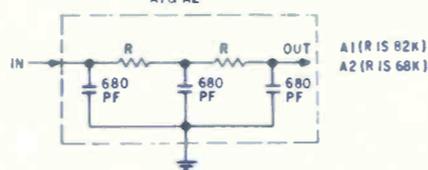


NOTE:
Voltage Waveforms taken with a wideband oscilloscope using a low capacitance probe. Color Bars from the WR64A Color Bar / Dot / Crosshatch Generator used for the chroma circuit voltage waveforms.

EARPHONE JACK ASSEMBLY (MODEL X1225 ONLY)



EQUIVALENT CIRCUIT OF
A18 A2



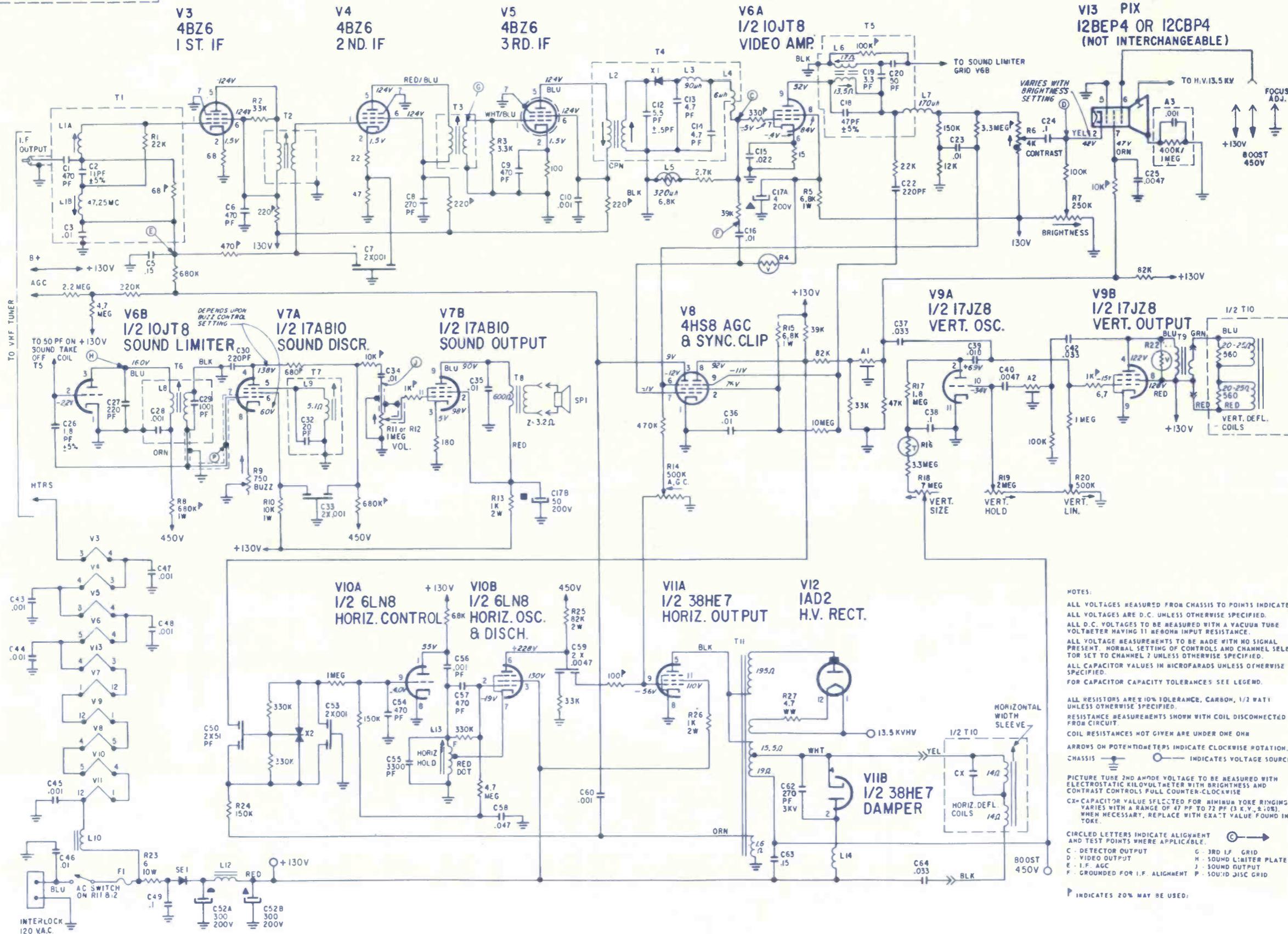
V3
4BZ6
1 ST. IF

V4
4BZ6
2 ND. IF

V5
4BZ6
3 RD. IF

V6A
1/2 10JT8
VIDEO AMP.

V13 PIX
12BEP4 OR 12CBP4
(NOT INTERCHANGEABLE)



NOTES:
 ALL VOLTAGES MEASURED FROM CHASSIS TO POINTS INDICATED.
 ALL VOLTAGES ARE D.C. UNLESS OTHERWISE SPECIFIED.
 ALL D.C. VOLTAGES TO BE MEASURED WITH A VACUUM TUBE
 VOLTMETER HAVING 11 MEGOHM INPUT RESISTANCE.
 ALL VOLTAGE MEASUREMENTS TO BE MADE WITH NO SIGNAL
 PRESENT. NORMAL SETTING OF CONTROLS AND CHANNEL SELEC-
 TOR SET TO CHANNEL 2 UNLESS OTHERWISE SPECIFIED.
 ALL CAPACITOR VALUES IN MICROFARADS UNLESS OTHERWISE
 SPECIFIED.
 FOR CAPACITOR CAPACITY TOLERANCES SEE LEGEND.
 ALL RESISTORS ARE $\pm 10\%$ TOLERANCE, CARBON, 1/2 WATT
 UNLESS OTHERWISE SPECIFIED.
 RESISTANCE MEASUREMENTS SHOWN WITH COIL DISCONNECTED
 FROM CIRCUIT.
 COIL RESISTANCES NOT GIVEN ARE UNDER ONE OHM
 ARROWS ON POTENTIOMETERS INDICATE CLOCKWISE ROTATION.
 CHASSIS \perp INDICATES VOLTAGE SOURCE.
 PICTURE TUBE 2ND ANODE VOLTAGE TO BE MEASURED WITH
 ELECTROSTATIC KILOVOLT METER WITH BRIGHTNESS AND
 CONTRAST CONTROLS FULL COUNTER-CLOCKWISE
 CX - CAPACITOR VALUE SELECTED FOR MINIMUM YORE RINGING.
 VARIES WITH A RANGE OF 47 PF TO 72 PF (3 K.V., $\pm 10\%$).
 WHEN NECESSARY, REPLACE WITH EXACT VALUE FOUND IN
 TUBE.
 CIRCLED LETTERS INDICATE ALIGNMENT
 AND TEST POINTS WHERE APPLICABLE. \odot
 C - DETECTOR OUTPUT G - 3RD IF GRID
 D - VIDEO OUTPUT H - SOUND LIMITER PLATE
 E - I.F. AGC J - SOUND OUTPUT
 F - GROUNDED FOR I.F. ALIGNMENT P - SOUND DISC GRID

P INDICATES 20% MAY BE USED.

1035

SYLVANIA
TV Chassis A06,
A07 Series

ELECTRONIC TECHNICIAN **TEKFA**X

COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS
AND TECHNICAL INFORMATION FOR 7 NEW SETS

September • 1966

PICTURE TUBE HIGH VOLTAGE ANODE MAY HAVE A POTENTIAL
OF 17,000 VOLTS.
OBSERVE ALL HIGH VOLTAGE PRECAUTIONS WHEN SERVICING
THE CHASSIS.

— PARTS CODING —

Sound Section _____ 100-199
Video Section _____ 200-299
Vert. and Sync Section _____ 300-399
Horiz. and H.V. Section _____ 400-499
L.V. Supply, Misc. _____ 500-599

VOLTAGE MEASUREMENT CONDITIONS UNLESS OTHERWISE SPECIFIED.

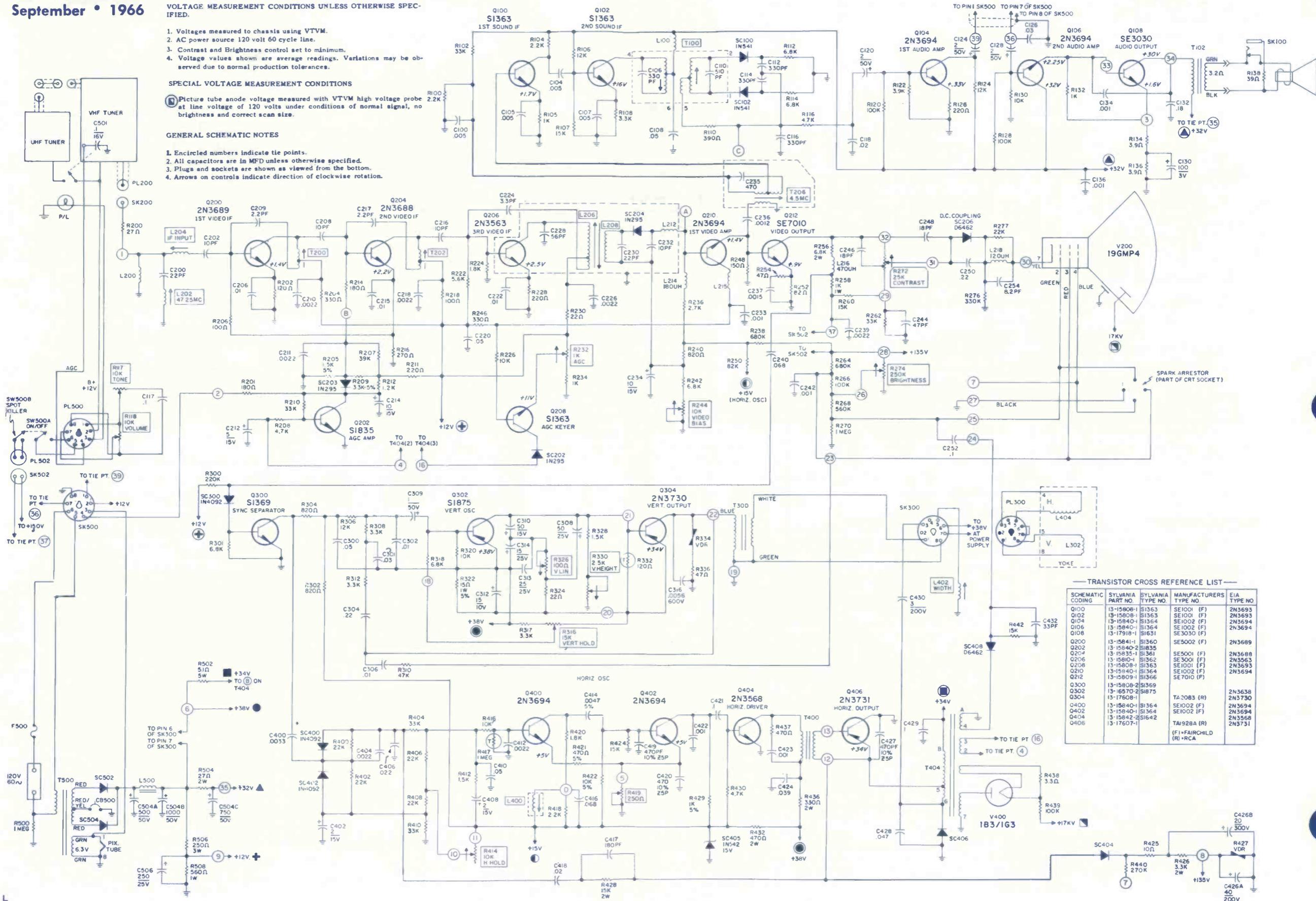
1. Voltages measured to chassis using VTVM.
2. AC power source 120 volt 60 cycle line.
3. Contrast and Brightness control set to minimum.
4. Voltage values shown are average readings. Variations may be observed due to normal production tolerances.

SPECIAL VOLTAGE MEASUREMENT CONDITIONS

Picture tube anode voltage measured with VTVM high voltage probe at line voltage of 120 volts under conditions of normal signal, no brightness and correct scan size.

GENERAL SCHEMATIC NOTES

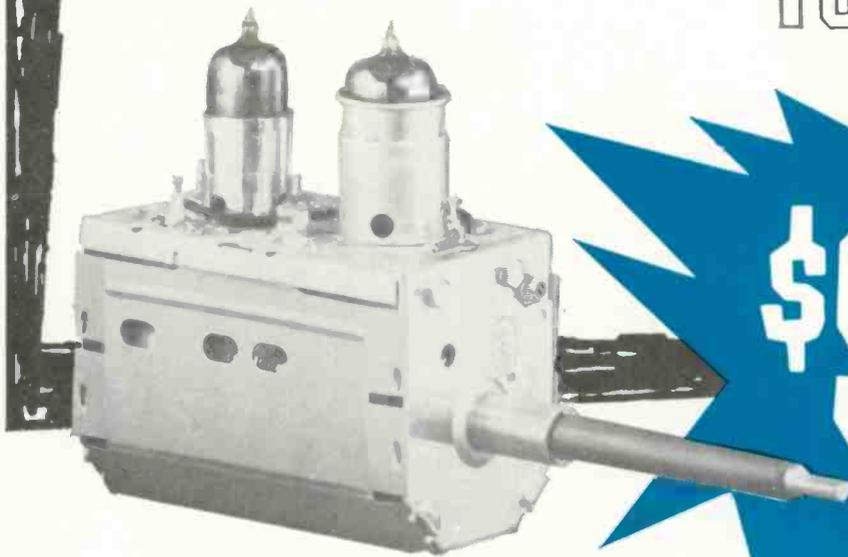
1. Encircled numbers indicate tie points.
2. All capacitors are in MFD unless otherwise specified.
3. Plugs and sockets are shown as viewed from the bottom.
4. Arrows on controls indicate direction of clockwise rotation.



— TRANSISTOR CROSS REFERENCE LIST —

SCHEMATIC CODING	SYLVANIA PART NO.	SYLVANIA TYPE NO.	MANUFACTURERS TYPE NO.	EIA TYPE NO.
Q100	13-15808-1	SI363	SE1001 (F)	2N3693
Q102	13-15808-1	SI363	SE1001 (F)	2N3693
Q104	13-15840-1	SI364	SE1002 (F)	2N3694
Q106	13-15840-1	SI364	SE1002 (F)	2N3694
Q108	13-17918-1	SI631	SE3030 (F)	2N3693
Q200	13-15841-1	SI360	SE5002 (F)	2N3689
Q202	13-15840-2	SI835	SE5001 (F)	2N3688
Q204	13-15835-1	SI361	SE3001 (F)	2N3683
Q206	13-15810-1	SI362	SE1001 (F)	2N3693
Q208	13-15809-1	SI363	SE1002 (F)	2N3694
Q210	13-15840-1	SI364	SE1002 (F)	2N3694
Q212	13-15809-1	SI366	SE7010 (F)	2N3694
Q300	13-15808-2	SI369	TA2083 (R)	2N3630
Q302	13-16370-2	SI875	TA2083 (R)	2N3730
Q304	13-17608-1	SI364	SE1002 (F)	2N3694
Q400	13-15840-1	SI364	SE1002 (F)	2N3694
Q402	13-15840-1	SI364	SE1002 (F)	2N3694
Q404	13-15842-2	SI642	TA1928A (R)	2N3568
Q406	13-17607-1	SI366	(F) FAIRCHILD (R) RCA	2N3731

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 orig-

inal 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 CORPORATION

(Factory-supervised tuner service authorized by Sarkes Tarzian)

MIDWEST — 817 N. Pennsylvania St.
Indianapolis, Ind., Box 1642
Tel: 317-632-3493

EAST — 547-49 Tonnele Ave., Jersey City, N. J.
Tel: 201-792-3730

SOUTH-EAST — 938 Gordon St., S. W.
Atlanta, Georgia
Tel: 404-758-2232

WEST—

SARKES TARZIAN, Inc.
Tuner Service Division

10654 Magnolia Blvd.,
N. Hollywood, Calif.
Tel: 213-769-2720



Getting a hernia and not getting paid for it?

Switch to Elenco dipped Mylar®-paper capacitors and you won't have to worry about call-backs, lost profits, broken reputations or broken anything else.

The only ordinary thing about them is their price.

You get capacitors that meet the requirements of high-reliability computer and missile systems. You get capacitors that hold their rating at 125°C continuous operation. Yet you get them at TV set prices.

Elenco dipped Mylar-paper capacitors come in just about any value you need from .001 mfd to 1.0 mfd. And just about any TV rated voltage you need, too, from 100V through 1600V.

Ask your Authorized Arco Distributor to put them on your next order. Without fail.

Tell him you're counting on his support.

(While you're at it, ask about other Elenco types: padders and trimmers; high voltage dipped micas.)

Arco Electronics

A Division of Loral Corporation
Community Drive, Great Neck, N. Y.
Dallas, Texas, Pasadena, California,
Menlo Park, California.

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SEPTEMBER 1966

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ELECTRONIC TECHNICIAN

WORLD'S LARGEST ELECTRONIC TRADE CIRCULATION

Cover

Confronted by an affluent but more discriminating customer, the Hi Fi stereo specialist must display his wares to the utmost advantage today.

FEATURES

Stereo and Monophonic Tape Recorders 45
This article tells you how to troubleshoot and repair modern tape recorders

Understanding Solid-State Stereo Amplifiers 50
Tells you what you'll need to know to successfully service solid-state amplifiers

Striking It Rich in Audio and Visual Communications Systems 54
How long-range planning points to a successful audio and visual communications operation

Aligning and Troubleshooting FM/Stereo Equipment 57
Major service problems and alignment procedures described

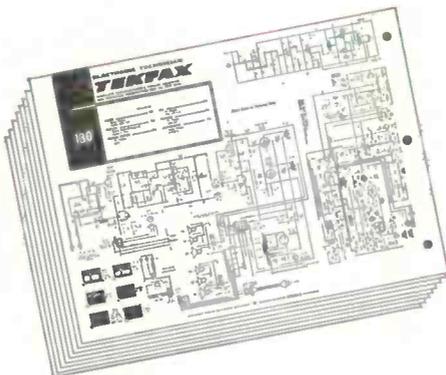
Servicing Solid-State Portable Phonographs 60
Stylus and cartridge replacement, adjustments and important service considerations

Semiconductors From A to Z 63
A continuing series which covers transistor circuits and helps you to understand how to troubleshoot them faster

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TEKFAX — 16 PAGES OF THE LATEST SCHEMATICS



- Group 169 September • 1966
- CANADIAN GENERAL ELECTRIC: TV Chassis M618
- EMERSON: TV Chassis 120837, 839, 840, 841, 842, 843, 846, 847, 848
- MOTOROLA: TV Chassis T5594
- RCA VICTOR: Color TV Chassis CTC20
- SYLVANIA: TV Chassis A06, A07 Series
- WESTINGHOUSE: TV Chassis V-2498 Series
- ZENITH: TV Chassis 13X15

LETTERS

TO THE EDITOR

Superior 1280 Set Tester

I need a schematic and parts list with values for this set tester. Can any reader help me?

TOM McCAUSLAND

Portland, Ore.

He'll Stick With ET

Your articles on television servicing have been a great help to me . . . ET

is truly an educational necessity . . . Just keep up the good work on your magazine . . . I have read all other electronics magazines and they just do not compare with yours . . . I believe I will just stick with your magazine as it is the best I've found yet . . .

CLARENCE W. CATTELL

Findlay, Ohio

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good and we have been able to use some of the ideas most effectively. Keep up the good work . . .

ROBERT FINCH

Edmonton, Alberta, Canada

Needs Japanese Radio VOT

Can any reader help me locate a vertical output xformer replacement for a "Rocket," 8-in. TV set, model 8HL, manufactured by Egawadenki-Kenkyusho of Tokyo, Japan? I wrote the manufacturer and never heard from them. The tube used in the vertical output is a 12BH7.

A. SARLOWSKI

Brookfield, Wisc.

Needs Import Motor

I have a "Saja Export MS/51" tape recorder made in West Germany. I need a motor for it and have no address of the company. Can anyone tell me what their address is or if parts are available in the United States?

H. HANSON

Mobile, Ala.

Needs Tube Tester Chart

Can any reader tell me where I can find an up-to-date roll chart or where to obtain information to update a Simpson model 555 tube tester?

TOM BUTTS

Marshall, Mich.

Has Solar Manual

I have the complete manual on the Solar Capacitor Analyzer, model "CF," which I can photostat for a reasonable charge if any reader wishes it. The schematic alone is available too.

B. N. PHELPS

Omaha, Neb.

Auto Ignition Systems

There's one subject ET has not covered — ignition systems for automobiles . . . ET furnishes very valuable information in other areas.

HERMAN BOLST

Peekskill, N.Y.

•As you know, ELECTRONIC TECHNICIAN is devoted entirely to service-dealers and technicians who make their living in TV-Radio, Hi Fi, two-way radio and audio communications. It also covers some industrial electronics subjects which a portion of our readers are involved in. Most transistorized ignition systems today are serviced by auto mechanics.—Ed.

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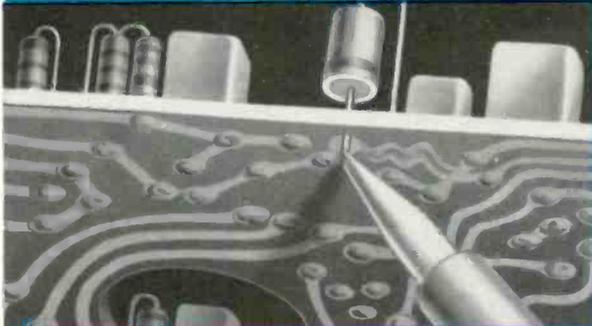
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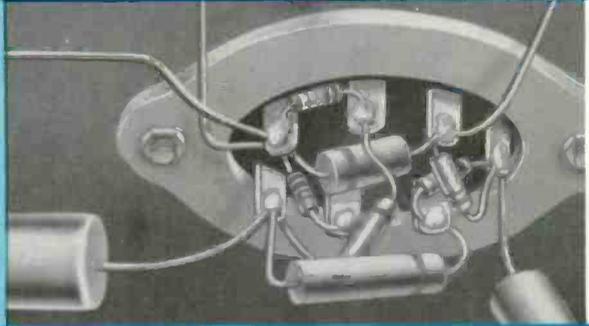
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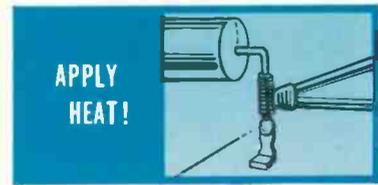
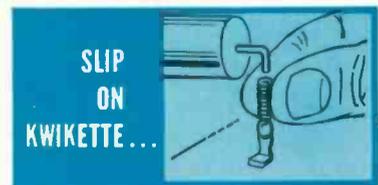
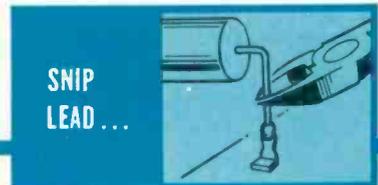
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65-6107

SEPTEMBER 1966

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23

LETTERS TO THE EDITOR

Needs Antique Tubes

I have subscribed to *ELECTRONIC TECHNICIAN* for almost 10 years and have found it one of the best. I particularly like the schematics in *TEKFAK* and the down-to-earth troubleshooting articles. I have an old Westinghouse H-148 radio which the owner wishes repaired — primarily for sentimental

reasons. I need two tubes, a 3E6 and 1LA6, which seem hard to come by. Can anyone tell me where I can find these tubes?

GEORGE ROBERTS

Maywood, N.J.

•*There should be a few of these still collecting dust on jobber or service-dealer shelves. Can anyone help this reader?—Ed.*

Needs Schematic

Can any ET reader help us locate a schematic for a Model S-1, Serial

#5093 Scribe Tape Dictaphone, manufactured by Scribe International Corp., previously at 10-005 Franklin Ave., Franklin Park, Ill. According to the information I have, they are apparently out of business.

R. COOPER BAILEY

Richmond, Va.

Using Readers Service Card

Just a little note to let you know how well I appreciate your fine magazine . . . But there isn't enough room on the Reader Service card to get all the information I need, especially if it's a long firm name. Keep up the good work!

S. RASMUSSEN

Silverton, Ore.

•*Advertised products, New Products, Catalogs and Bulletins are all numbered. Corresponding numbers appear on the Readers Service card. All you have to do to obtain information is to circle the number on the card which appears next to the product information you are interested in and then drop the Reader Service card in the mail box.—Ed.*

Transistor Book

Regarding the Book Review Section of the April 1966 issue of *ELECTRONIC TECHNICIAN*. I am interested in purchasing a good text with recent advances in transistor techniques and applications . . . This book ("Transistors: Principles and Applications") may be what I am looking for . . . Please furnish me with the address of the publisher . . .

JACK FORRY

San Francisco, Calif.

•*The address of Hart Publishing Co. is 510 6th Ave., N.Y.*

New Product Info

Please forward my name and address to the makers of "Terado Solid-State Inverter" as shown in New Products section in the June 1966 issue of *ELECTRONIC TECHNICIAN*.

E. J. OLSON

Eureka, Kan.

•*This information was readily obtainable by circling the proper number on the Readers Service card and dropping the card in the mail box. The address of Terado appears on page 88 of the May issue listed in the 1966 ELECTRONIC TECHNICIAN's Directory. The address is 1068 Raymond Ave., St. Paul, Minn. Most readers of ET use the Reader Service card regularly.—Ed.*



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LETTERS TO THE EDITOR

TEKFAX Pages

You say that you publish 16 pages of **TEKFAX** schematics every month. I have gone through every issue since January and can find only eight pages.

PAUL GILBERT

Ashland, Ky.

•The **TEKFAX** section consists of 8 double pages. Each folded sheet is the size of two printed pages in **ELECTRONIC TECHNICIAN**. The schematics take up the equivalent of 16 printed pages in **ET**.—Ed.

Technician's Directory

It seems to me that I have seen a list of electronic equipment and component manufacturers with their addresses in some copy of **ET** but can't seem to find it again.

TED BOOTH

Thief River Falls, Minn.

•The directory appears in the May 1966 issue of **ET**, beginning on page 74.—Ed.

Likes Business Profiles

I have enjoyed and gained much valuable information from your series of reports on other TV businesses. Thank you and I hope you keep up the good work.

LLOYD OUGH

Wauneta, Neb.

Low and Hi Fi

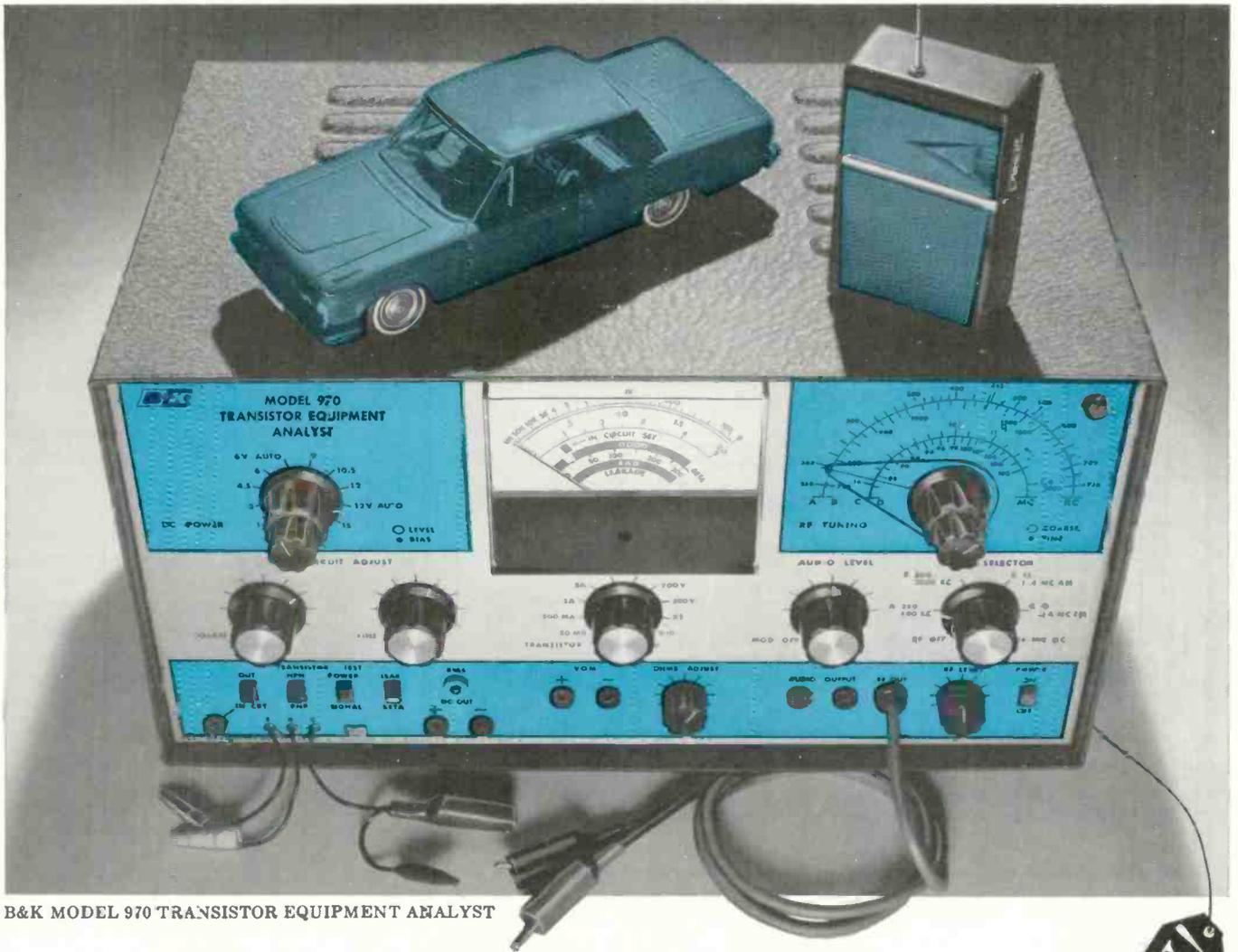
Is it worthwhile to put a "Matel Barbie" record player into a Hi Fi cabinet with 2 oval speakers?

GEORGE WONG

La Palma, Calif.

•What's a "Matel Barbie" record player?—Ed.





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EDITOR'S MEMO

Specialize or Diversify?

Some time ago, a speaker at a national convention of TV-radio service-dealers and technicians urged all concerned to *diversify* their operations. Little or no attempt was made to explore the pros and cons of the matter.

Now, at a recent management seminar of the National Appliance & Radio-Tv Dealers Assn. (NARDA), two speakers argued the subject — one taking the side of diversification and the other urging us to be specialists.

The argument reminds us of the once popular "heridity vs. environment" game played by the so-called "intelligentsia" of an earlier period. Actually, the game was played for generations until scientists discovered that *both* heridity and environment were *equally* important.

We will wager that the argument of diversification vs. specialization in this business will also go the same way — like the dodo — into extinction.

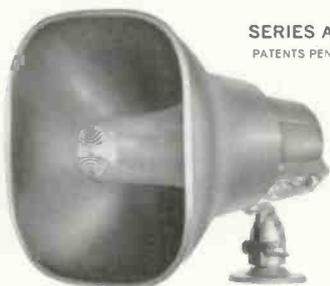
Additionally, a lot of confusion is being piled up about the subject. One speaker, for example, urged service-dealers to tie themselves to *one* manufacturer (implying specialization) but continued on to mention a long list of *diversified* products to be sold and serviced. It's not easy to tell what these narrow-approach individuals are really talking about.

The truth is, whether you diversify or specialize is, first, a matter of what you want to do. Your particular locality may also be a point to consider. Likewise the kind of customers you have. And if you're small — a two or three-man organization — you obviously cannot diversify. If you want to diversify you'll need more working capital and you'll have to set up the proper organization. But you can be successful either way. It all depends on how you plan, organize and run your business, the kind of customers you have and the kind of service you give them.

To diversify or specialize is not the question confronting TV-radio service-dealers today. The problem is to "keep up," adjust to change, grow — compete. This has nothing to do with diversifying or specializing.

In this business, the argument of "specialize or diversify" is just so much hogwash!

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Poll shows appliance dealers prefer Channel Master color antennas by tremendous margin. We're not surprised. Read why.

When it comes to color antennas, we know our place. That it happens to be **first** place—and that Channel Master has been up there a long time—is a sweet thing to know. (Just try and budge us.)

But—once in a while— isn't it nice to have somebody else confirm what you've always known?

What happened was this: One of the nation's top three publications in the radio-TV-appliance merchandising field—(name on request)—made an independent survey of color set appliance dealers. Result? The lopsided box-score, in case you haven't noticed,

is down below. Please observe that the opposition isn't even close.

Now as long as Channel Master Crossfires are up there we wanted to know why they're up there. So we requested the same publication to take a second poll. And just as we thought: Any specific brand of antenna may be preferred on many counts. But one reason leads all the rest. Performance! That's why the Crossfires are No. 1. They work better! (With color sets or black-and-white, naturally). This includes our VHF/FM series for suburbs-to-fringes, our Coloray ghost-killer series, and our

Ultradyné Crossfire 82-channel FM or Ultradyné UHF only series.

To what do we owe our success? Our principles. (Unique engineering ones, of course. All of them patented or with patents pending.) They make the Crossfires the mightiest antennas ever developed. With remarkably high gain and up to 30-to-1 front-to-back ratios. (Maybe the competition's principles just aren't as powerful as ours.)

So call your nearest Channel Master distributor, join the rest of the gang, and come on up. The installation's fine and the profit's high.

High Man
On The
Totem Poll!



OF THE 5 TOP-SELLING
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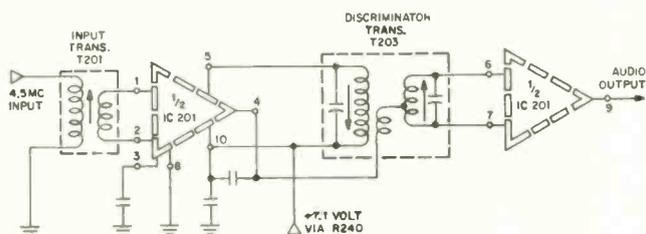
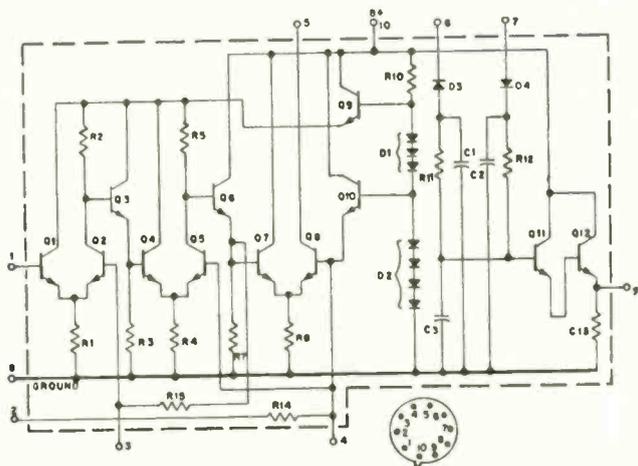
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TECHNICAL DIGEST

RCA VICTOR

TV Chassis KCS153X Integrated Audio Circuit — Servicing

If audio trouble develops in this model, the integrated circuit should be considered the component least likely to be at fault. The following procedure has been found



effective when checking the integrated circuit. A signal injector is used to determine whether or not the circuits following and preceding the integrated circuit are functioning. If trouble appears to be in the circuit that incorporates the integrated circuit, pass a signal through that circuit as well. Check the voltages on the pin connections of the integrated circuit device. These voltages are very significant. All external components associated with the integrated circuit should be checked before the "chip" is replaced. Should it be necessary to remove and install a new integrated circuit, great care should be exercised to prevent additional damage.

MAGNAVOX

TV Chassis T915 — A Description of Production Changes

Most of the production changes in this series do not contain a code. They consist of the following: Better sync separation has resulted when R239 was changed from 820 Ω to 330 Ω . Vertical sync has been improved by changing R403 from 82K to 47K. By removing capacitor C606, the horizontal hold range is increased. A decoupling network has been added to prevent horizontal pulses from

getting into the video. The network consists of resistor, R251, (33 Ω 20%) inserted between R220 and the vertical hold and bias controls, plus electrolytic capacitor C244 (10 μ f + 100% - 10%) between R220 and R251 connected to ground. By changing R308 from 33K to 27K and adding another decoupling network the hum in the sound was reduced. This decoupling network consists of resistor R314 (5.6K 10%) inserted between R308 and the collector of the audio driver transistor, Q203 (70N1), plus electrolytic capacitor C138 (4 μ f 15v + 100% - 10%) between R308 and R314 connected to ground. By changing C303 from 2.2pf to 1.5pf and R304 from 1K to 1.2K, "popping" and intermittent sound is eliminated. Variations in characteristics of the VHF tuner and IF are compensated by substituting a 1500 Ω pot for the 680 Ω resistor (R236) and by changing R212 to 4.3K. The vertical linearity is improved by changing C405 from 0.33 μ f to 0.22 μ f and C406 from 1.5 μ f to 1.0 μ f.

A BA production code suffix was used to identify the following production changes: A diode is connected between the high-voltage horizontal transformer (T603) and the collector of the AGC keyer transistor Q206 (79PI). This transistor is given additional protection against failure by inserting resistor, R252 (100 Ω 10%), between the diode and the transformer. The capacitor C235 was removed from the junction of D204 and R235 to ground. Noise immunity was improved by changing C238 from 1 μ f to 0.33 μ f and C604 from 1 μ f to 0.47 μ f, plus inserting resistor R624 (1K 10%) between the emitter of the phase splitter transistor Q209 (76N1) and capacitor C602. Resistor R212 was changed from 10 Ω to 470 Ω for the new VHF tuner. The driver stage was decoupled from the output stage by adding capacitor C412 (0.01 μ f 20%) between the base of the vertical output transistor Q403 (64N1) and ground. The "blocking" of sound was eliminated by adding capacitor C322 (2.2pf \pm .25) between the collector of the sound IF transistor, Q301 (69N1) and ground.

OLYMPIC

TV Chassis NCP and NDP — To Eliminate Horizontal Drift

If horizontal drift is experienced in these chassis, proceed as follows: 1. Change S141 (820pf) to a 1000 pf temperature compensating capacitor. 2. Change R149 to 470K. 3. Short terminal 4 of the AFC couplate (Z102) to ground. 4. Shunt out the horizontal frequency coil (L115). 5. Check to see that the proper frequency range has been attained by varying the hold control. In some instances it may be necessary to increase R149 to 680K. 6. Remove the short from terminal 4 and the jumper from the frequency coil. 7. Adjust the frequency coil until the picture is synchronized horizontally.

Snivets

Some reports have been received indicating trouble with snivets in fringe area reception on UHF and VHF. Most cases are cured by replacing the 21JZ6. In some instances it may be necessary to use a different tube type, a 21GY5 for example, in place of the 21JZ6. To make this change, place a jumper from pin 10 of the 21JZ6 to ground.

These changes have been made in production on the NDP chassis commencing with run 10. On the NCP chassis the changes started with run 16.

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famous-name gifts!

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**"HALF PINT" DOLL WITH
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This 10½" all-vinyl toddler
is fully jointed with tiltable
head, moving eyes and rooted
hair. "Half Pint" is a real
charmer in printed cotton
dress, shoes, and socks.



**THE AMERICAN FAMILY
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Latest edition. Written and
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staff of educators, scholars, and
specialists. The entire family
will consult this one-volume
encyclopedia regularly.



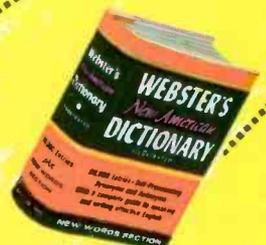
**COMBABLE SHEEP
DOG WITH COMB
(TB-455-6)**
Girls of all ages will have
fun combing and recombng
its tresses. 12" high and 12"
long. Pale yellow body with
white ears and tail.



**TAKRAW GAME—
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(TB-11056)**
Originated in Malaya.
Comes with two cane
cages for throwing and
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ball. Great for kids and
adults, the motions are
similar to those in the
game of Jai Alai.



**"MARCIE AND HER
TROUSSEAU" FASHION DOLL
(TB-800)**
Marcie is a doll of real elegance
... complete with a wardrobe of
fashionable clothes. Fashion-
conscious little ladies will have
fun dressing Marcie for
different occasions.



**WEBSTER NEW AMERICAN
DICTIONARY (TB-1016)**
Newly revised and up-to-date,
this is an authoritative
dictionary planned and
written by modern
educators to meet high
standards for school,
home, and office use.

**AMF 20" ROADMASTER
AMFLITE GIRL'S DEBUTANTE
BICYCLE (TB-U5287)**

Girls will go for its styling... twin strut *high-rise* handle bars, chrome headlight and fenders, contour-styled buddy saddle, white sidewall tires... In flamboyant magenta with white trim.



**TWO-SIDED 18" DART BOARD
(TB-03016)**

Made in England. This board is $\frac{3}{4}$ " thick for long steady service. Comes with six English-made darts; has 20 point target with Bull's eye on reverse side.



**LOUIS MARX "ZAZOOM"
DUMP TRUCK (TB-5204)**
This automatic dump truck features *real motor noise*. Three separate switches activate 21 different functions. Boys will spend hours with this thrilling true-to-life toy.

A gold mine of gifts can be yours when you buy RCA entertainment receiving tubes! RCA's **TOY BONANZA** brings you a comprehensive selection of toys for boys and girls... and an authoritative, up-to-date dictionary and an encyclopedia for the entire family. Great for birthdays, Christmas... *any time* you want to make the kids happy!



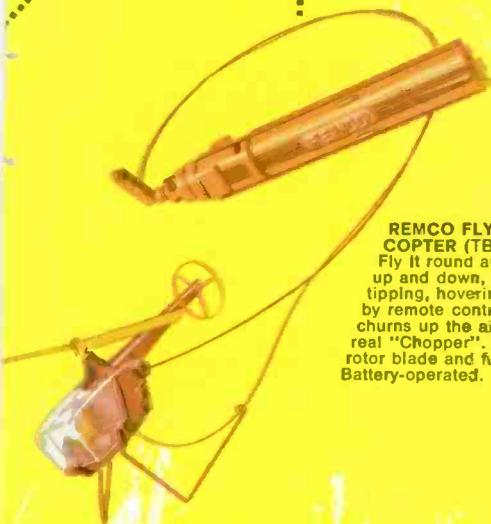
**AMF 20" ROADMASTER
BOY'S RENEGADE DELUXE
BICYCLE (TB-U1278)**

Every boy can be king of the road! 20" cantilever frame, chrome-plated truss rods, *high-rise* chrome handle bars and chrome fenders, white sidewalls... in a handsome blue with white trim.

**REMCO "BATMAN"
ELECTROMAGNETIC
WRIST RADIO (TB-795)**
"Batman" is never without his wrist radio. Loud, clear, 2-way voice transmission with secret code buzzer. Comes with 2 wrist radios and wires. Sends and receives voice and code.



**REMCO FLYING STUNT
COPTER (TB-751)**
Fly it round and round, up and down, tilting, tipping, hovering... all by remote control. It churns up the air like a real "Chopper". Sturdy rotor blade and fuselage. Battery-operated.



**AMF JUNIOR
MUSTANG
(TB-A535)**
A child-pleaser if ever there was one, this pedal-drive junior car has *real Mustang Sports Car styling!* 36" long by 16" wide, in bright red finish with black, white and silver trim.

Experience for Sale.....45¢

Sure seems we started something!

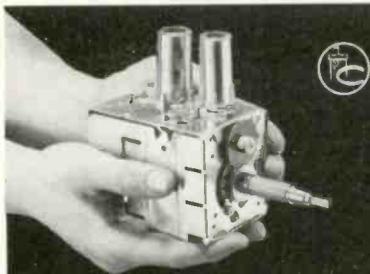
Yes; over ten years ago, when we started overhauling tuners (all makes and models), we set a price of \$9.95 for this service.

Apparently there are those who would like to imitate our achievement—and for 45¢ less.

Maybe the special skills, special equipment and downright old fashioned experience we built up during these past years are worth that little extra.—You be the judge.

Remember; 45¢ buys you more than a quarter of a million man/hours of experience, plus true devotion to our business . . . our only business . . . overhauling your television tuners the best way we know how. And in over ten years we sure know how!

Castle — The Pioneer of TV tuner overhauling
Not the cheapest — just the best.



For complete tuner overhaul we still charge only \$9.95. This includes all labor and parts; except tubes and transistors, which are charged extra at low net prices.

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

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

Exact Replacements are available for tuners unfit for overhaul. As low as \$12.95 exchange. (Replacements are new or rebuilt.)

CASTLE

TV TUNER SERVICE, INC.

MAIN PLANT: 5713 N. Western Ave., Chicago 45, Illinois
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CANADA: Castle TV Services, Ltd. . . . Nation-wide service.
For service in Canada write to Chicago or use reader service card in this magazine.
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TECHNICAL DIGEST

MOTOROLA

TV Chassis TS594 Video IF Circuits — Circuit Description

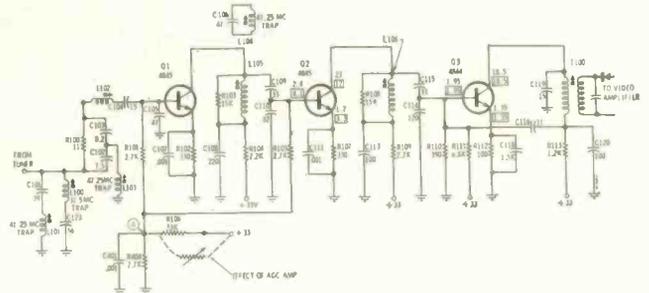
The transistor video IF system consists of three stages — each stage being basically a common emitter circuit with the input signal applied to the base and the output signal obtained from the collector. Since the transistors used are silicon NPN types, both the base and collector are more positive than the emitter.

The coupling circuit between the tuner and IF system is very similar to those used in conventional tube receivers. It contains the usual 41.25 and 47.25MHz traps plus an additional 37.5MHz trap used for rejecting the adjacent upper video channel. This additional trap is secured to the top of the 41.25MHz trap for easy accessibility when touching up the coil for signal conditions in the field.

The input signal applied to the base of the first IF transistor is tuned by L101, C104 and C105 which form a series resonate circuit. Capacitor C104 isolates the transistor's base from dc present in the tuner. With this capacitor, in conjunction with C105, the input impedance matches the impedance of the transistor.

An emitter resistor (R102, R107, or R112) is used in each stage for the dc stabilization of the transistor. The ac portion of the signal passing through the emitter is shorted to ground by a capacitor (C107, C111 or C118) to eliminate the signal loss which would otherwise occur in the emitter resistor.

In each stage a collector resistor (R104, R109 or R113) is connected to a +33v buss and decouples the signal output from the voltage source. When stronger signals cause the transistor to conduct more current, the voltage drop across the resistor increases, reducing the collector voltage.



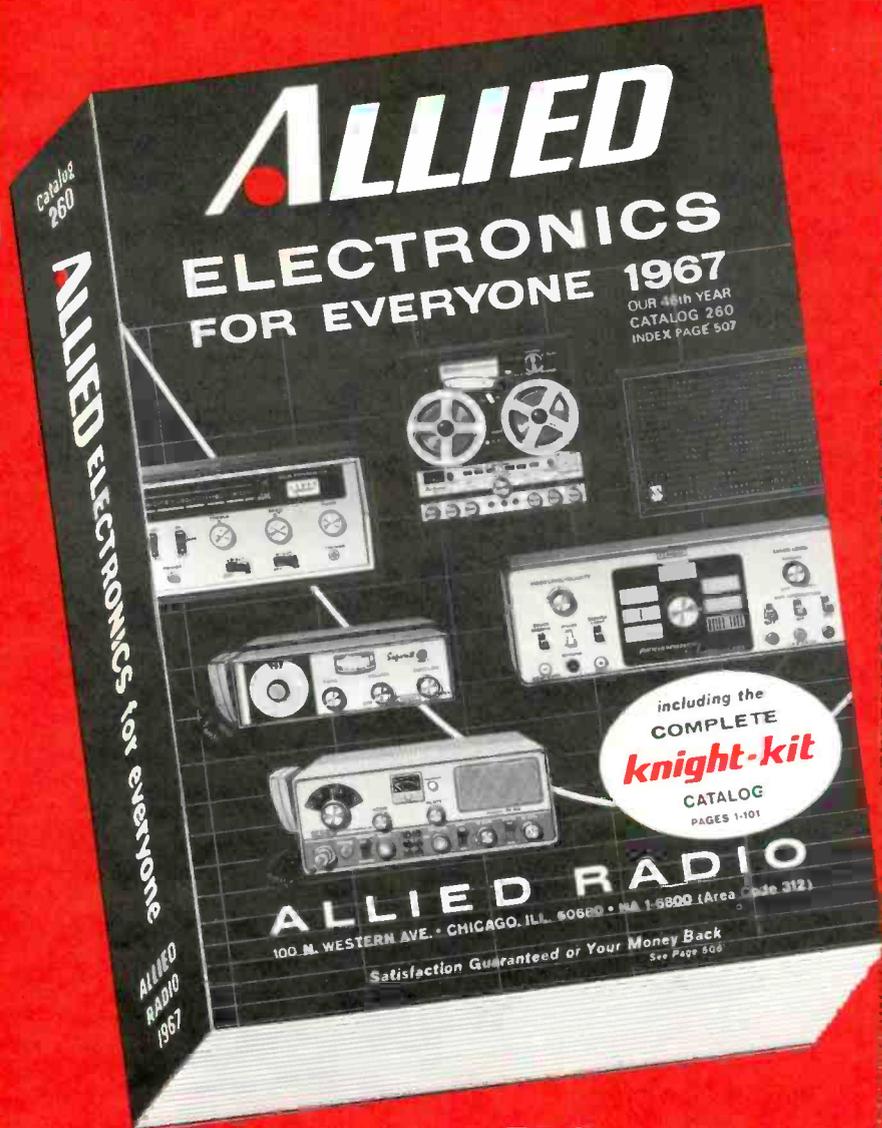
This reduction in the collector-to-emitter voltage, as a result of the stronger signal, reduces the gain of the amplifier. By increasing the forward biasing of the transistors in the first two stages, the AGC system causes them to conduct more current — further reducing the collector-to-emitter voltage and the gain of the amplifier.

A capacitor (C108, C113 or C120) bypasses the collector resistor in all three stages. The voltage drop across this resistor is the result of only the dc portion of the collector current. This degenerates or reduces the gain of these two stages and neutralizes or eliminates their tendency to oscillate. An additional capacitor (C116) couples a small portion of the output of the third stage back to the base of that stage. The resulting negative feedback provides that stage with additional stabilization.

The signal output in the collector circuitry of the first two stages is tuned to approximately 44MHz — the center of the over-all passband. The coil used (L105 or L106) is

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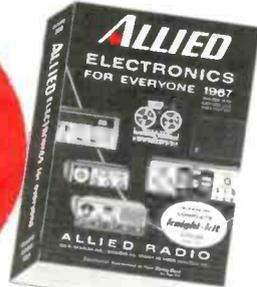
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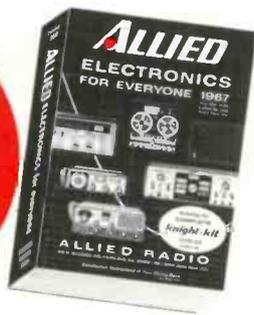
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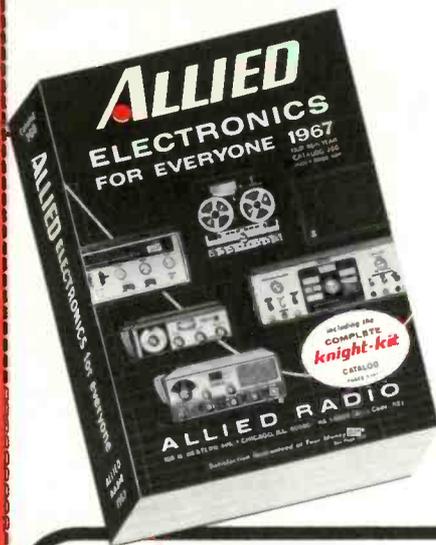
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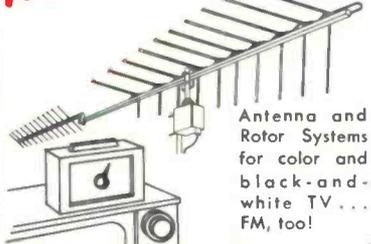
Knight-Kit® Portable Solid-State Color/Bar Pattern Generator. A top value!

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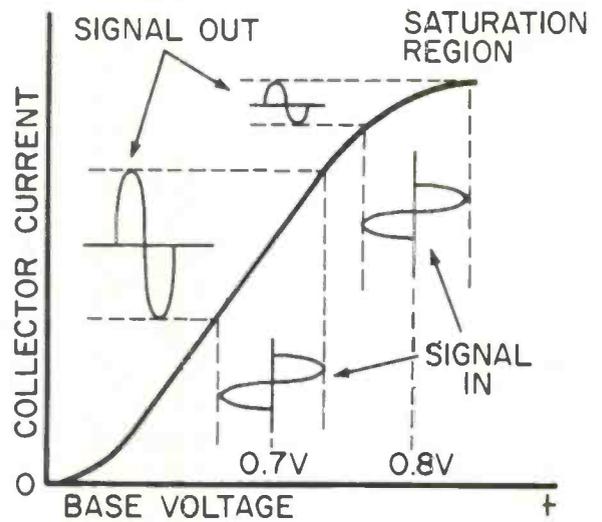
TECHNICAL DIGEST

very broad and contributes little to the overall selectivity of the system. In series with the coil are two capacitors (C109 and C110 or C115 and C114) which like the capacitors (C104 and C105) in the first stage, isolate the base of the transistor from the dc of the previous stage and make the input impedance of the circuit match the impedance of the transistor.

The output circuit in the first stage also contains a 47.25MHz trap designed to further attenuate the lower adjacent channel sound to the desired level.

Selectivity of the IF system is accomplished by taps incorporated in the input circuitry and by the band width of the 3rd IF transformer (T100).

As previously indicated, the forward bias of the first two stages is controlled by the AGC system. Under "no signal" conditions about +2.5v is developed by the AGC system at point "A" in the circuit. This 2.5v bias source develops a 0.7v emitter-to-base voltage in the first two IF stages — causing these stages to function with maximum gain. When a signal is received, the voltage at point "A" in the circuit increases in proportion to the strength of the signal. For a moderately strong signal, 4.4v is developed by the AGC system at point "A" — resulting in a 0.8v emitter-to-base voltage. As a result of the larger forward bias, the transistors conduct more current — reducing the gain of the circuits. This reduction in gain is shown on the transistor's forward biasing characteristics graph.



Transistor's forward bias characteristics graph



Helps stop ghosts!

Zenith Quality Wavemagnet® Indoor TV Antenna

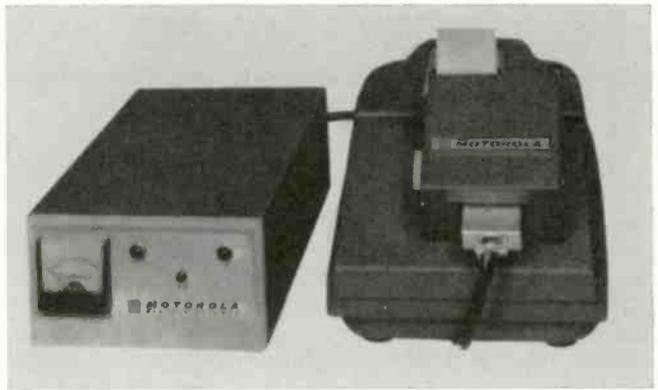
Designed for finest all-channel (2 to 83) reception in color or B&W. Special network provides stepped-up basic dipole impedance, resulting in lower voltage standing wave ratio than ordinary VHF indoor antennas . . . cuts down snow, reflections and ghosts. Two full-size UHF loops, one behind the other, develop an unusually high front-to-back ratio (equal to that in many outdoor antennas), remarkably reducing ghosts and man-made interference. Order as Part Number 973-56 from your Zenith distributor!

*Built to the quality standards
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The quality goes in before the name goes on

at last...
instant color patterns
at your finger tips...
zero warm-up time



Central office equipment in the Motorola remote alarm system includes the digital decoder (on left) and printer (right). Signals transmitted from remote location are received by base station, decoded by the decoder and printed out five times on tape by the printer.

Remote Alarm, Control Network

■ A multi-function remote alarm and control system which provides instantaneous and individual indications of remote equipment failures has been developed.

The system operates on VHF frequencies and may be licensed to work in conjunction with a regular two-way radio communications network. The system may also be operated on developmental frequencies assigned by the Federal Communications Commission (FCC).

The alarm system can be tied into as many as 12 functions at each site. The control system can actuate as many as 10 SPDT control relays at each site.

Equipment in the alarm system includes remote alarm senders and antennas at remote sites and a base station receiver, decoder and printer at the central office. When a malfunction occurs, the remote sender transmits tone codes which are repeated five times, at one minute intervals. If no other radio transmissions interfere with the signals from the remote sender, all five transmissions are received by the central base station. The signals are then decoded and the information printed out in digits on a paper tape.

The alarm system can be connected to overload relays at utility sub-stations. When a relay is tripped, the tone codes for that relay are transmitted to the central office and printed. Similarly, generators and generator drives can be tied into the alarm system. Then, should the equipment overheat or slow down, an immediate alarm indication is transmitted and printed at the central office.

Once the tone transmissions have been received, the office dispatcher may then contact drivers of radio-equipped vehicles and assign repair duties to the closest available vehicle.

The combined alarm and control system provides the basic indication of outages with the capability of emergency control. Additionally, optional status reporting facilities can be incorporated into the combined system to report the status of particular alarm functions on command. When the status reporting option is employed, the system may be operated on one of the developmental frequencies assigned by the FCC. ■

THE ALL NEW SENCORE CG135 DELUXE TRANSISTORIZED COLOR GENERATOR

The big push is on in Color TV. Equip yourself now with the new, solid state Sencore CG135 and cash in on the booming volume of new service business as Color-TV zooms! Instant, service-ready RCA standard color bars, cross-hatch, white dots and individual vertical and horizontal bars enable you to set up or trouble-shoot more Color TV sets per day; earn top money in this fast growing service field. It's an analyzer too: Color gun interruptors, unmodulated video for chroma circuit trouble isolation and unmodulated sync pulses to keep Zenith receivers in sync for this test, make color trouble shooting a snap. Sturdy all-steel construction for rugged, heavy duty in the field or shop. Another Best Buy in profit-building service instruments from Sencore at

\$149⁹⁵

COMPARE THESE FEATURES: SEE WHY THE CG135 IS IN A CLASS BY ITSELF

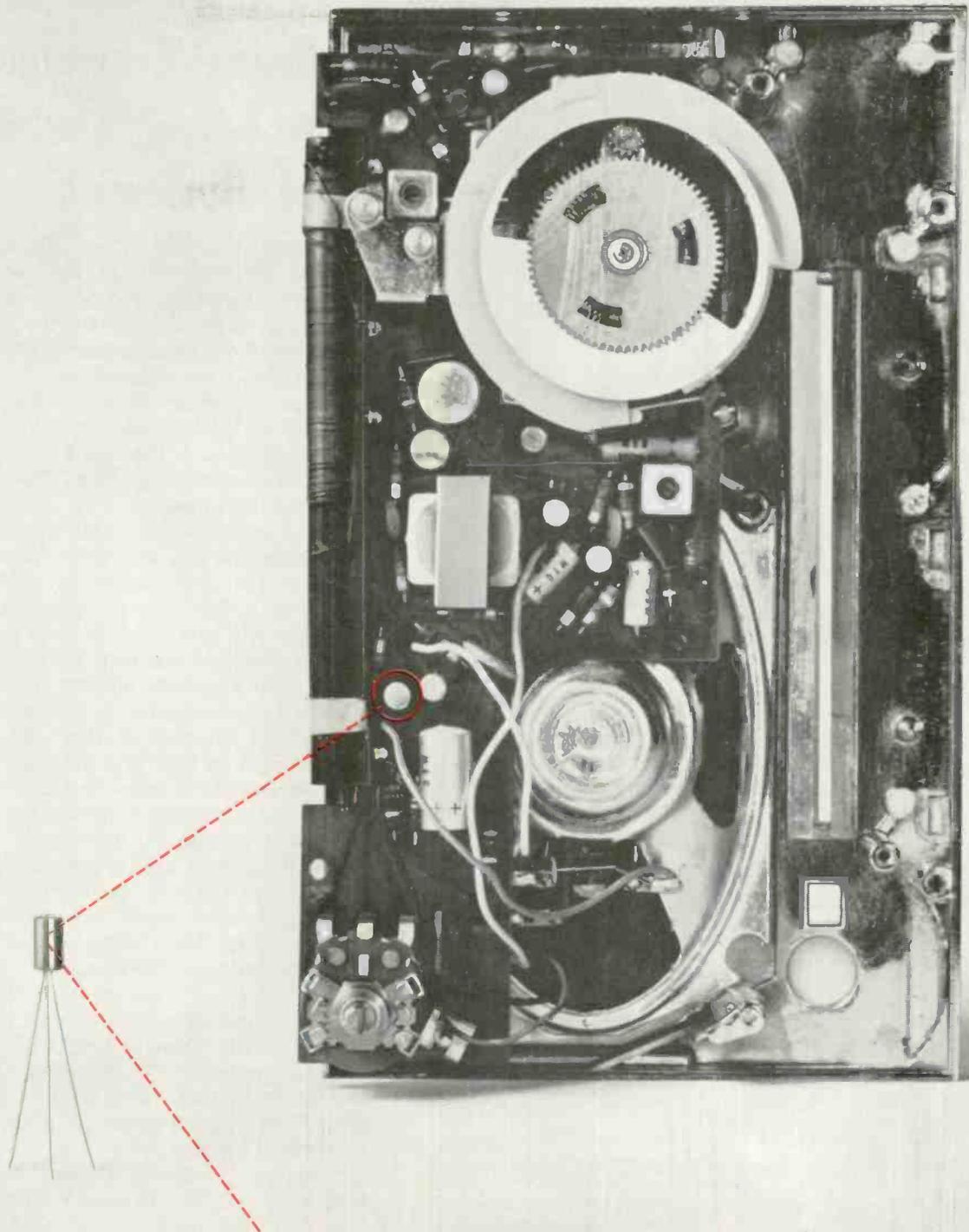
- Solid state construction employs high priced GE "Unijunctions" to develop six "jump out proof counters" that guarantee stable patterns at all times with no warm-up
- Standard RCA licensed patterns as shown on schematics throughout the industry
- Handy universal color gun interruptors on front panel
- Lead piercing clips insure non-obsolence
- CRT adaptors optional
- Crystal-Controlled 4.5mc Sound Carrier Analyzing Signal to insure correct setting of fine tuning control
- RF output on Channel 4 adjustable to Channel 3 or 5 from front of generator when Channel 4 is being used
- No batteries to run down; uses 115 V AC
- Less than one foot square, weighs only 8 lbs.

professional quality — that's the difference!

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One RCA SK-3004 can replace this transistor and more than 700 other transistors as well!

And it will work! Because RCA SK-3004 is one of RCA's "Top-of-the-Line" series of replacement semiconductors—16 transistors and 2 rectifiers. Each of these top quality replacement semiconductors has been carefully designed for a specific application in entertainment-type equipment. Result: You can quickly choose the one type that will provide top performance in the equipment you are servicing.

All 18 RCA Top-of-the-Line types and the devices they replace—more than 4,000 transistors, foreign and domestic, and more than 1,300 selenium and silicon rectifiers—are listed in RCA's Replacement Guide, SPG-202A. You should have a copy handy if you service solid-state entertainment-type equipment. Ask your RCA Distributor about it or write: RCA Commercial Engineering, Section I46SD, Harrison, N. J. RCA Electronic Components and Devices, Harrison, N. J.

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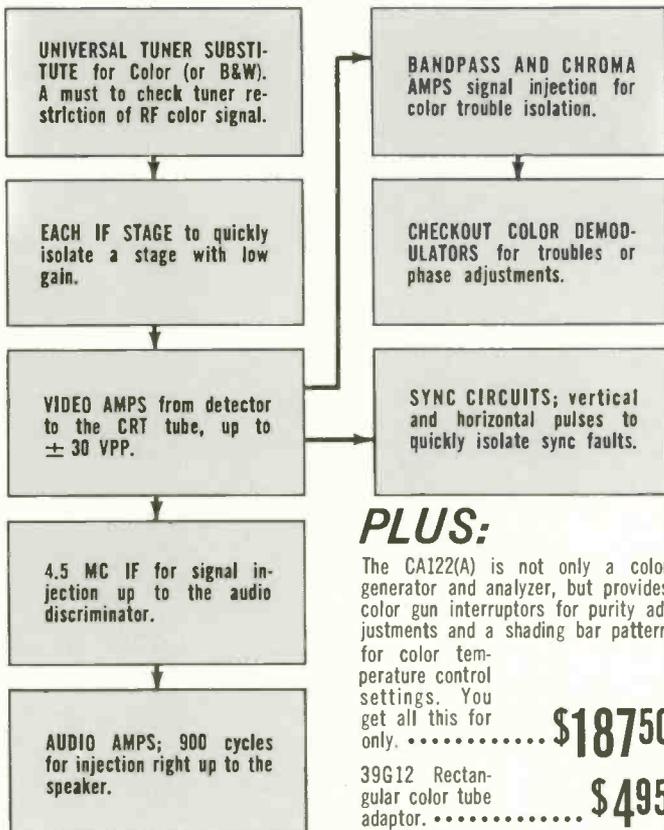
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PINPOINT COLOR TV TROUBLES IN SECONDS...



WITH THE NEW IMPROVED SENCORE CA122(A) COLOR CIRCUIT ANALYZER

It's a standard ten color bar generator; produces vertical lines, horizontal lines, crosshatch, and adjustable dots, PLUS a complete TV analyzer for color and B&W—at less money than color generators only. Here is what the CA122(A) will do for you by tried and proven signal injection into these stages.



PLUS:

The CA122(A) is not only a color generator and analyzer, but provides color gun interruptors for purity adjustments and a shading bar pattern for color temperature control settings. You get all this for only.....

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39G12 Rectangular color tube adaptor.....

\$495

See your distributor today. He has the CA122(A) in stock now.

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Electronic Computer Helps High School Students Solve Homework

■ Through the cooperative efforts of International Business Machines (IBM) and the Catholic Schools Diocese of Brooklyn, N.Y., six students are presently being assisted by a computer 50 miles away. A 12-button "pad" for commanding the computer is attached to the student's home telephone.

When a student wishes assistance with a problem, the computer's telephone number is dialed in a normal fashion. The pad is then used to inform the computer of the mathematical problem. The computer gives a spoken, audible answer.

To enter an operation or instruction, the user presses the appropriate key and then presses the asterisk, or star key. For example, to say "Multiply," the user presses the multiply key and then the star key. To store a number for later use, the user presses the "Keep," key, the star key, and then the single digit designating the location where the number is to be stored.

The keep instruction is very useful where numbers will be used repeatedly or where the answer to one calculation is to be used in a following calculation. Numbers can be placed either in temporary storage (location 0) for use in the very next calculation only or in permanent storage (1 through 9) for use any time.

At the end of each message, the user presses the star key twice to start the calculation.

If a student wants to multiply 342 times 13. Student enters: 342 (Multiply) * 13 ** Computer answers: "Your answer: plus four four four six."

The square root of 17 may be wanted.

Student enters: (Square root) * 17 **

Computer answers: "Your answer: Plus four point one two three one zero five six two five six one seven seven." Note that answers are given to an accuracy of 14 decimal figures.

Suppose a physics student needs to convert a temperature of 98.6 degrees Fahrenheit to Centigrade. The following must be solved for the conversion: $C = 5/9(98.6 - 32)$.

Student enters: 98 (Point) * 6 (Subtract) * 32 (Keep) * 0 **

The student has requested the computer to temporarily hold the reply.

Computer replies: "Your answer holds: plus six six point six."

Student enters: (Multiply) * 5 (Keep) * 0 **

The reply held is multiplied by 5, the product being held as requested.

Computer replies: "Your answer holds: Plus three three three."

Student enters: (Divide) * 9 **

The product held is divided by nine.

Computer replies: "Your answer: plus three seven."

Another version of the audio response unit is being used to provide quotation service to the New York Stock Exchange. Member brokers can obtain current

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Integrated Circuits (TTL) • SUHL I family • SUHL II family • Digital Functional Array • Linear Circuits.

Diodes & rectifiers • Germanium point-contact diodes

• Germanium gold bond diodes • Silicon epitaxial planar diodes • Silicon alloy diodes • UHF silicon point-contact diodes • Monolithic diode assemblies • Discrete diode assemblies • Silicon epoxy rectifiers • Silicon glass rectifiers.

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Once again, you can turn to the roof tops for a fast dollar in antenna installations. But this time, you can do it the easy way. No more running up and down ladders, locating cumbersome AC extension cords, lugging heavy tube operated field strength meters on the roof, or worse yet, getting the shock of your life from the AC line as you hold onto a soil pipe. Here is a new portable field strength meter to fill your every need in VHF, UHF or FM antenna installations. Many customers want all antennas on one mast thus creating interaction. Here is where the FS134 goes to work. You can optimize antenna location and orientation in seconds. Just connect the antenna, tune in the station and adjust. Self-contained speaker blasts forth the sound from the TV or FM station to insure that you have the exact signal that you are looking for. The FS134 is so light weight (only 9 lbs.) that you can take it with you up the chimney if necessary. Get rid of the assistant at the other end of the transmission line and the needless "yelling" back and forth. Get the FS134 today . . .

only

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COMPARE TO ANY OTHER FIELD STRENGTH METER
AT TWICE THE MONEY

- Sensitivity . . . 30 microvolts ± 3 DB on VHF-FM and 30 microvolts ± 6 DB on UHF • Sound system sensitive to 5 microvolts for locating and identifying weak stations • Input impedance . . . 300 ohms or 75 ohms • 500 KC band width • Powered by easy to get "C" cells
- 4" meter with 2% accuracy calibrated in DB and microvolts.

professional quality — that's the difference!

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market data from the computer's files. Audio response units also advise bank personnel of the current status of customer's checking, savings and loan accounts. They are providing department store sales clerks with fast credit authorization. They are also advising telephone subscribers about the status of non-working telephone numbers.

The day will soon arrive when people throughout a community will have access to a central computer system through their home telephones. ■

Practical Gallium Arsenide Technology Developed

■ Gallium arsenide and its alloys are man-made substances that emit or control microwaves, light and laser beams. A number of experimental components have been produced in gallium arsenide by new production methods. These include:

Semiconductor lasers to generate visible light at room temperature;

Microwave sources using the "Gunn Effect" to produce radio waves at frequencies as high as 40GHz for possible use in high-definition, "picture-taking" radar systems;

Electroluminescent diodes for alpha-numeric displays and illuminating instrument panels;

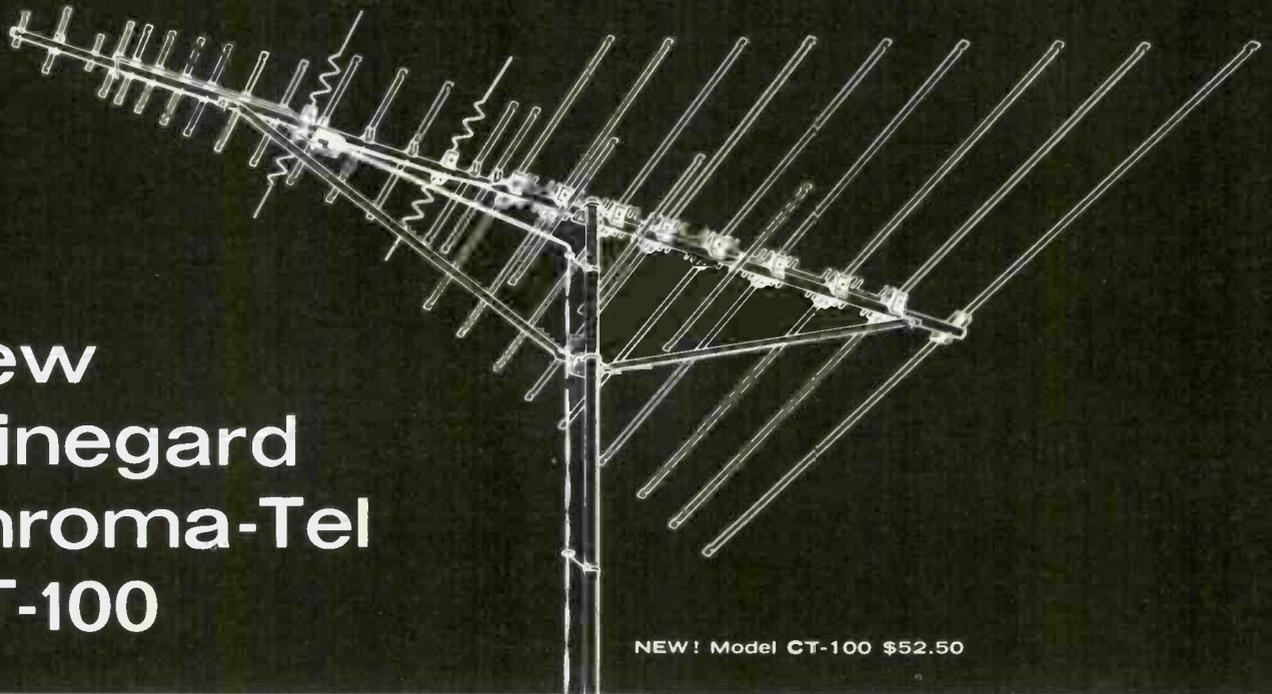
Electro-optical components capable of putting 100 million bits of information per second on a visible laser beam for use in high-information-capacity communications systems;

Microwave varactor diodes with a high cut-off frequency and voltage breakdown.

Most solid-state, transistor-like components at present are made in single crystals of germanium or silicon by alloying or diffusing selected impurities into them. It is the presence of these impurities — atoms of other materials — in controlled amounts that accounts for their valuable electronic properties. Past attempts to apply these techniques to gallium arsenide and its alloys have proven marginal. The new technology was perfected by Dr. James J Tietjen, of the RCA Laboratories technical staff, in a program sponsored in part by the Advanced Research Projects Agency of the Department of Defense. The "vapor phase growth" technique makes possible the synthesis of complete components in crystals of gallium arsenide and its alloys by the introduction of impurities in a single continuous operation that is part of the crystal-making process itself. This technique resembles the natural process that produces frost on a windowpane. All of the materials to be used in building a component are prepared separately in gaseous form. The gases are mixed in varying proportions that are easily regulated, and allowed to flow over a solid crystal of gallium arsenide or one of its alloys. Since the crystal is kept slightly cooler than the gas mixture, the bases begin to condense on its surface in such a way that their atoms form an extension of the crystal itself, like bricks newly added to an unfinished wall. In this way, an electronic component is "grown" on the foundation crystal and is identical to it in every respect except for the impurity atoms it incorporates. ■

First UHF/VHF/FM 2-83 antenna that really works in fringe areas

New Winegard Chroma-Tel CT-100



NEW! Model CT-100 \$52.50

Winegard's sensational new CT-100 Chroma-Tel has 29 elements in all. And they're all working to provide the finest all-band reception (UHF-VHF-FM) even in difficult fringe areas.

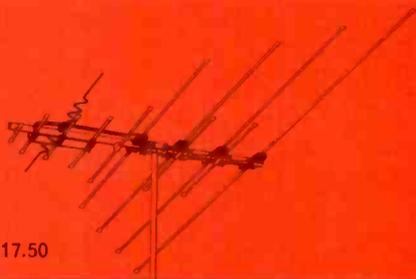
In addition to those 29 elements, the CT-100 incorporates a unique matching network that guarantees maximum signal transfer to the downlead—and on all channels 2-83 plus FM. Gives sharpest color and black & white reception.

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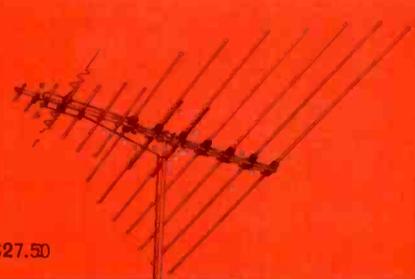
performance) . . . and our Impedance Correlators (special phasing wires that automatically increase the impedance of Chroma-Tel's elements to 300 ohms).

That's Winegard's new CT-100 Chroma-Tel. Bigger and better. But not too big. The full-line of Winegard Chroma-Tels still offers half the bulk; half the wind loading; half the truck space; and half the weight of all other all-band antennas—and at much lower prices. No wonder Winegard Chroma-Tels (now 4 models) are the hottest performing, hottest selling all-band antennas on the market! Better call your Winegard distributor or write for Chroma-Tel Fact Finder 242.

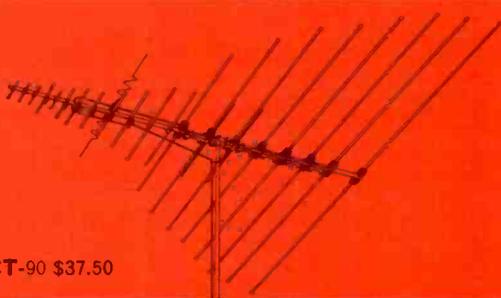
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"As every serviceman knows, major TV repairs represent an increasingly large part of the service business and the average time per repair has increased"...

says Willard Horne of Horne Radio and Television in Evanston, Illinois.

After more than 25 successful years in the service business, twenty of them in the same location, Mr. Horne can be considered an authority on how to keep a business profitable. Mr. Horne says, "In order to be successful, our 3-man shop has to be competitive on the large jobs as well as the small ones. With the increase in bench time that we were experiencing and the limitations on what we could charge, there was a reduction of profit that had to be stopped. Then we bought a B&K Model 1076 Television Analyst."

"Now our customers get the same extra-value service on the big repairs and the small ones," said Mr. Horne. "We use the Television Analyst for troubleshooting a wide variety of complaints, particularly for those that require touch-up align-

ment, location of IF overloads and color convergence. We are more competitive now that we use the B&K Television Analyst because we spend far less time on the jobs that used to be dogs, with benefits both to the shop and our customers."

* B&K Model 1076 Television Analyst checks every stage in a black and white or color TV receiver. Nine VHF RF channels, 20 to 45 MC IF, audio, video, sync, bias voltage and AGC keying pulse are available. The model 1076 provides its own standard test pattern, white dot, white line crosshatch, and color bar pattern slide transparencies. It includes a blank slide which can be used for closed-circuit-TV display floor promotion. Its net price is \$329.95.

Find out how you will increase your TV service profits with a B&K Model 1076. See your distributor or write for Catalog AP 22.



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ELECTRONIC TECHNICIAN

Stereo and Monophonic Tape Recorders

You can't troubleshoot and repair them unless you know how they work

■ Tape recorders have become commonplace in many homes today. They are not yet as widely used as TVs, radios and record players, but they can no longer be ignored by TV-radio technicians and service-dealers. Servicing this equipment can become a profitable business for alert technicians who know enough about them to make reliable adjustments and repairs.

Modern Tape Recorders

Home tape recorders selling from \$250 to \$300 are capable of reproducing audio better than most studio equipment just a few years ago. Most units are easy to operate and maintain.

As we know, tape is passed through the recorder at a constant speed during the recording or playback process. This is done with a capstan shaft, pressure roller and mechanical metering device. During recording or playback the tape passes between capstan shaft and spring-loaded pressure roller. While the tape is being metered at a constant speed through the capstan assembly, the takeup reel must receive sufficient drive torque to wind the tape. Fast forward and rewind op-

erations are accomplished by applying a large amount of power to the takeup and rewind hubs.

The simplest units have a combination record/playback head plus an erase head. This equipment uses the same head for record and playback. If it has only one record/playback amplifier, a single section record/playback head and a single section erase head, it is called a monophonic recorder. If the head covers the entire tape width, it is a full-track monophonic recorder; if the single channel track width is approximately 0.080 in. (about $\frac{1}{3}$ the tape width) it is called a half-track monophonic recorder. A complete tape recorder includes speaker or speakers and a power amplifier all in the same housing. Most units being built today for home entertainment are four-track stereo units.

Another type of unit which has gained popularity in recent times is the component deck. This equipment is usually designed without recording or playback amplifiers. Separate external amplifiers are required to complete the system.

Recorder Electronics

During the recording process, in-

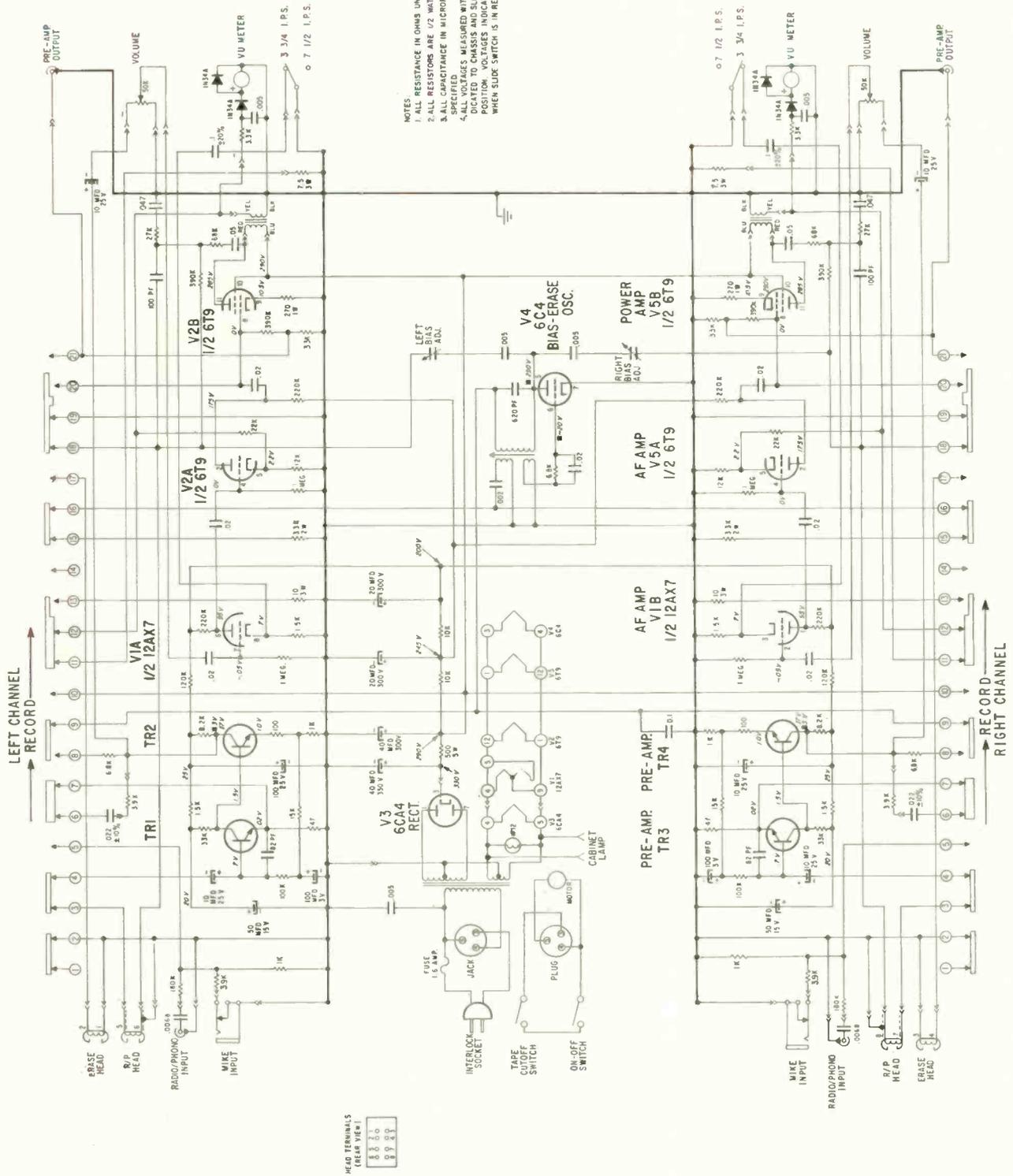
put signals are amplified, pre-equalized and presented as a recording current signal to the head. A supersonic oscillator, operating between 30Hz and 100kHz adds a bias current to the audio current supplied to the head. During playback, the bias oscillator is disabled and the head is used as a playback device. The head output, a very low level signal, is amplified and post-equalized before it is fed to the power amplifier.

One factor that makes magnetic recorder amplifier requirements somewhat complex is the need to pre-equalize during recording and post-equalize during playback.

If a magnetic head is properly biased during the recording process it is possible to magnetize the tape as it passes the gap. Alternating audio current produces a corresponding magnetized condition proportional to the current amplitude. As the signal frequency increases, the magnetization amplitude remains the same but the peaks are closer together on the tape.

If a length of tape is passed across a playback-head gap, a voltage will be generated in the head that increases proportionally with fre-

Tape Recorders . . .



NOTES:
 1. ALL RESISTANCE IN OHMS UNLESS OTHERWISE SPECIFIED.
 2. ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED.
 3. ALL CAPACITANCE IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
 4. ALL VOLTAGES MEASURED WITH V.T.M. FROM POINTS INDICATED TO CHASSIS AND SLIDE SWITCH IN PLAY-BACK POSITION. VOLTAGES INDICATED BY ■ ARE MEASURED WHEN SLIDE SWITCH IS IN RECORD POSITION.

HEAD TERMINALS
(FRONT VIEW)

8	9	10	11
12	13	14	15

Fig. 1—Schematic of Zenith 81Z stereo and monophonic hybrid tape recorder.

quency. If the playback-head output is 0.1mv at 50Hz, for example, it would be 0.2 at 100Hz, 0.4 at 200Hz, etc. The voltage across the current increases directly as the frequency increases. There is a point, however, where electrical, core and gap losses take over and the playback-head response will taper off and decrease. At 7.5ips, this action begins slightly above 1kHz; this so-called head-response peak is approximately 3 to 5kHz.

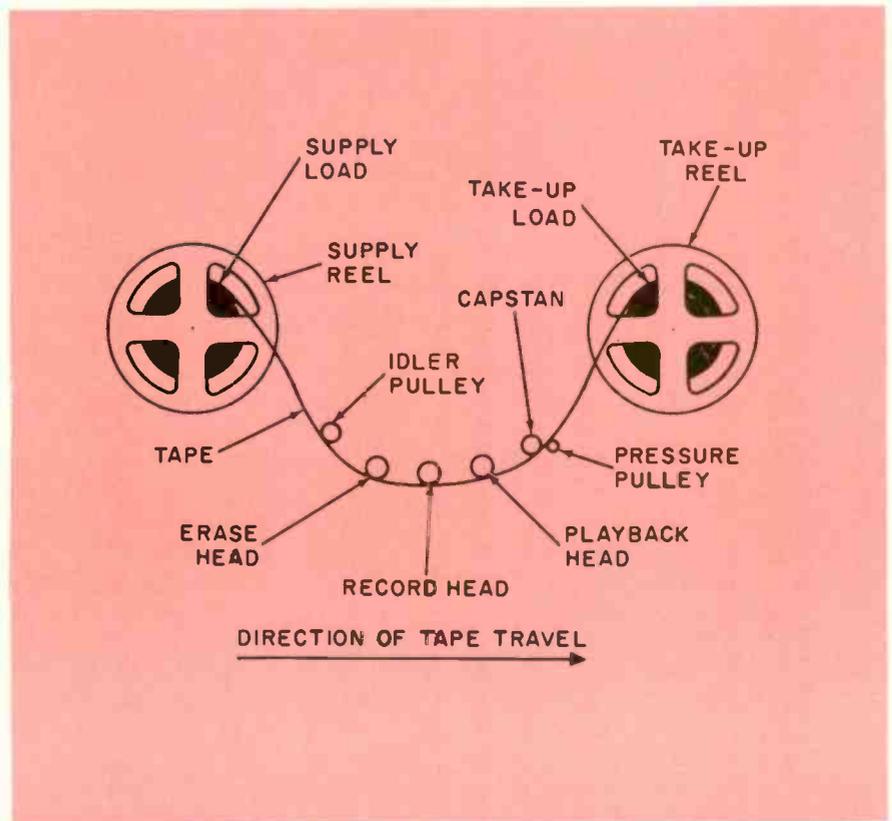
Typical Tape Recorder

Much of the tape recorder equipment made today is transistorized or hybrid. The schematic of a 4-track, stereophonic hybrid unit is shown in Fig. 1. This is the Zenith model 81Z. Actually, this unit is manufactured by 3M Revere/Mincom Division, and is similar to the Revere model 1281. It operates at 3.75 and 7.5ips and will record both stereo and mono tapes.

The mechanical parts of a tape recorder are, in many respects, similar to a record player. The tape must be pulled at the proper speed (which must be constant and not vary) and the motor must be sufficiently powerful to pull much more than its expected load. The capstan is equivalent to the main drive shaft of a record player and must be flywheel loaded. A typical tape transport is shown in Fig. 2.

The over-all tape transport must provide extremely smooth tape movement and pull the tape past the heads at a constant speed with no slack at either reel. The spring-belt drive is one of the most common drive methods and connects

Fig. 2—Typical tape transport mechanism.



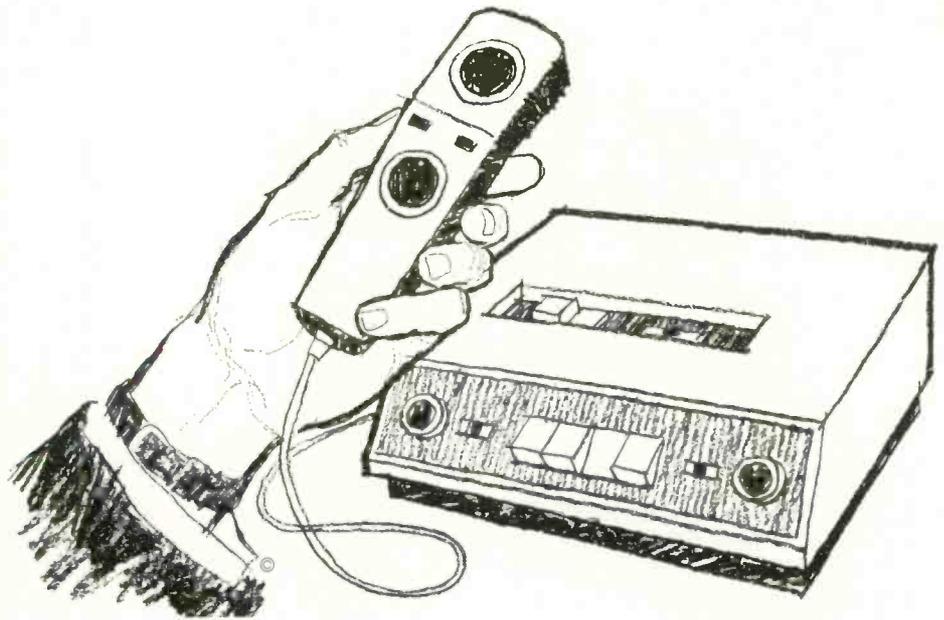
the drive to both reels—supply and take-up — and the pulleys are made so the take-up reel will move slightly faster than necessary at the innermost edge of its diameter. The spring tension allows slippage so the reel can rotate only at the speed of the tape past the capstan. Drive to the supply reel is generally released from the main drive and the spring slippage acts as a drag since the drive pulley is anchored.

Friction-clutch drives are also used and, except that slippage is supplied by a clutch mechanism which uses leather or some other

similar material for slippage, it serves the same purpose as the spring belt.

A third drive system is the motor-drag drive. Here separate torque-type induction motors are used on each reel shaft. The motors are connected in a manner so the one driving the take-up reel runs as fast as allowed by the speed of the tape across the capstan. The supply reel motor is torqued in reverse. The amount of torque is inversely proportional to the take-up reel speed. When the take-up slows, the supply-reel motor increases torque in the

Tape Recorders...



reverse direction — increasing drag on the supply reel.

Maintenance and Repair

The problems you will confront in troubleshooting and repairing tape recorders will center around cleaning, lubrication, replacing worn heads, defective switches and head demagnetization.

During normal operation, oxide from the tape builds up on the head, tape guides, pressure rollers, capstan and pressure and drag pads. This oxide build-up can cause poor playback, weak recording, distortion, poor erase and up-and-down travel of the tape as it passes between the pressure roller and capstan. These parts should be cleaned periodically. Frequency of cleaning will vary with the type and age of the tape being used and the amount of time the equipment is in use. The more the equipment is used, the more often it should be cleaned. Cleaning should always be done with "Q" tips dipped lightly in alcohol.

You should have manufacturers service specifications, disassembly instructions, schematics and all other data on the equipment you are servicing. And make certain that you do not use metal objects around heads—and don't use a pipe cleaner because it may damage or scratch the head surface.

All drive surfaces must be kept free of grease and oil. Use only a soft clean cloth to clean the motor pulleys, drive belts, flywheel, take-up pulley, rewind pulley and turntable drums. Detergent and water may be used if necessary. But do not use alcohol or any other solvent to clean the drive surfaces as the cleaner may damage the drive belts.

Take-up clutch felts, where used, must be free of grease and oil. If the felt should become contaminated it should be replaced. Pressure and drag pads should be cleaned with alcohol and after they are dry they should be roughened with an emery board.

Equipment is lubricated before it leaves the factory and it should not require lubrication for quite a while. If it becomes necessary to disassemble the equipment or it needs lubrication, the lubricant should be applied as follows:

The capstan and flywheel bearing, the clutch pulley bearings, the turntable bearings, the rewinder idler pulley bearings and clutch pressure bearing should be lubricated with a drop of sewing machine oil or equivalent. "Cosmolube," or equivalent, should be applied between brake arms and the motorboard, between the pause lever and motor board and to all points of contact on push-button latching bars and other sim-

ilar mechanisms. "Molykote G," or equivalent, may also be required on the top and bottom of pause levers and similar devices. Make sure that no oil or grease gets on pulleys, idler wheels, belt clutch discs and felts, outer periphery of flywheels and all parts that might transfer oil and grease to them. Wipe all excess oil from parts that have been lubricated.

There are times when head adjustments are necessary. Instructions for making head height and azimuth on the Zenith 81Z, for example, are as follows (see Fig. 3), 1. Thread the recorder with tape. 2. Push tape drive tab to START position. Place finger on roll pin in record pressure pad and pull back pressure pad. Tape should move smoothly past the head. 3. Use a #2 Bristol wrench and adjust head height by turning head adjustment screw (172). 4. Adjust head height until top of pole piece is even with tape.

To adjust azimuth: An alignment tape, obtainable from Ampex or the larger distributors, should be used to align the head. This tape should have a full track recording at a frequency higher than 6kHz. 1. Thread the recorder with tape. 2. Place channel function in PLAY position. 3. Push tape drive tab to START position. Adjust azimuth screw (177) for maximum output. 4. In lieu of the alignment tape, play

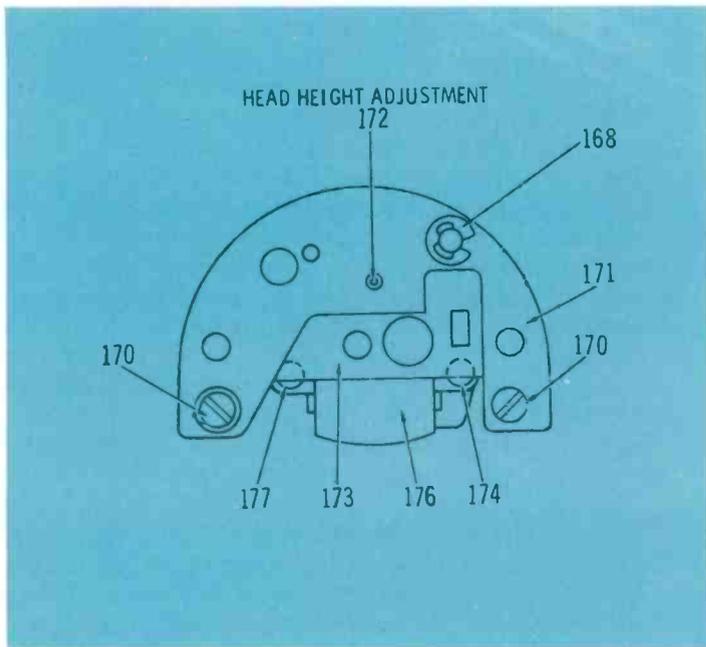


Fig. 3—Head assembly adjustment points.

a commercial prerecorded 4-track tape and adjust the head for maximum treble tone. 5. After adjusting the azimuth, check to see that the head height has not been disturbed. Use "Locktite" cement on the adjustment screws.

You may also need to measure bias voltage on this particular equipment. It is done as follows: 1. Connect a VTVM (capable of accurately measuring voltage at 75kHz) between the left channel switch contact #18 and chassis ground. 2. Operate both channels of the recorder in RECORD position. 3. Adjust left channel bias adjust trimmer for a 30v reading on the VTVM. 4. Remove VTVM lead from left channel switch contact #18 and connect it to the right channel switch, contact #18. 5. Adjust right channel bias adjust trimmer for a reading of 30v on the VTVM.

Some other mechanical troubles may arise. **When there's no tape drive in either play or record position:** 1. Tape may not be properly threaded through automatic cutoff switch. Tape must pass between post and pin. 2. Speed selector (ON/OFF) tab not moved completely to 7.5 or 3.75ips position — in which case no power is applied to the recorder. 3. Fan blade obstructed, keeping motor from turning.

If the take-up reel does not func-

tion: 1. Take-up belt loose, oily or out of position. 2. Insufficient pressure on clutch. Use additional washers with item #18. 3. Take-up clutch plate face dirty. Clean felt with alcohol or replace. 4. Roll pin on pressure roller arm assembly. Remove top mechanism plate riveted assembly and attached parts and reassemble.

When the tape drive tab malfunctions: 1. Rapid function knob not centered. 2. Power cam latch spring broken. 3. Pressure roller arm spring broken.

If the tape spills when functions are changed: 1. Brake arm spring weak or broken. 2. Brake arm binding on shaft. 3. Brake roller, leaf spring broken.

If no fast forward: 1. High speed idler spring broken. 2. High speed idler tire oily. Clean with alcohol or replace. 3. Right brake not releasing. Check for binding parts.

No reverse or stalls in reverse: 1. Loose motor pulley. Tighten set screw. 2. Broken rewind arm spring. 3. Right brake arm not releasing.

Speed irregularities (wow and flutter): 1. Oil or dirt on drive surfaces—idler, motor pulley, flywheel or pressure roller. Clean thoroughly with alcohol. 2. Weak springs (65 and 138 shown in service literature) causing poor idler contact. 3. Force of pressure roller against capstan

too great or too small. Check for defective spring. 4. Misalignment of flywheel bearings. Check by holding idler wheels away from flywheel and rotate by hand. A slight drag caused by take-up belt is normal. 5. Binding motor bearings. Check by rotating fan or motor pulley by hand. 6. Pressure roller binding. Clean and lubricate bearing. 7. Spindle rubbing on top plate. 8. Brakes not releasing. Check for missing springs, bent or binding levers. 9. Improper clutch operation. Clean clutch faces with alcohol or replace felts. 10. Counter binding. Clean and lubricate shaft and bearings.

Tape squeak or squeal: Tape squeak or squeal is heard as a high-pitched warbling sound that accompanies recording or playback. It can be heard in quiet surroundings by listening to the head assembly with the volume control set at its minimum. Squeak or squeal can be minimized as follows: 1. Clean head, pressure pads and tape guides with alcohol. 2. Use good name-brand tape. Poor quality tape may be helped by treating it with silicone lubricant. 3. Replace pressure pads, or place thin Teflon film tape over pads. This provides a smooth, wear-resistant surface to contact the back of the tape. 4. Slightly decrease the normal tension of pressure pad springs. ■

Understanding Solid-State Stereo Amplifiers

Study the circuits and
you'll see they're not as
difficult to service as
you may imagine

■ A lot of "ballyhoo" has indicated that solid-state stereo equipment is difficult to service. This is simply not true. Specialists who have worked in this area for the past few years have unanimously voiced the opinion that the equipment is easier to service than regular monophonic gear. This seems logical. Because two identical amplifiers are used in stereo equipment and since both amplifiers seldom go bad at the same time, the good amplifier can be used as a "standard" to check out the defective amplifier (See "Rapid Fire Location of Stereo Amplifier Faults," May 1966 ELECTRONIC TECHNICIAN.)

Typical Solid-State Stereo Amplifier

A typical solid-state stereo amplifier, with silicon-diode power supply is shown in Fig. 1. This is the A551-04 Magnavox amplifier. Note that the solid-state power supply operates from a regular 117vac source, using a step-down transformer and it is designed to provide approximately -44vdc at 300ma after rectification. This power supply

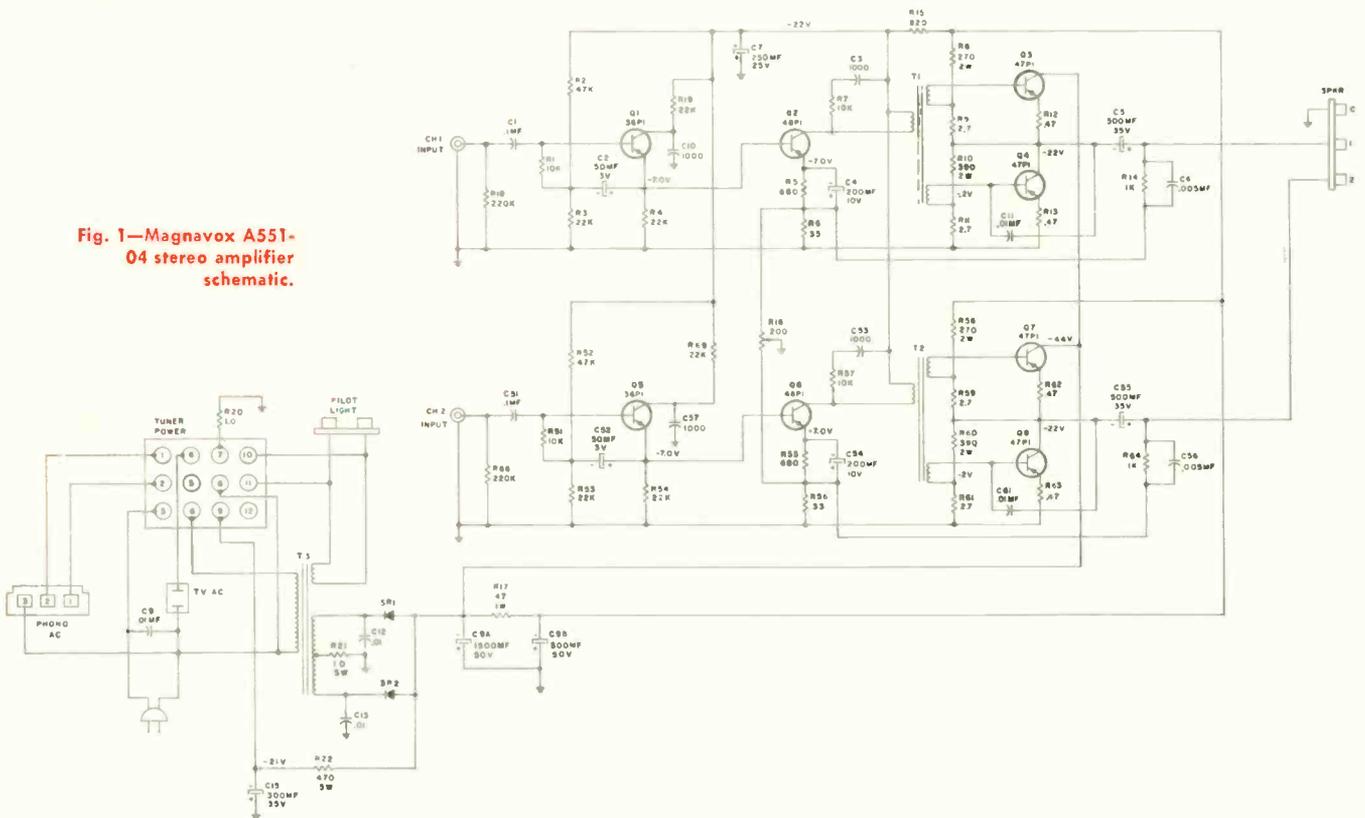
furnishes voltage to a separate AM/FM tuner in addition to the amplifier. The amplifier is rated at 25w per channel—or 50w total music power output—according to EIA (Electronic Industries Association) standards. It should be noted also that the output of this amplifier is transformerless—it is designed to use the speaker voice coil as the load. This is common design practice in many present day solid-state audio circuits. Finally, it should be noted while servicing this equipment that the total speaker impedance to each channel in this particular circuit should be near 8Ω.

Although we will take a brief over-all look at this amplifier, no effort will be made to analyze it fully. But let's take a moment to look-in on the very important input, or pre-amplifier, stage.

The first stage is the well known common-collector, or emitter follower. It is widely used as a pre-amplifier stage in solid-state amplifiers.

As shown in Fig. 1, the common-collector circuit corresponds to the cathode follower in tube circuits. No

Fig. 1—Magnavox A551-04 stereo amplifier schematic.



input/output signal polarity reversal takes place in this stage. The input impedance is high, to take care of high impedance phono pickups, microphones and AM/FM tuner outputs. The input signal is applied between the base and collector. The output impedance is low because it is taken from across the emitter resistor. Although the voltage gain is less than unity(1), this sacrifice is normally justified in favor of this circuit's impedance matching characteristics.

Another important point to observe in this circuit is the "bootstrap" system used primarily to further increase the input impedance and obtain certain other advantages. Note also, the output signal is taken from the preamplifier emitter and fed directly to the base of the driver stage transistor.

Capacitor C2, a 50 μ f 3v electrolytic, is the bootstrap capacitor which increases the input impedance by coupling the signal developed across the emitter resistor to the junction of the base-biasing resistors. But we may as well touch on a few high points in the remaining circuitry.

The output from Q2 (the driver stage), is transformer coupled to the pushpull output transistors. The secondary windings of the driver transformer provide opposite-phase signals to the bases of these transistors. The transistors alternate functions during each half cycle in the conventional pushpull manner. In this connection it is important to note that when the applied signal becomes the negative half cycle, Q3 is reverse biased — driving it to cutoff. Simultaneously, Q4 will conduct and amplify the half cycle. Audio is coupled to the speaker by a 500 μ f capacitor. These references are to one stereo channel. The other channel, of course, functions in the same manner.

Bias and Bias Stability

To effectively service and repair solid-state stereo Hi Fi amplifiers, it is helpful to further understand basic circuitry involved.

Every technician knows about tube "bias." We already know that bias on a tube grid determines its operating point. We know that this

bias must be selected so that the input amplitude variations do not drive the tube either to cutoff or to saturation. But bias on transistors is somewhat different than it is on tubes. The base-emitter voltage and the emitter current on a transistor establishes bias conditions and must be maintained within a narrow area despite variations in gain, reverse bias current and temperature changes.

Because there are two types of bias stability — current and voltage — involved in transistor circuits, these circuits must be designed to maintain stability under varying voltage and temperature.

Temperature changes that "hunt" around average room-temperatures have little adverse effect on transistor circuitry. But when the transistor temperature rises beyond 75 degrees, troubles develop. Chart I shows what happens to the collector current of a transistor when the temperature rises beyond 75 degrees. As the temperature increases the emitter-base junction resistance decreases and the collector current jumps upward. If this process (run-away or

"avalanche" effect) is allowed to continue, the transistor is destroyed.

In practical circuitry, two methods are generally employed to counteract this effect. 1) A large-value resistor is used in the emitter circuit so the emitter-base resistance change with temperature is small compared to the total emitter resistance and 2) forward bias on the transistor is reduced as the temperature increases by using a resistor, a thermistor, a diode, Zener diode or a transistor regulator.

Design engineers attempt to keep the base resistance as low as possible and the emitter resistance as high as possible in transistorized circuits.

One basic voltage divider temperature compensating bias circuit is shown in Fig. 2.

A temperature rise will cause more current to flow through the transistor (because of a decrease in emitter-base junction resistance). But the emitter resistance is larger than the base-emitter junction resistance and variations at the base-emitter junction are overcome by the presence of the emitter resistor.

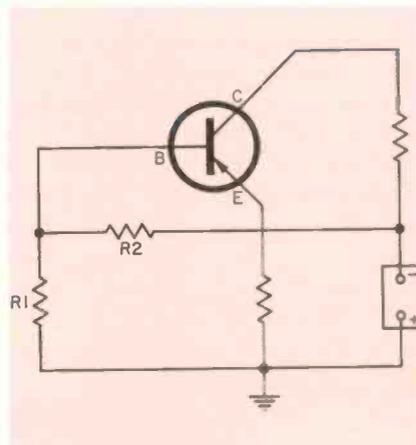


Fig. 2—Voltage divider bias circuit.

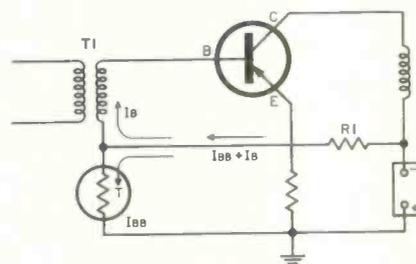


Fig. 3—Thermistor compensating circuit.

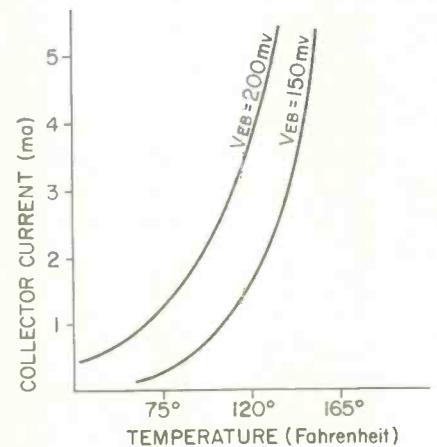


Chart I. Collector current vs temperature change.

Understanding Solid-State . . .

This resistor is frequently called a "swamping" resistor.

Very large input variations could cause overloading and signal distortion. But this swamping resistor limits overloading somewhat. The negative alternation of the input signal increases forward bias and, hence, current flow. The voltage drop across the swamping resistor increases and opposes the changing forward bias enough to prevent the swing from going into the distortion region of the transistor's operating curve. Positive alternations of the input signal also decrease the amount of current flowing through the emitter resistor and the voltage drop across it. In other words, if the forward bias tends to increase or decrease too much, an opposing voltage develops which keeps the current from exceeding transistor limits. At least two other resistive methods of compensating for temperature changes are used in solid-state amplifier circuits.

Other Temperature Compensating Circuits

Every technician knows that a thermistor is a temperature-sensitive element which is widely used to limit the effects of temperature changes

on the base-emitter junction of transistors, especially in pushpull amplifiers. It is a temperature-sensitive resistor that decreases resistance as the temperature rises. A simplified thermistor circuit is shown in Fig. 3. The thermistor can be placed in either the base or the emitter circuit and serves the same purpose in either location — to reduce the forward bias slightly as the temperature increases — and hence maintain the collector current within the transistor's normal limits.

When the transistor is functioning normally, a base current, I_b , and a base bias current, I_{bb} , flow through R1 as shown in Fig. 3. The bias current (I_{bb}) returns to ground through the thermistor while the base current goes through the base lead to the emitter. The polarity of the voltage drop across the thermistor sets the forward bias. If the temperature rises, the resistance of the transistor's base-emitter junction decreases and more collector current is allowed to flow — but the thermistor's resistance decreases and allows more current to flow through it. This increased current flowing through R2 causes a larger voltage drop across it. The voltage available for forward bias is reduced — and collector current flow is also reduced — maintaining it at a safe value.

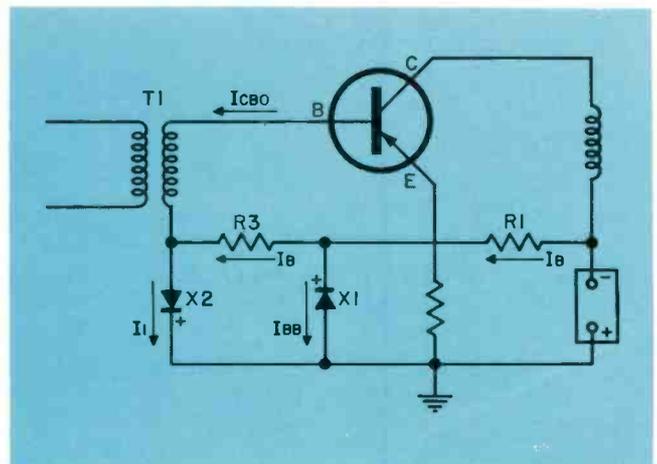
Because some critical transistorized amplifier circuits require better regulation, diodes, Zener diodes and transistors are used for temperature compensation. A simplified diode

compensating circuit is shown in Fig. 4.

Diode X1 is forward biased. When the transistor is operating normally, current flows through R1 and X1 to ground and through R3 to the transistor base. The voltage divider which consists of R1 and X1 is similar to the voltage divider network previously shown in Fig. 2. As the temperature increases, the resistance of X1 decreases and more current is allowed to flow through R1 and X1. Additional current through R1 causes more voltage to be dropped across it, so that less voltage is available for forward bias. When a temperature rise causes an increase in current, the stabilizing component (X1) allows more current to pass through itself. This reduces the voltage available for forward bias and reduces current flow to a safe value.

It is also desirable in some circuits to limit base reverse current (I_{CBO}). As shown in Fig. 4, diode X2 is reverse biased. Under normal operating temperatures, little reverse current flows. But if the temperature should rise above 100 degrees, an increasing amount of reverse current will flow. A small amount of the diode's reverse current flows through X2 in the direction shown. The current (I_1) flowing through the diode has two components — a small part of I_b and the reverse bias current, I_{CBO} , from the transistor. As the temperature rises, the reverse current of the transistor increases. But at the same time, the reverse

Fig. 4—Diode compensating circuit.



capability of X2 also increases so that the diode is able to pass additional current. Since current through X2 consists of a portion of I_b , more current flows through R1 and R3 —increasing the voltage drop across both. This reduces the amount of voltage available for forward bias. This reduction in forward bias, of course, decreases transistor current and keeps the transistor operating within its normal limitations.

Voltage Stabilization

Most stereo amplifier power supplies are ac operated and amplifier input voltages may fluctuate. Zener diodes are frequently used in power supplies to maintain a constant supply voltage to the load.

Suppose the load demands more current (during a loud music passage, for example). This would normally cause the supply voltage to drop because the filter capacitors cannot supply the required voltage instantaneously. During normal operation a certain amount of current (I_1) flows through the diode (Fig. 5). As the load current increases, the diode current decreases. (As we know, the Zener diode will conduct varying amounts of current with no change of voltage drop across itself when the "avalanche," or breakdown point, is reached.) Conversely, as the load current decreases, more current will flow through the diode. Regardless of the amount of current drawn by the load, a relatively constant current flows through dropping

resistor R1 — permitting the supply voltage to stay at the same potential.

Likewise, if the ac input to the power supply rises, increased current supplied by the Zener diode will flow through R1 and cause a large voltage drop across it. The load current and supply voltage will remain constant. If the input voltage decreases, the current through R1 and the voltage drop across it would decrease because of a reduction in diode current. This also would maintain a constant voltage and load current.

Zener diodes are frequently used in the base circuit of a transistor to provide a well regulated power supply voltage to critical circuits: AM/FM tuners, for example. The Zener diode sets the base voltage of the transistor at the breakdown voltage of the diode. Any variations in the unregulated input voltage are automatically compensated for by the diode.

Troubleshooting

As previously mentioned, stereo equipment is easier to troubleshoot than monophonic equipment. This is true because the good channel amplifier can be used to compare the defective unit. Suppose, for example, noise is coming from the speakers. Make sure the noise is present on all program sources — tape, radio, etc. If it is, it will usually be present on only one channel although it may appear to come from both. To find out which channel is

bad, adjust the balance control to its extreme position. If the noise is apparent at only one extreme, you can easily tell which channel is generating the noise. If one extreme control setting does eliminate the noise, it must be originating ahead of the control.

If the balance control does not affect the noise, then the noise is originating at a point between the control and the speaker. By listening closely near each channel's speaker system you should be able to determine which channel is defective.

Suppose the noise is unaffected by the balance control. Then go to the loudness control. If the noise stops when the loudness control is turned down, we know the noise is being generated somewhere between the balance control and we have isolated it to a relatively narrow area.

This technique can be used to locate sources of distortion, noise, hum or other problems where the channel is not "dead." If the trouble is hum or low frequency noise, however, the treble control may not affect the sound at the output. In this event, turn the bass control to help find the defective stage.

The key voltage in most amplifier circuits is the collector voltage. If the bias voltage is incorrect, the error will be multiplied at the collector and indicate if the bias voltage is incorrect. And we can always compare the readings to those in the good channel. ■

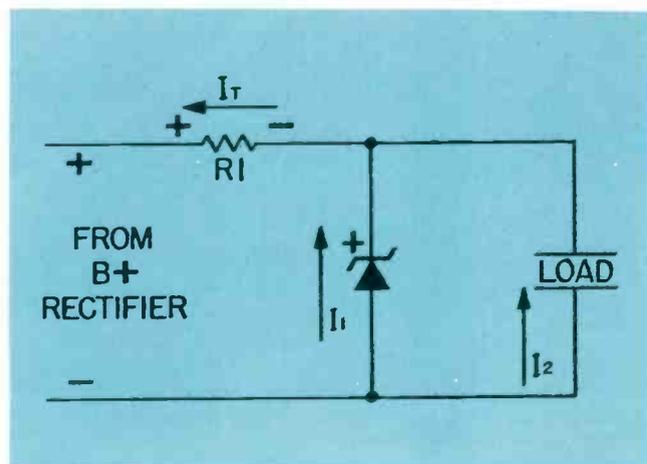


Fig. 5—Zener diode being used as a voltage regulator.

Proper exposure and long-range planning point to rosy future for this electronics equipment specialist

Striking it Rich



Sales engineer, Stan Rodenburg, prepares an audio-visual nurse call to be installed in a local nursing home.



A technician checks out a signaling and communications console being prepared for a client.



Sales Engineer, Stan Rodenburg, adjusts beam control on CCTV system which was installed for 'Teach and Review' course at the Teachers College, University of Nebraska.



A Notifier Engineering technician finishes an installation while the customer, a store manager, looks on.

in Audio and Visual Communications Systems

■ Notifier Engineering Corp., Lincoln, Nebraska, is a relatively young company and is operated by young people. It specializes in intercommunications and paging systems, burglar and fire alarms, closed-circuit TV and video tape equipment. Its executive vice president, Don Nielsen, is in his early thirties and he is definitely not for the "fast-sell."

"I'm more concerned in the future than in the present," Mr. Nielsen declares. "Each step we have taken here has been carefully planned in a long range program."

The company is capitalized at \$100,000 and its officers include a president, Oliver T. Joy, a treasurer, Margaret Joy, and Mr. Nielsen. Two salesmen, 3 technicians and a bookkeeper-secretary complete the normal staff.

Growth Picture

Starting in October 1963, the company had gross sales of \$160,000 after the first business year. Sales rose to \$215,000 the following year and "this year it will be from \$250,000 to \$305,000," Mr. Nielsen predicts enthusiastically.

His prediction can be counted on because he keeps a daily review of all sales. He also maintains a monthly record. "We know exactly what we're doing in dollars and cents," the energetic young man says. "We are also able to make a comparison with what we did in that same month a year ago," Mr. Nielsen declares.

His records also permit a breakdown on where the new business came from, whether in retail, contract, inspection and maintenance, rental and leased equipment or special services.

"We run a gross profit on every breakdown each month," Mr. Nielsen explains. "We also run a net profit breakdown in each product area."

"In 1963 we realized that we had obtained a good market penetration but we either had to expand our operating area or expand our line," Mr. Nielsen says. "After careful thought the officers of the corporation decided to broaden our product line. We made a survey of the equipment being offered in this area. This included audio visual communications equipment. We then went to look at the equipment to decide what we wanted to handle."

After this, Mr. Nielsen wrote to manufacturers asking if they were already represented in the area and how successful they were in the Lincoln area.

"This period of product selection ran from the middle of 1963 to the middle of 1964," he says.

Having made product selections, Mr. Nielsen then visited each manufacturing plant involved.

"We got better acquainted with products, learned all we could about the equipment and established a basic marketing policy with the manufacturer."

"After that, we arranged trade shows and product exhibits in our area to create an awareness of the products."

It was about this time that Mr. Nielsen realized that it would be necessary for his firm to add a salesman specialized in audio and audio-visual equipment to call on prospective customers.

Because the company already had an established business in fire and security alarms, Mr. Nielsen had a ready list of potential customers for his new salesman. "It was merely a matter of convincing these old customers to combine various forms of communications systems with their signaling gear which we had already installed," he recalls.

Advertising and Promotion

When the second salesman was

added, Don Nielsen went into action with a direct mail campaign aimed at all their existing customers.

"We sent out four thousand letters explaining our new activity. Enclosed was manufacturers' literature telling about the audio and audio-visual products we were selling and installing in business, industrial and educational establishments. This direct mail effort has been continued and expanded. We now send out letters to potential customers in the new construction field. These letters go out on a weekly basis—and they are *personalized* letters."

In addition to this direct mail campaign, a number of equipment showings have been set up in other cities: Sioux City, Iowa; Hastings and Grand Island, Nebraska and also locally.

"We send invitations to architects, engineers and contractors in various areas asking them to attend our two day product shows," Mr. Nielsen says.

Most of the company's advertising budget has been spent on these shows and demonstrations. The total advertising and promotion budget is a little less than 8 percent of gross sales. Mr. Nielsen believes that the money now being spent on these promotions will not begin to pay off for three or four years.

"For the coming year," he predicts, "we may direct most of our budget to long range direct mail. Four or five pieces of mail may be directed to prime potential customers, telling them about our products, our company and the extent of our progress in the field of audio and audio-visual communications."

Don Nielsen makes it clear that he is not interested in merely "surviving" in this business. "I want to *excell* in this field. We have not yet hesitated to serve any customer who wants to see or use our equipment," he emphasizes.

Striking It Rich

Nielsen and sales engineer Stan Rodenburg look over sales figures which have increased almost 50 percent in less than 3 years.

Work truck in front of Jack & Jill supermarket where the company has installed an intercommunications and music distribution system. System includes paging and telephone services for the supermarket's customers.

Don Nielsen in front of the spacious plant which he directs as executive vice president.

Work trucks of Notifier Engineering are designed to open on center side to enable technicians to carry out their gear with greater ease.



Mr. Nielsen has also contributed a lot of time and know-how on a number of non-profit projects in order to build goodwill and create product exposure.

One project was a recent AAA swim meet where his company installed a closed-circuit TV system. "This was entirely without profit for us," he says. "But we knew we would gain product exposure."

Another effort in this direction was the help Nielsen's firm gave the State of Nebraska. "They wanted to conduct a survey to show which State Agencies could use closed-circuit TV in times of emergency. We installed our equipment on helicopters to show how instant information could be provided in certain emergencies. Additionally, we have worked with the Civil Defense Agency in setting up certain equipment which met their needs."

Sales Policies

"Shortly after our letters go out to prospective customers," Mr. Nielsen continues, "we follow up with a personal call which is made by one of our salesmen. Any building, business or plant which has a need for audio or audio-visual communications equipment, fire or

burglar protection, receives our attention. We make every effort to create business."

The salesman not only calls on owners; at construction sites, he calls on engineers and architects as well.

"In selling," Mr. Nielsen says, "our sales staff and I rely very heavily on new construction for sales leads." Mr. Nielsen makes many first contracts for his salesmen. He then passes the accounts along to them so they can earn the commissions on the sales.

"We follow each lead," the young vice president says. "And we try to obtain plans and specifications so we can offer bids."

Mr. Nielsen believes very strongly in "creative salesmanship" and does everything he can to encourage it in his salesmen.

"We want our salesmen to stimulate the thinking of prospective customers," he says. "And we also want them to show potential customers what equipment is available and what the equipment can do for them," he adds.

This approach has obtained some important business in the immediate area. An order for closed-circuit TV for instructor improvement courses has been obtained from the University of Nebraska, Teachers Col-

lege, in Lincoln. The system shows the teacher-student how to improve their classroom instruction. This is a lease arrangement.

A specially designed security and communications system has also been installed in a nursing home in Lincoln. "When certain doors open or shut, lights show on a big board that notifies the superintendents of the movements of patients who should be in bed," Mr. Nielsen explains.

The youthful executive vice president is very enthusiastic about the future of his company. "There is a tremendous market opening up for audio and audio-visual communications equipment," he says. "And we must adapt ourselves to answering all the questions our prospective customers ask and show them how their problems can be solved."

He foresees the time when TV will become as important to business and industry as it already has in the home.

"TV can definitely offer the answer to many communications problems that business and industry has," he says. "And if it can be offered in its fullness by men who know their business, the outlook is unlimited." ■

Aligning and Troubleshooting FM/Stereo Equipment

Use test instrument best suited
for rapid alignment and adjustments

■ Every working technician today is thoroughly familiar with the theory covering FM/stereo broadcasting and reception. For this reason, we will review the principles only briefly and in a simplified way before proceeding to practical servicing problems.

The principles of stereo multiplexing are very simple. As we know, a monophonic FM telecast uses a single microphone and mixes all the tones which modulate the carrier.

A stereo broadcast, however, uses two microphones and sounds from different directions reach each microphone with different intensities and at different instants in time. This is shown in Fig. 1. Two different tones, 400 and 800Hz, are shown being fed into separate microphones. The information is picked up with a stereo receiver, as shown in Fig. 2, and is eventually fed into two different speakers.

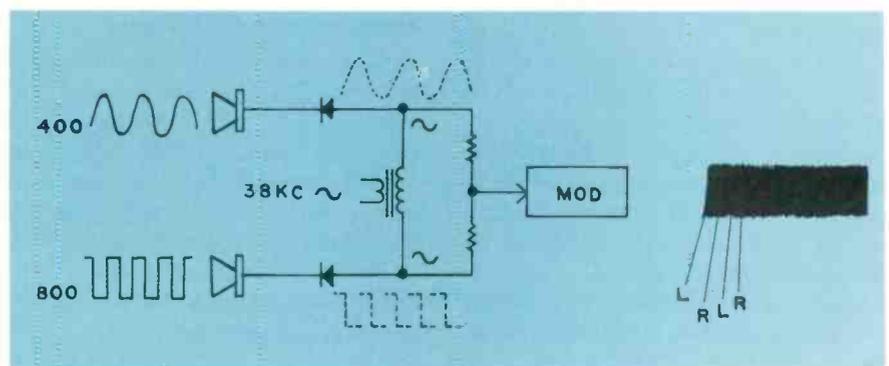
Let's assume (Fig. 1) that only the two signals shown enter their re-

spective microphones and that neither signal enters the other signal's microphone. Then each signal passes through its own switch (a diode). One diode is turned on while the other is turned off by alternately biasing them forward and backward with a 39kHz signal.

The diode outputs become interleaved segments of each audio signal — the audio from one channel is present while the other is absent. Now the signals are mixed and fed to an FM modulator where they are averaged. When the resultant modulated signal is fed to a monophonic receiver the audio will be identical to the signal existing in the one-microphone FM transmitter. Although the carrier actually contains discrete bits of left and right channel information, it is switched at such a rapid rate that it acts exactly like a monophonic signal — because the left and right signals (L+R) are added.

When this signal is picked up by a stereo receiver, however, the proc-

Fig. 1—In stereo systems, sounds from different directions reach each microphone with different intensities and at different times.



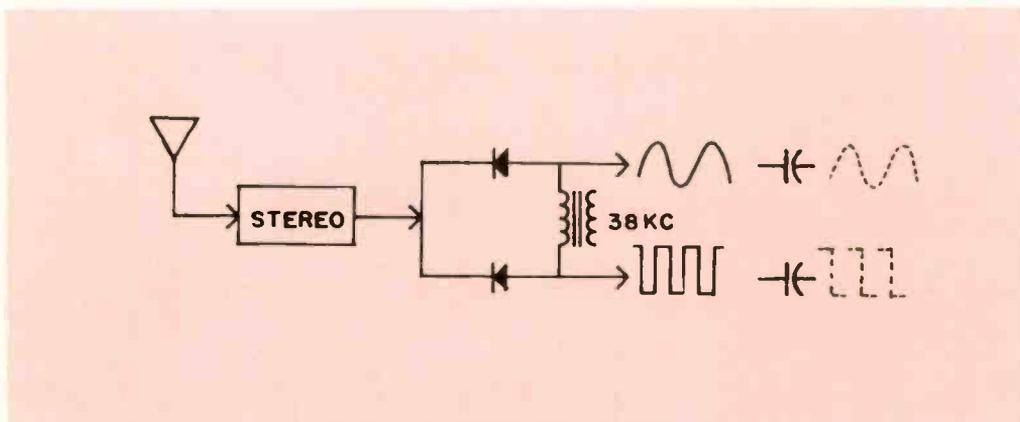


Fig. 2—The stereo receiver functions to re-direct left and right signals to their respective channels.

ess becomes entirely different. Since the audio signal does contain bits of left and right channel information, which are alternately and precisely spaced by a 38kHz switching signal, they can be put back in their proper channels by switching another pair of diodes off and on alternately at the same rate as those at the transmitter (Fig. 2).

The 38kHz switching signal at the receiver must be switched at the same rate and phase as the switching signal at the transmitter. This is done with a 19kHz *pilot* signal in the transmitter which keys the 38kHz switching signal. The pilot signal also keys the 38kHz oscillator in the receiver. The total relationship of these signals is shown in Fig. 3.

To explain this in a slightly more technical way, the main channel transmitted by an FM/stereo station contains the sum of the left and right signals (L+R) with audio information ranging from 50Hz to 15kHz. This makes the system compatible because any standard monophonic FM receiver can pick up the information.

The stereo sub-channel contains the difference information (L-R). This difference signal amplitude modulates a 38kHz subcarrier by using a balanced modulator which produces sidebands between 23 and 53kHz with the carrier suppressed. A 38kHz signal must be inserted at the receiver to effect demodulation. A 19kHz *pilot* carrier is added to the transmitted signal. This

19kHz signal is removed by the receiver and is used to synchronize the receiver with the transmitter.

The SCA (Subsidiary Communications Authorization), or "store-casting" frequency, extends from 60 to 74kHz — frequency modulated on a 67kHz carrier. The SCA carrier occupies 10 percent of the total modulation.

A typical electron tube FM/stereo multiplexing circuit is shown in Fig. 4. The 19kHz pilot is removed from the composite signal by a tuned circuit (L3, C46, R93) and amplified by V7A. Diodes CR5, CR6 and V7B form a frequency doubler. The 38kHz output of this stage is used to gate the left and right channel diodes, CR2 and CR3. The 180deg phase change necessary for left and right channel demodulation is accomplished with a center tapped secondary.

The composite signal is also fed into the diode detectors through C51, L5, C53, L6, R44 and C54. The two outputs (L&R) signals are obtained from the detector.

Major Service Problems

Two primary problems arise in servicing FM/stereo equipment. The first problem concerns inadequate antennas. Because FM/stereo tele-casting imposes more strenuous demands on antenna capabilities, this fact must be carefully considered by service technicians. Not only must antenna gain be higher for FM/stereo reception, but a clean signal, without multipath and lead-in

reflections must be delivered to the receiver by the antenna. The second most important consideration concerns proper adjustment of the receiving equipment to provide adequate channel separation — to prevent channel "spill-over" or cross-talk between channels.

As we know, the FM spectrum extends from 88 to 108MHz. The FM antenna must be designed to provide sufficient gain, as flat as possible, across this bandwidth. And because stations are frequently not all located in the same direction from the receiving location, a rotator is almost always desirable for orienting the antenna in the proper direction for best reception. Additionally, to maintain proper gain and eliminate lead-in mismatch under all weather conditions, good 300 encapsulated type lead-in is highly desirable. Coax type line should not be used except when nearby ambient impulse noise conditions make its use necessary. This, however, is seldom a problem because the particular frequency spectrum and the nature of FM reception — the noise limiting effect of the receiver — seldom allows any but the most intense impulse noises to arrive at the speaker system.

Alignment

Because most manufacturers recommend alignment procedures that vary somewhat from other manufacturers, you should provide yourself with service data and instructions for each piece of equipment

Servicing Solid-State

■ An urgent, immediate need exists for both general and specific information on servicing typical semiconductor type portable and table-top phonographs. For this reason, mechanical operations — cycling and automatic record changer problems — will be covered in more detail in forthcoming articles.

The first article in this series (ELECTRONIC TECHNICIAN, August, 1966) pointed out the need for technicians to provide themselves with exact manufacturers' specifications and service instructions for this equipment. This is especially necessary in the area of disassembly instructions because of variations existing in instructions for each piece of equipment — even between units made by the same manufacturer.

Cases

One unit we have seen frequently during the past year is the Westinghouse CP466 (V-2524-4), which has come into the shop for styli, cartridge replacements and other repairs. Instructions for removing the chassis are very helpful.

1. Remove all knobs.
2. Remove the four phillips-head screws that hold the control panel to the cabinet.
3. Remove the escutcheon.
4. Pull out the control panel mounting board. The chassis is secured to the mounting board with four palnuts.

5. If further disassembly is needed, remove the motorboard from the changer (held by four phillips-head screws) and unplug the motor and tone arm lead connections.

6. Unsolder three leads to the output jacks at the rear of the cabinet.

Stylus and Cartridge Replacements

To replace a stylus in this equipment:

1. Turn the lever handle half way between the two playing positions.
2. Pull the stylus away from the spring clip.
3. Install the new stylus with the "78" marking facing upward.
4. Slide the stylus under the spring clip and push the spring clip up so the stylus can be pushed into the cartridge groove under the spring clip.
5. One of the stylus arms should rest in the fork of the couplet (See Fig. 1).
6. Turn the lever handle to the desired playing position.

A cartridge wiring diagram is shown in Fig. 2. Before replacing the cartridge, write down the sequence in which the colored wires are connected to the cartridge terminals.

1. Pull the snap clip on the cartridge holder gently away from the cartridge and then pull the cartridge from the holder (see Fig. 1).
2. Remove the push-on connectors from the cartridge terminals, and connect them to the terminals of the new cartridge as shown in Fig. 2.
3. Slide the two studs (Fig. 1) on the sides of the cartridge into the notches in the holes on the cartridge holder. Push the cartridge up until the snap clip locks in place.

Most Frequent Adjustments

The common adjustments found necessary on this equipment is stylus set-down, pressure and tone arm height. These adjustments are shown in Fig. 3. The stylus should set down about $\frac{1}{8}$ inch in from the edge of the record. The set down adjustment screw is turned clockwise to make the needle set down further in from the record's edge.

Stylus pressure on this record changer is between two and three grams. Remember, when the stylus force spring is stretched longer —

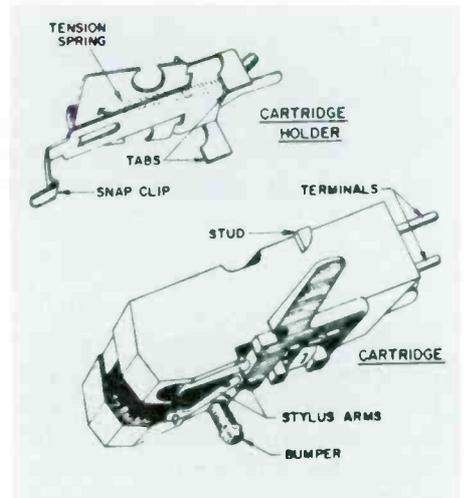


Fig. 1—Cartridge and cartridge holder for Westinghouse 670V040D01 record changer used in CP466 (V2524-4) portable phonograph.

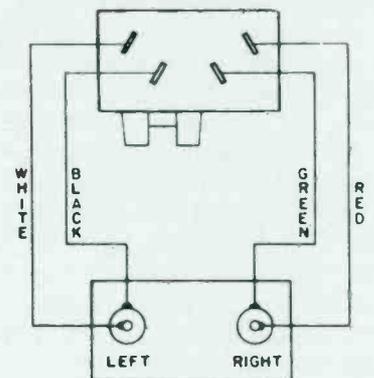


Fig. 2—Stereo cartridge diagram.

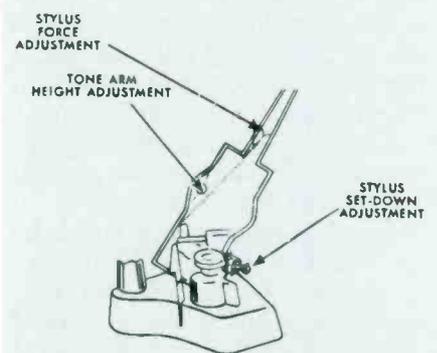


Fig. 3—Tone arm adjustments.

Portable Phonographs

the stylus pressure becomes *less*.

The tone arm height adjustment should be set so the tone arm clears a $\frac{7}{8}$ inch stack of records on the turntable by about $\frac{1}{8}$ inch. The height adjustment is turned counter-clockwise with a $\frac{1}{4}$ inch nut driver to raise it higher.

A schematic of the entire solid-state circuit used in this phono, including power supply, is shown in Fig. 4.

Another Typical Unit

Another unit we have had experience with is the G-E portable stereo phono, RPA331BN. It uses the RD225-7 automatic record changer mentioned in the first article of this series. The stereo amplifier is the T2C shown in Fig. 5. It is

not too difficult to disassemble and reassemble if you have the instructions. To remove the record changer: 1) Remove screw and cover on right side of changer buckets. 2) Reach inside opening in changer bucket and flip shipping screw to a vertical position. 3) Tilt changer upward and unplug the power and signal leads to the changer. 4) Flip the other shipping screw to a vertical position and lift changer out of bucket.

The amplifier is removed in the following manner: 1) Remove control knobs. 2) Remove the two screws holding the escutcheon and plate containing the 45rpm spindle clip. 3) Slide the plate up out of cabinet spring clips and carefully remove from cabinet. Exercise cau-

tion to prevent scratching the changer compartment sides. 4) Remove the two screws holding the amplifier to the cabinet. 5) Disconnect and label all leads for reassembling and remove amplifier from cabinet. When reinstalling the amplifier, be sure to mount it in the same position it was in before removal. It can be mounted physically upside down which will reverse the controls.

Styli and cartridge replacement and some basic adjustments for the RD225-7 were described in the aforementioned first article.

Important Service Considerations

Once you work on a half dozen of these portables and table models,

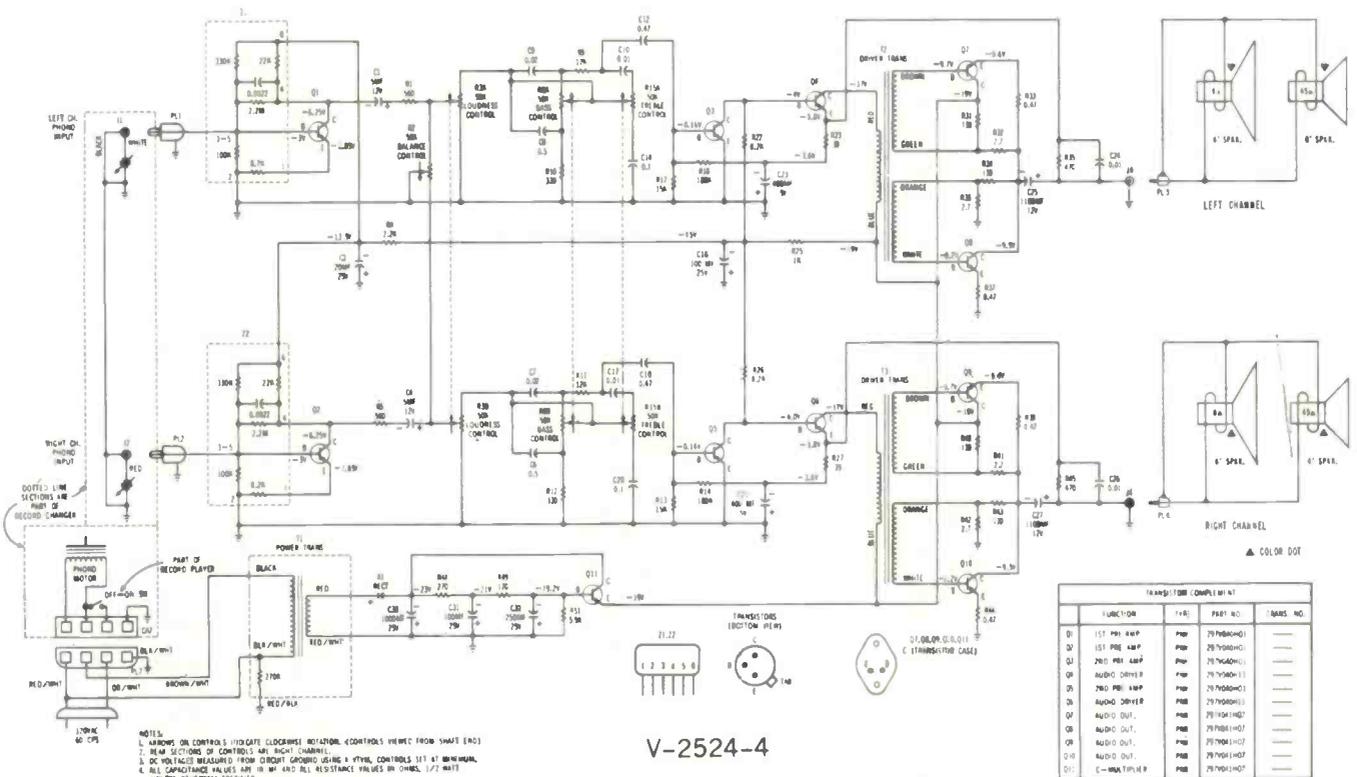


Fig. 4—Schematic of V-2524-4 Westinghouse stereo phono amplifier.

Servicing Solid-State...

you'll learn that the solid-state troubleshooting and repair techniques involved for the various types and brands will be about the same. This does not disregard the need for individual disassembly instructions and schematics, however.

Carefully consider the following important practices: 1) When replacing power output transistors make sure the transistor mounting assembly conforms to the original. For example, note the exploded view of the power transistor assembly on the Westinghouse V-2524-4 amplifier service instruction manual. Various mounting methods are used for power transistors. Some may use a heat sink and insulating wafer having heat conducting grease to dissipate maximum heat through the chassis. Others may not use a heat sink. Machine screws, shoulder and

lockwashers and nuts may also be used instead of self-tapping type mounting screws. Some manufacturers recommend replacing the mica insulating washers when replacing transistors. And do not forget to put silicone grease on both sides of the new insulating wafer.

Make certain that you do not operate a transistor amplifier when the speaker is disconnected or without a comparable resistive load across the output. This applies to both channels on stereo amplifiers.

When a transistor goes bad in a push-pull amplifier stage, replace both transistors with a matched pair. And if one goes bad by shorting, replace the emitter bias resistor with a similar type — preferably one having a five percent tolerance.

Make certain you do not short out the audio output when the am-

plifier is in an operating condition.

Use only 60-40 solder and a pencil type soldering iron of 25w or less.

Tin the component leads before soldering them into the circuit. Clip out defective resistors and capacitors. Do not attempt to unsolder these components from a printed board. Then use prepared spiral connectors to replace a new component. Slip a spiral over the soldered-in stubs of each defective component. The leads from the new component are then slipped into the other ends of the two spiral connectors. Leads are then joined by flowing a small amount of solder over the entire length of both spirals.

The next article in this series will cover other specific problems encountered in servicing solid-state portable phonographs. ■

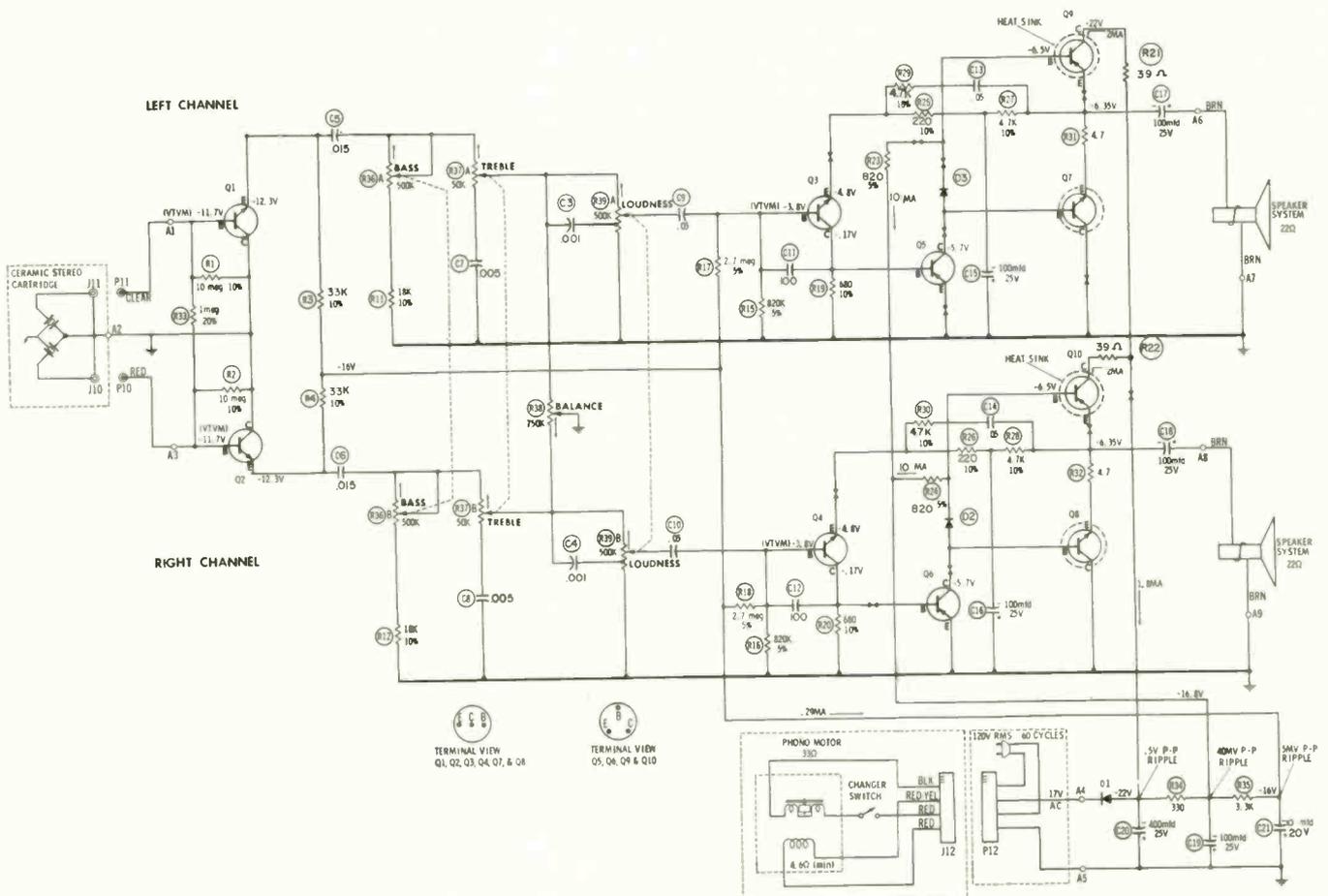


Fig. 5—Schematic of T2C solid-state stereo phono amplifier.

Semiconductors From A to Z

Understand how transistor circuits operate and you can troubleshoot them faster

■ A previous article in this series on junction transistors described the three basic transistor circuits and how two of these circuits can be combined to form a single circuit with dual independent inputs. We will continue to describe the function of junction transistor circuits with the aid of labels applied to the dual input NPN circuit (Fig. 1).

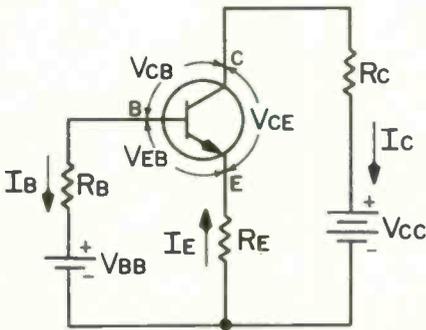


Fig. 1 — Input currents I_B and I_E effect the circuit's output current (I_C).

NPN transistors must be forward biased before they can conduct a significant current — the base and collector being made positive with respect to the emitter. This bias is provided by the collector-to-emitter voltage source (V_{CC}) and the emitter-to-base voltage source (V_{BB}). These sources combine to develop an emitter-to-base voltage (V_{EB}), a collector-to-emitter voltage (V_{CE}) and a collector-to-base voltage (V_{CB}).

Two significant currents result from these bias voltages. They are the emitter-to-collector current (I_C) and the emitter-to-base current (I_B). At normal temperatures good transistors will not experience a significant base-to-collector current. Since both the base current and collector current in the transistor originate in the emitter, the emitter current (I_E) must equal the sum of these two currents ($I_C + I_B = I_E$).

PNP transistors must also be forward biased before they can con-

duct current — the base and collector being made negative with respect to the emitter. By substituting a PNP transistor for the NPN transistor described, the polarity of the biasing voltages is reversed and the direction of the resulting current is also reversed. Though reversed, the emitter current is still the sum of the collector current and the base current.

Voltage drops within the circuit occur across the emitter resistor (R_E), base resistor (R_B) and collector resistor (R_C).

Relative size of currents

About 92 to 99 percent of the current flowing through the emitter passes through the collector of a junction transistor. The remaining 8-to-1 percent is the base current. The collector current (I_C) is much greater than the base current (I_B). The collector current nearly equals the emitter current (I_E). The ratio of collector current to emitter current is called Alpha ($\alpha = \frac{I_C}{I_E}$).

The collector current must always be less than the emitter current since all forward-biased junction transistors normally experience a base current. Therefore, the value of α must always be less than one.

The smaller the base current, the nearer the collector current comes to equaling the emitter current, and the nearer α comes to becoming one. Typical values of α for junction transistors range from 0.92 to 0.98.

The ratio of collector current to base current is called Beta ($\beta = \frac{I_C}{I_B}$). The smaller the base current, the larger the fraction becomes and the greater the value of β . Typical values of β for a junction transistor range from 25 to 100.

Self Biasing

Multiple voltage sources have been required for the circuits we have described. For economy, these circuits can be revised to use a single voltage source.

The voltage source (V_{BB}) for biasing the base of the common-emitter amplifier (Fig. 2A) is able

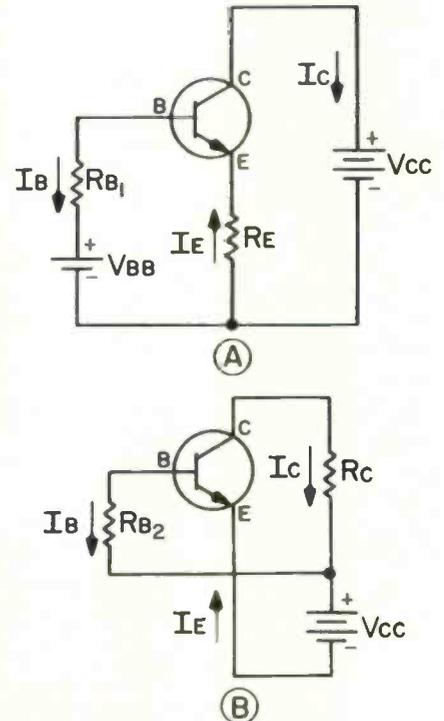


Fig. 2 (A and B)—Common-emitter voltage sources are combined by increasing R_B .

to provide the desired emitter-to-base voltage (V_{EB}) with the necessary base current (I_B) passing through the base resistor (R_{B1}). The same emitter-to-base voltage (V_{EB}) and base current (I_B) can be obtained from the voltage source (V_{CC}) used to provide the collector-to-emitter bias (Fig. 2B). This can be done with a base resistor (R_{B2}) of an appropriate higher value. The increase in resistance is equal to the additional voltage drop ($V_{BB} - V_{CC}$) divided by the base current (I_B).

Semiconductors . . .

$$(R_{B2} = R_{B1} + \frac{V_{CC} - V_{BB}}{I_B}).$$

The common-collector amplifier (Fig. 3A) can be revised in the same manner as was the common-

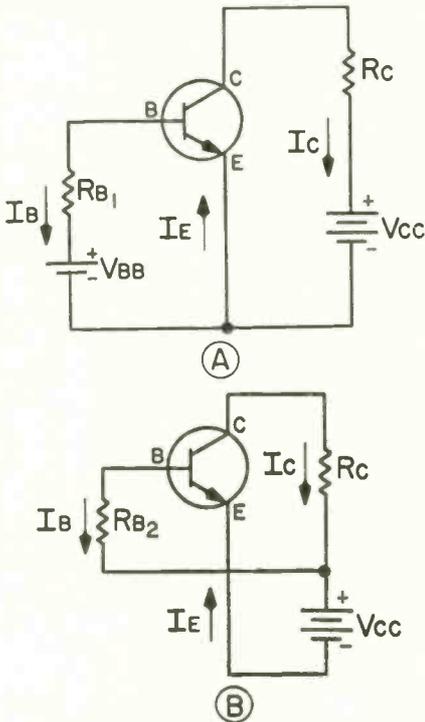


Fig. 3 (A and B)—Common-collector voltage sources are combined by increasing R_B . emitter amplifier (Fig. 3B). By increasing the base resistor (R_B), the same emitter-to-base voltage (V_{EB}) and base current (I_B) can be obtained from the higher collector-to-emitter voltage source (V_{CC}).

The common-base diagram (Fig. 4A) can be revised (Fig. 4B) without changing the circuit. The same

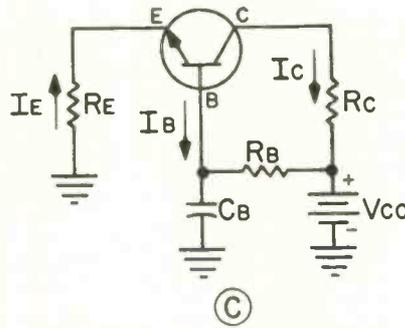
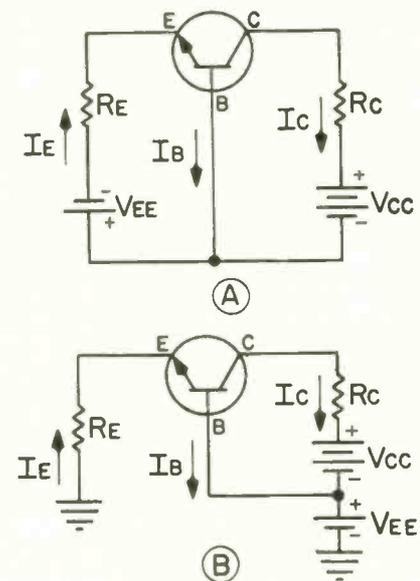


Fig. 4 (A, B and C)—Common-base circuit can be modified for single voltage source.

emitter-to-base voltage (V_{EB}) and base current (I_B) can be obtained by inserting a base resistor (R_B). The value of the base resistor can be determined in the same manner as it was for the other two circuits ($R_B = \frac{V_{CC} - V_{BB}}{I_B}$). The base of the

transistor is no longer grounded by its biasing voltage source (V_{EE} or V_{CC}). The effect of an ac ground must, therefore, be obtained by using a capacitor (C_B).

The compound circuit (Fig. 1) can also be modified (Fig. 5) by

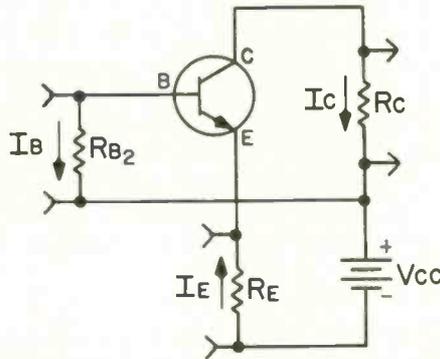


Fig. 5—The compound circuit can be modified to use a single voltage source.

increasing the base resistor (R_B) to the proper value (R_{B2}). The compound circuit is a combination of the common-base and common-emitter circuits. The common-base circuit (Fig. 4) required a capacitor (C_B) to function without signal loss. The two inputs shown in the compound circuit (Fig. 5) should each be tuned to its own separate frequency to eliminate a corerresponding signal loss of the other signal at each input.

Effect of Temperature

Most conductors have a low resistance to currents at very low temperatures and higher resistances to

currents at higher temperatures. Semiconductor materials do not have this characteristic. Most semiconductors have a very high resistance to currents at very low temperatures. This resistance decreases as the temperature increases.

When transistors conduct current, their internal resistance to current flow results in a power loss. This loss occurs in the form of heat. Heat sinks transfer the heat away. Not all of the heat can be removed, however, and the transistor's temperature will tend to rise. The increased temperature will reduce the transistors internal resistance — resulting in an emitter-to-collector (I_{EC}) and emitter-to-base (I_{EB}) current increase (Fig. 6).

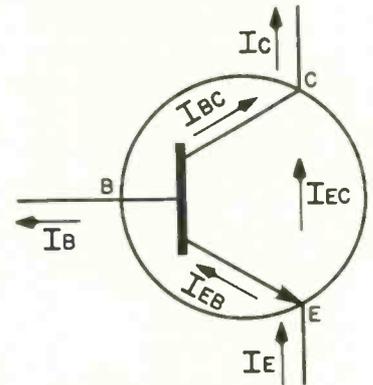


Fig. 6—Transistors contain various currents that are effected by temperature.

We indicated previously that good transistors will not experience a significant base-to-collector current when operating at normal temperatures. But when the resistances in a transistor are reduced by higher temperatures, the base-to-collector current becomes significant. In germanium transistors this current doubles for about every 9°C rise above room temperature and in silicon transistors this current doubles for about every 11°C rise above room temperature. Having been very low, the relative changes in the base-to-collector current (I_{BC}) is much greater than the relative changes in the other currents.

At normal temperatures we consider the base current (I_B) equal to the emitter-to-base current (I_{EB}). However, at higher temperatures some of the emitter-to-base current continues through the transistor as the base-to-collector current (I_{BC}), reducing the remaining base current ($I_B = I_{EB} - I_{BC}$).

The collector current (I_C) then contains both the emitter-to-collector current (I_{EC}) and the base-to-collector (I_{BC}). ($I_C = I_{EC} + I_{BC}$). The emitter current (I_E) still contains only the emitter-to-base current (I_{EB}) and the emitter-to-collector current (I_{EC}). ($I_E = I_{EB} + I_{EC}$) Note that the emitter current (I_E) is still equal to the base current (I_B) plus the collector current (I_C). [$I_E = I_B + I_C = (I_{EB} - I_{BC}) + (I_{EC} + I_{BC}) = (I_{EB} + I_{EC})$]

The biasing circuits shown are not satisfactory when the temperature of the transistor is allowed to change. As the transistor's temperature increases, the base current (I_B) decreases and the voltage drop across R_B becomes smaller.

The emitter-to-base voltage (V_{EB}) then increases and approaches the collector-to-emitter voltage source (V_{CC}). Since the forward bias of the base has been increased, the transistor will conduct more current. The increased current will result in the generation of more heat and result in the further reduction of the transistor's base current (I_B). The temperature and base current will continue to change until either the circuit is overloaded or the transistor burns out. This is called thermal "run-away" or avalanche effect.

Bias Stabilization

Circuits can be designed to compensate for the thermo effect in transistors. Collector-to-base feedback (Fig. 7) in one way to improving

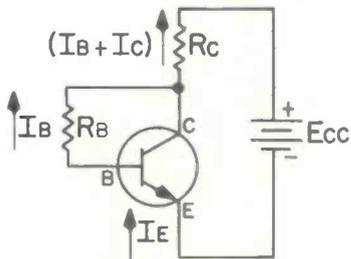


Fig. 7—Collector-to-base feedback improves transistor stabilization.

bias stabilization. Instead of connecting the base resistor (R_B) directly to the voltage source (V_{CC}), it is connected to the collector resistor (R_C). As the temperature of the transistor increases, the collector current (I_C) increases, causing the voltage drop across the collector resistor to also increase. The higher

temperature also causes the base current (I_B) to decrease, reducing the voltage drop across the base resistor (R_B). Since the collector current is much larger than the base current, a greater change occurs in the voltage drop across the collector resistor than across the base resistor. The net effect of the changes in voltages across the two resistors, is a reduction in the forward bias of the transistor's base (V_{EB}). This reduction in the base bias reduces the collector current and stabilizes the circuit.

"Emitter swamping" is another way to stabilize a transistor circuit (Fig. 8). As the temperature of the

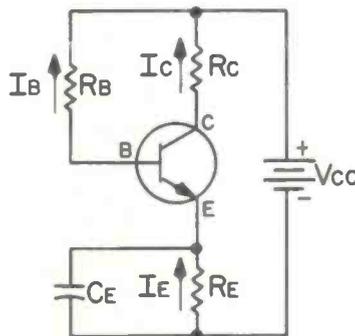


Fig. 8—Transistors can be stabilized with an "emitter swamping" circuit.

transistor increases, there is an increase in the emitter current (I_E) and a decrease in the base current (I_B). This results in a greater voltage drop across the emitter resistor (R_E) and a smaller voltage drop across the base resistor (R_B).

Since the emitter current is much larger than the base current, the voltage drop across the emitter resistor is greater than the voltage drop across the base resistor. The forward bias of the base (V_{EB}) is equal to the voltage source (V_{CC}) minus the voltage drop across the base resistor ($I_B R_B$) and the voltage drop across the emitter resistor ($I_E R_E$). ($V_{EB} = V_{CC} - I_B R_B - I_E R_E$).

As the temperature of the transistor increases the current change reduces the forward base bias of the transistor and stabilizes the circuit. By connecting a capacitor (C_E) across the emitter resistor (R_E), only the dc portion of the voltage drop affects the circuit bias. The ac portion is able to pass through, reducing the signal loss in the resistor.

The collector-to base feedback and emitter swamping circuits de-

scribed provide some bias stabilization. In both circuits the reduced voltage drop across the base resistor (R_B) reduces the stabilizing effect of the emitter or collector resistor. By using an additional resistor the effect of a changing base current can be reduced. By designing a voltage divider (Fig. 9) so that the cur-

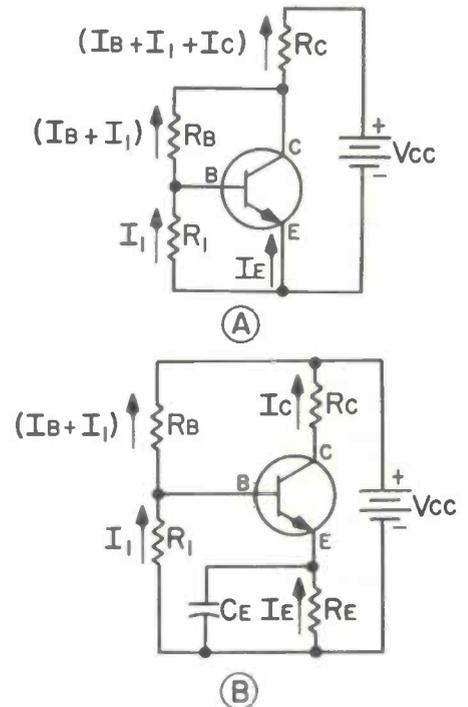


Fig. 9 (A and B)—Voltage dividers can be used to stabilize a transistor circuit.

rent (I_1) passing through the resistors (R_B & R_I) is much greater than the base current (I_B), the voltage drop across the base resistor (R_B) is more greatly influenced by the voltage divider current (I_1) than it is by the base current (I_B). The resulting change in the voltage drop across the base resistor is reduced, increasing circuit stabilization.

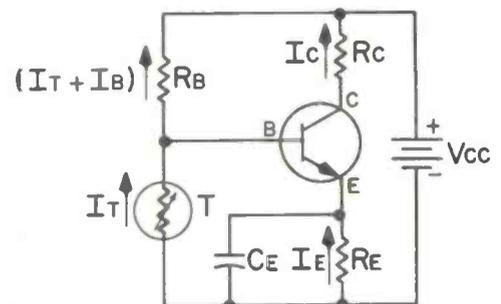
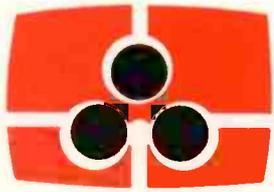


Fig. 10—Thermistors compensate for transistors over limited temperature range.

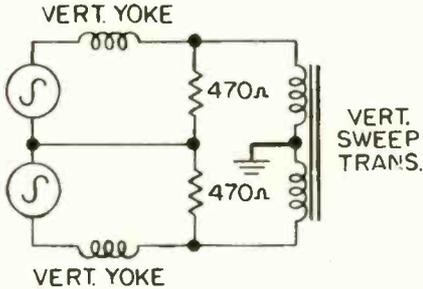
The voltage divider can be improved (Fig. 10) by substituting a thermistor (R_T) for the second resistor
continued on page 109



COLORFAX

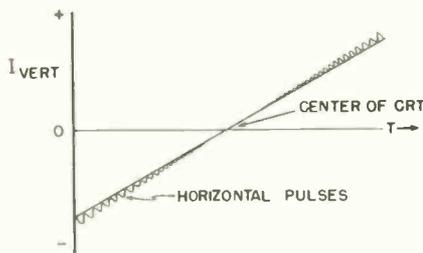
G-E CB Pincushion Correction

A deflection yoke will have a uniform magnetic field within its aperture when a linear current is flowing through its horizontal and vertical



windings. If it is used with a spherical face CRT a rectangular raster will be produced on the screen. If the same deflection yoke is placed on a flat face CRT a raster will be produced.

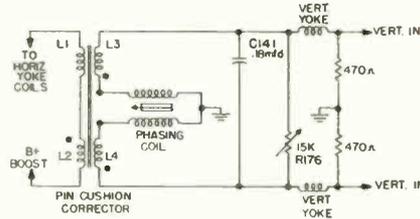
In a B/W TV receiver permanent magnets can compensate for this pin-



cushion effect. They are placed around the perimeter of the deflection yoke, and either push or pull the electron beam to produce the desired rectangular raster. In a monochrome CRT a single electron gun is used. In a color CRT there are three electron guns to be concerned with. Because of the geometric placement of the guns, a permanent magnet could not be placed in a position where it would have a uniform effect at the same time on all three electron guns and it would cause a misregistration problem. Therefore, another form of electrical compensation is used in conjunction with the deflection yoke, to correct the shape of the raster and eliminates the pin cushion effect.

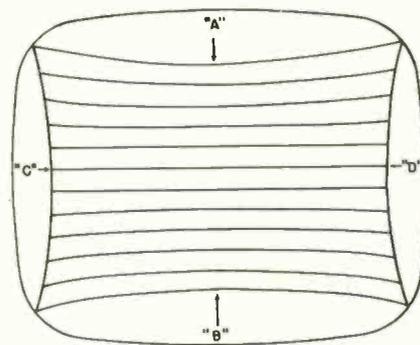
Top and Bottom Correction Circuit

The largest amount of beam correc-



tion is needed at points "A" and "B" toward the outer edges of the picture tube screen. The top- and bottom-pin-cushion corrector circuit consists of a two-current generator connected in series with the vertical coils of the deflection yoke.

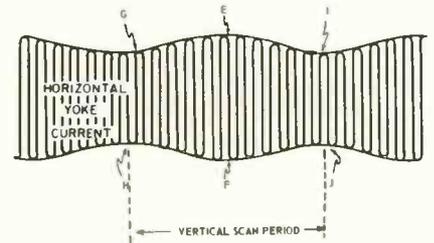
A composite current flows through the vertical coils of the deflection yoke. The current consists of the normal ver-



tical sweep current and a horizontal sinewave current supplied by the current generator. The amplitude of the correction current is highest at the beginning and end of the vertical scan period and will progressively decrease to zero as the vertical sweep current passes through zero — which is coinci-

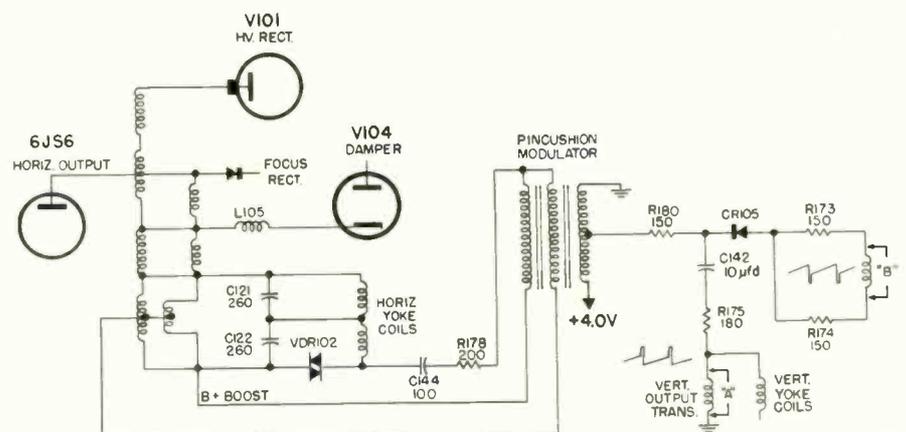
dent with the center of the picture tube.

The current generator consists of a series-resonant circuit containing the entire secondary winding of T108, the phasing coil, C141 and R176. A horizontal flyback pulse is fed to the primary of T108 from the horizontal coils on the deflection yoke. This pulse is



inductively coupled to T108's secondary winding where it will shock excite the series resonant circuit, causing it to ring at 15,750 Hz. The correction voltage fed to the deflection yoke's vertical windings is the voltage that appears across C141 and R176. This ac voltage will cause the vertical yoke current to vary slightly at a horizontal rate.

The correction voltage's amplitude will be highest at the beginning and end of the vertical scan period and zero when the beam is sweeping through the center of the CRT screen. This action occurs because T108 functions somewhat like a saturable reactor. The correction voltage's amplitude across 13 and 14 will be proportional to the vertical yoke currents amplitude at any instant. The output correction



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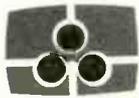
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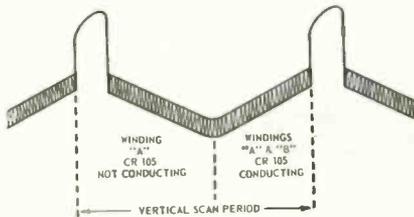
COLORFAX

voltage will be zero when the vertical yoke current is passing through zero. The output correction voltage will increase or decrease as the vertical yoke current increases or decreases.

Side Corrector Circuit

The side pincushion-corrector circuit straightens the sides of the bowed raster by modulating the horizontal deflection current at a vertical rate. This provides maximum horizontal deflection at points "C" and "D" and is accomplished by means of a modulation transformer which represents a changing load across the horizontal deflection yoke coils. Its impedance is maximum at points "E" and "F" and minimum at points "G," "H," and "J."

A dc bias voltage and a voltage waveform at the vertical rate are needed for this impedance change. The bias voltage is obtained from the cathode of the vertical output tube, and the vertical waveform is obtained from windings "A" and "B," of the vertical output transformer. These ac voltages



are 180° out of phase with one another.

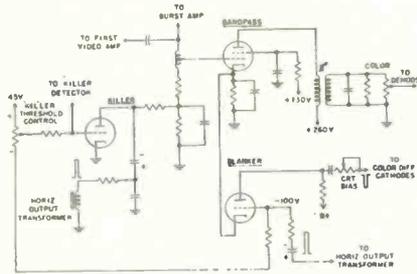
The dc bias voltage and a vertical waveform from winding "A" is connected to the cathode and of CR105 and a vertical waveform from winding "B" is connected to its anode. When diode CR105 is conducting, voltages are received from windings "A" and "B." When it is not conducting a voltage is received from winding "A" only. These windings and their associated waveforms can be seen in the simplified circuit diagram.

The composite waveform and dc bias voltage are fed to the primary of T107 to change its impedance at a vertical rate.

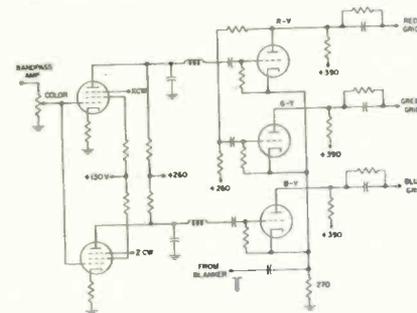
The saturated condition of T107 changes the load across the horizontal deflection coils and determines the amplitude of the horizontal sweep current flowing through them.

Bandpass Amplifier, Blanker and Killer Of Magnavox 45 and T904 Series

Color information exists in the form of sidebands that occupy a 0.5MHz



bandwidth on each side of the 3.58Mc sub-carrier. The 3.58Mc burst signal must also be extracted for synchronizing purposes. These frequencies are coupled through an 18pf capacitor to the chroma circuits. The small size of the coupling capacitor allows the chroma information to pass but



blocks the relatively low frequencies of the luminance signal. The chrominance signal is then coupled to the bandpass amplifier grid through the chroma take-off coil. This coil is broadly resonant to 3.58MHz and allows the color information to pass while attenuating all frequencies that are outside the passband.

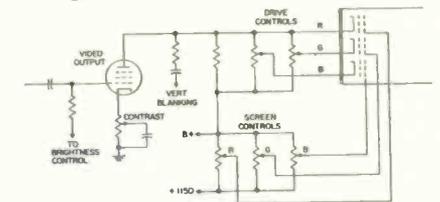
The sidebands are amplified by the bandpass amplifier and coupled through the color control to the synchronous demodulators. This amplifier is a special IF stage for the chrominance sidebands. A positive horizontal blanking pulse is used to cut-off the amplifier at the end of each scanning line. This is done to key out the burst signal that is present during the horizontal blanking period. The burst signal is eliminated at this point to prevent spurious colors from appearing on the screen of the CRT.

The job of keying out the burst signal is accomplished by the blanker stage. The cathodes of the blanker and the bandpass amplifier are connected together and share a common cathode resistor to ground. A positive pulse from the horizontal output transformer is coupled to the blanker amplifier grid. As this stage conducts, a positive pulse is developed, across the common-cathode resistor, high enough to cut-off the bandpass amplifier. The bandpass amplifier is cut-off at the time the burst signal is present on its grid—the burst does not appear in the plate circuit.

The blanker stage indirectly controls the bias voltage on the three CRT

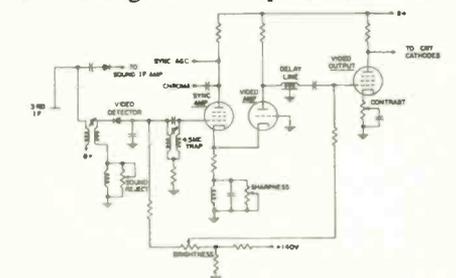
control grids. The positive horizontal pulse on the blanker grid is amplified and inverted in the plate circuit. It is then coupled through the CRT bias control to the common cathode of the color-difference amplifiers. The bias adjustment controls the amplitude of the pulses reaching the cathodes. The cathode and grid elements in each color-difference amplifier acts as a diode when the negative pulse is applied. The resulting current charges the coupling capacitors in each CRT grid circuit. These coupling capacitors discharge slowly through their 1M grid resistors and establish a bias on the grids. When the bias control changes the amplitude of the blanking pulse, the CRT grid bias is also changed.

Each triode's dc plate voltage is dependent upon the plate current flow—as the plate current increases the plate voltage decreases. Since the plate voltage is applied directly to the CRT grids, any change in the plate voltage is a change in the CRT bias. By varying the grid bias of the triodes with the blanking pulse the dc plate voltage and the bias on the CRT grids are changed.

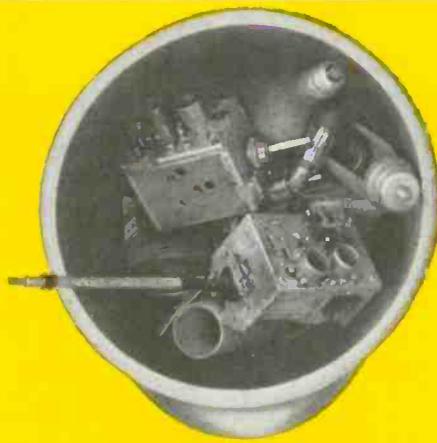


The blanking pulse is also amplified by each triode and serves to blank the CRT at the horizontal scanning rate. The blanking pulse is negative-going at the CRT grids since a signal inversion does not occur in a cathode-driven amplifier.

The bandpass amplifier conducts only when a color signal is received. To prevent noise signals from reaching the CRT grids the amplifier is cut-off

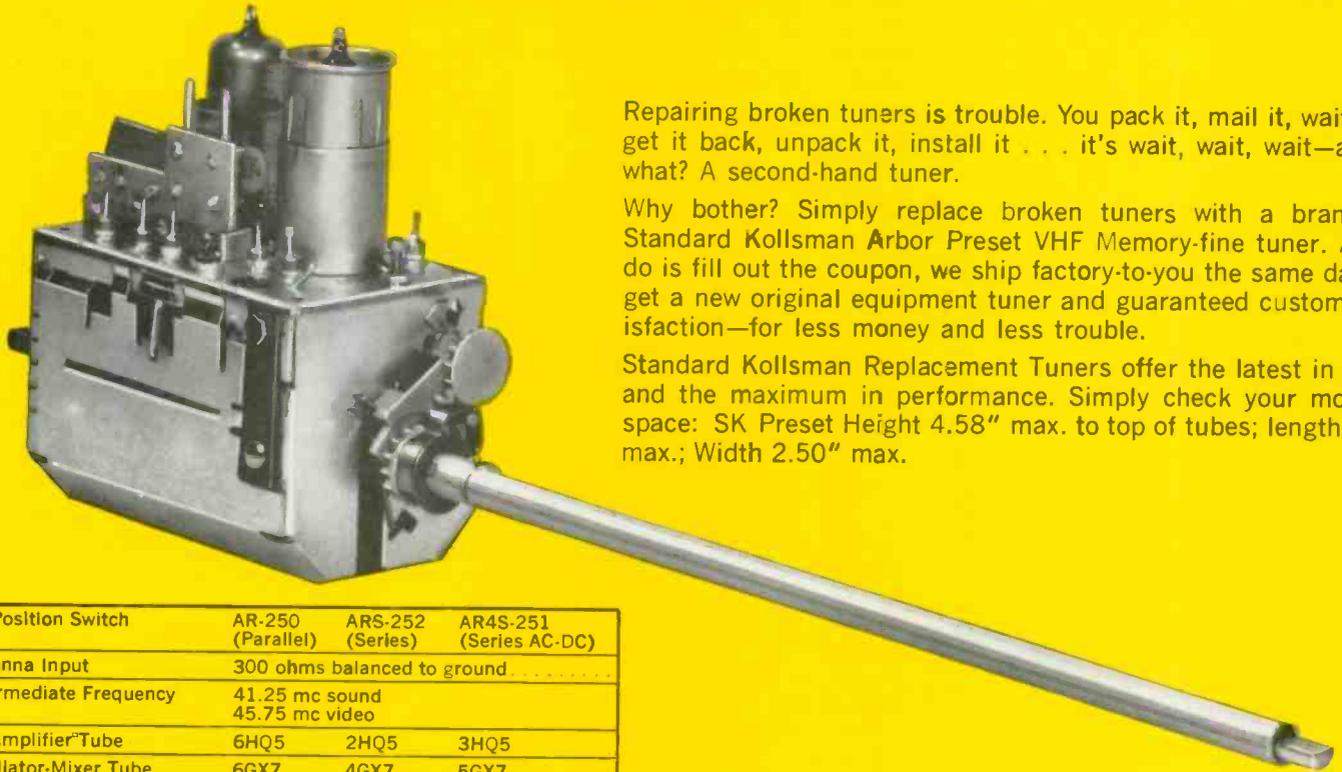


during a B/W transmission by the killer amplifier. The killer stage is similar to an AGC amplifier. A positive horizontal pulse is applied to the killer plate through a coupling capacitor. During B/W transmission the tube conducts on each pulse and places a negative charge on the plate side of the coupling capacitor. This negative dc voltage is applied to the grid of the bandpass amplifier—cutting it off.



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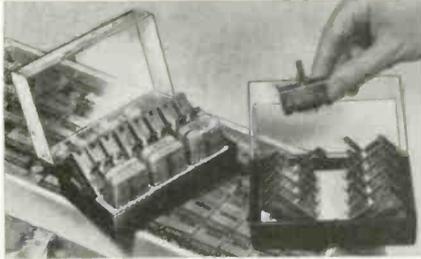
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NEW PRODUCTS

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Circuit Breaker Caddies 700

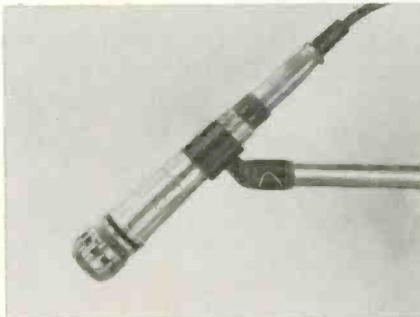
Two circuit breaker caddies for service technician field and shop work are now available from distributors. The caddies place circuit breakers and fuses at the fingertips for



instant servicing of B/W TV sets. Each TV circuit breaker caddy is furnished with an inventory control index card and up-to-date cross reference card showing application of circuit breakers in color and B/W TV sets. Littelfuse, Inc.

Entertainment Microphone 701

Designed for the entertainment field, the model 777 cardioid is said to provide high noise rejection.



It has an ON-OFF rotary switch, and provides rolled-off bass response to permit very close-to-mouth use without popping and breath noises, the announcement said. Impedance 150Ω only. Turner.

Artificial Mouths 702

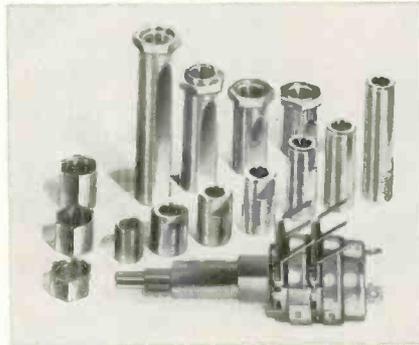
Artificial mouths designed to produce a constant sound pressure source for precise frequency response measurements of acoustical transducers are introduced. They consist of a permanent magnet, moving coil, loudspeaker driver unit meeting the exact throat dimensions of the WE KS series specifications and an equalizer individually tailored to the loudspeaker drive unit. The equalizer is designed to prohibit



any rapid change in slope throughout the rated frequency range and to compensate for variations in the loud-speaker units. Altec.

Bushings 703

The addition of 36 special bushings and 6 shoulder spacers to a line of exact replacement controls is an-



naunced. With these parts it is claimed that even the most unusual auto radio control can be exactly matched so technicians can meet all their replacement control requirements. Many control combinations with exact shaft lengths, exact shaft end, exact mounting hardware and exact resistance and taper are possible. Centralab.

CB Two-way Radio 704

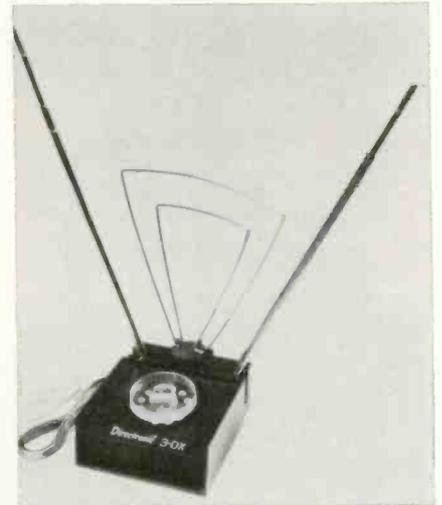
Announced is a 3 lb. 6 channel CB radio that measures only 2¼ x 8½ x 6¾ in. The unit features a front panel



speaker, public address system jack, electronic switching, solid-state circuitry, receive and transmit indicator light, LC filter, automatic noise limiting, two RF stages and 100% modulation. Price \$139.90. Pearce-Simpson.

TV Antennas 705

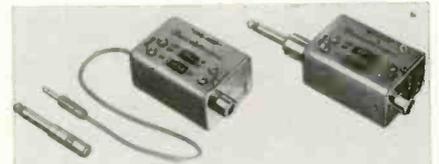
UHF/VHF antennas, with directional UHF tuning, is announced. A "rotor-dial" rotates the UHF phasing elements 360deg until the best position for reception of each UHF sta-



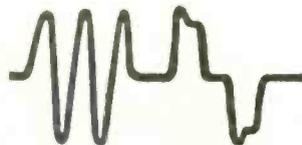
tion is reached. A "beam selector" has 12 positions for fine-tuning of VHF stations. The antenna comes in either a brass or a chrome finish with a neutral brown base. Snyder.

'Mix-Amp' Pre-amplifier 706

A transistorized "Mix-Amp" audio preamp is announced which is only the size of a pack of cigaretttes. It is



said to offer performance equal to much larger audio preamps and be ideal for in-line amplification or low level signals and provide impedance matching, high signal-to-noise ratio, linear frequency response and fixed gain. The unit has switch selected ON/OFF and HIGH/LOW impedance functions and is powered by a single "pen-lite" dry cell. Switchcraft.



Tips on replacing electrolytic capacitors



Finding the right electrolytic capacitor for a replacement job often becomes a matter of juggling three factors: what the circuit originally called for, what you can get quickly from a distributor, and what you have on hand in your shop. Here are a few hints that may help to make your life easier.

The important parameters about an electrolytic are voltage rating, capacitance, temperature rating and size. You have a certain amount of leeway on all four of these . . . and knowing how far you can stretch safely may save you a lot of shoe leather looking for the exact replacement.

Let's take voltage first. You can *always* substitute a capacitor with *higher* voltage rating than that originally required, with absolutely no harmful effects (except maybe on your pocket-book, because you may pay for extra capability that you don't need). But you should *never* replace with a voltage rating *lower* than the original.

How about capacitance? Our advice—don't go too far from —10% +50% of the original value. You've probably heard that standard industry specs allow tolerances of 10% low and up to 150% high. Actual manufacturing practice at Mallory, is to make capacitors to considerably tighter tolerances . . . because most radio and TV manufacturers won't tolerate the wider variations. Too small capacitance is apt to raise hum levels. Too high capacitance may lead to surge damage to silicon rectifiers.

On the temperature score, you don't have to worry if you use a Mallory FP-WP, TC, TT, or MTA type, because they're all rated for 85°C (except for three odd-ball TC's), and that's plenty for home instruments or industrial electronics. Our wax-filled cardboard tubulars are rated 65°C. The few cents extra that you might spend for a Mallory capacitor, compared to the cheapest ones you could buy, will assure you of *several* times longer service life.

How about size? Don't be surprised when you find that in many instances the Mallory replacement is *smaller* than the original capacitor (naturally, it will still fit chassis cutouts). That's because of our new techniques for deep-etching aluminum to increase the effective area of the anode. So we can get about nine times more microfarad-volt rating inside a given container than with plain foil.

One final tip. Our new Capacitor Replacement Guide makes it a cinch to find the exact part number to specify, to replace just about any electrolytic you may encounter. Ask your Mallory Distributor for a copy, or write Mallory Distributor Products Company, a division of P. R. Mallory & Co. Inc., P. O. Box 1558, Indianapolis, Indiana 46206.

How much aluminum foil makes 2 mfd at 150 WVDC?



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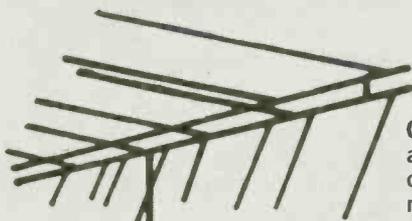
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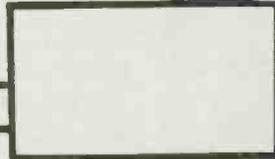


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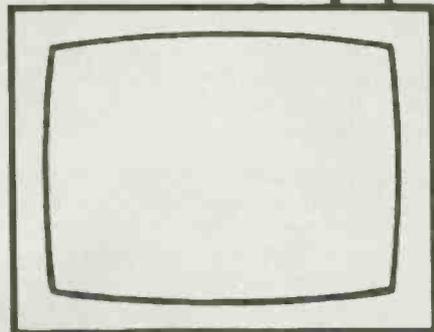


All-channel amplifiers (mast or indoor mounting) — use silicon transistors for greatest gain.

All-channel couplers and splitters—from the top rated manufacturer.



Tapoffs (flush mounted), Matching transformers (indoor & outdoor) — for use with coaxial cable (75 ohm).



NEW PRODUCTS

Anti-Snivet Tube 707

A 6KG6 output pentode is introduced for color TV horizontal deflection circuits. The 6KG6 is said to give snivet-free performance through a "cavatrapp" anode and other built-in



design characteristics developed to eliminate Barkhausen oscillations. As a result, the manufacturer claims snivet-suppression circuits can be eliminated, resulting in lower circuit costs. Maximum peak plate, 7000v. Maximum plate dissipation, 34w. Peak anode current, 1.4a. Ampex.

Driver Unit 708

Introduced is a 30w public address driver unit which has a built-in transformer and watts/impedance selector switch. It is designed for RC6 radial and DR series directional trumpets



but may also be used as a highly efficient replacement driver on any industry-standard horn having 1- $\frac{3}{8}$ in.-18 threads. Frequency response, 120-Hz to 14kHz. Size 4- $\frac{3}{4}$ x 4- $\frac{7}{8}$ in. List \$38.50. Atlas.

... for more details circle 111 on postcard

Get this \$65 RCA color TV course FREE



when
you buy
this



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

or this



WR-69A RCA TV-FM Sweep Generator

or this



WR-99A RCA Marker Generator

or this



WO-91B RCA 5" Scope

That's right! RCA Institutes famous Home Study Color TV Servicing Course FREE, when you buy ANY ONE of the instruments shown here. Buy all four...get four courses. Enroll all your technicians while you equip your shop with the instruments you'll need for color TV servicing anyway.

Here's how it works: Simply buy one, or all, of the four instruments shown, the WR-64B, WR-69A, WR-99A, or WO-91B—ALL essential color TV test instruments—from your Authorized RCA Test Equipment Distributor between now and November 15, 1966. Fill out your warranty registration card and attach the white identification label on the carton. Send them to RCA, Test Equipment Headquarters, Bldg. 17-2, Harrison, New Jersey. We will send you the enrollment form and a binder

containing the first two lessons. When you complete the lessons and forward them to RCA Institutes for grading, the next lessons will be supplied to you directly from RCA Institutes, all without charge to you.

But do it now. This offer is good only for equipment purchased between September 1, and November 15, 1966. To allow for postal delay, we will honor cards received up until December 1, 1966. Here's your chance to equip your shop for color servicing while we train your people for FREE!

Electronic Components and Devices, Harrison, N.J.



The Most Trusted Name in Electronics

Don't blame the TV set for poor color reception

Good TV reception starts on the roof. If the signal delivered to the TV set isn't good to begin with, there's nothing any TV set can do about it. The moral: start at the top with the best. That's Color Ranger UHF/VHF/FM log periodic antennas by Blonder-Tongue.

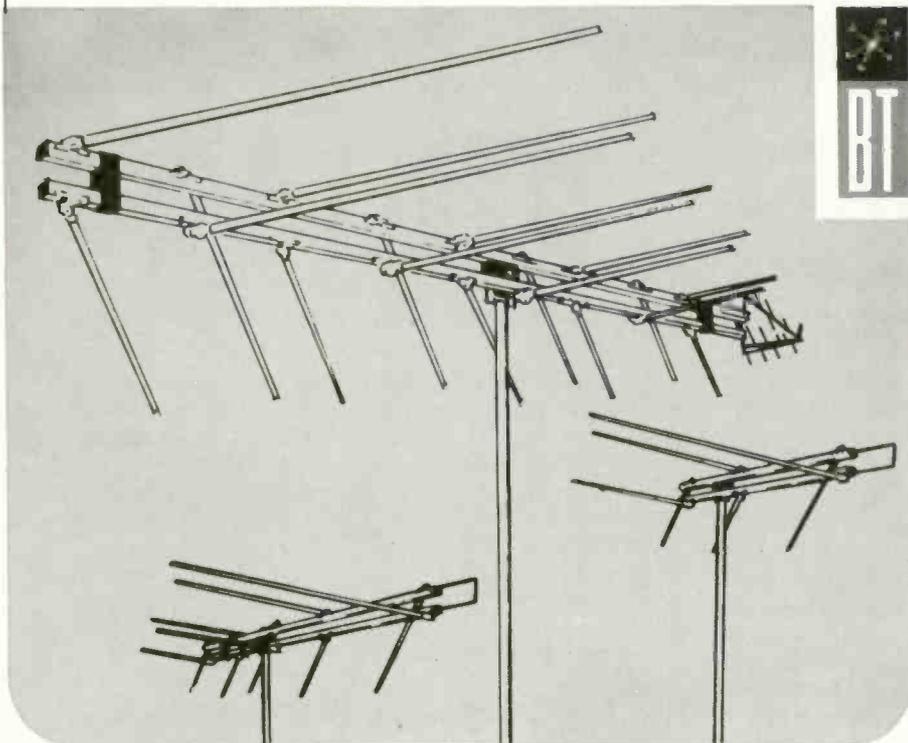
There's a Color Ranger for any location from deep fringe to prime signal area, and they all offer flat response for top reception on *all* channels; a broad, flat bandpass for top color reception; exceptional front-to-back ratio to eliminate ghosting, and precise impedance match to insure maximum signal transfer to the set to prevent reflected signals in the cable.

Color Rangers have construction features found on no other antenna: double-boom construction; extra thick elements reinforced with 6" tubing; spring-loaded knife-edge contact points which maintain permanent electrical contact; strain-relief lugs for 300-ohm twinlead connections with a choice of 75-ohm coax or 300-ohm connection.

For UHF there's the 11-element log periodic U-Ranger. Slips quickly and easily on any VHF Color Ranger, makes your VHF Color Ranger an all-channel antenna . . . and with only a single download! No additional couplers to buy!

If you go for FM-Stereo, get acquainted with the Stereo Rangers unbelievably brilliant high-fidelity FM-Stereo reception. Color Ranger and Stereo Ranger antennas are just two more reasons for you to go all-channel from antenna to TV set with color-approved and certified-for-stereo Blonder-Tongue TV/FM products. Write for free catalogs #52 and #88.

Blonder-Tongue Laboratories, Inc., 9 Alling Street, Newark, N. J.
Blonder-Tongue—the name to remember, for TV reception you'll never forget



. . . for more details circle 112 on postcard

NEW PRODUCTS

Field Set

709

A transistorized portable field meter that has four separate functions in one light-weight unit is introduced. The unit is designed to read field strength directly from 10mv to 10v with an



accuracy of 3% from 535 kHz to 1605kHz. The signal generator is said to have a calibrated output from 10mv to 1v with an accuracy of $\pm 1\%$, and frequency range of from 535kHz to 1605kHz with a readout accuracy of $\pm 3\%$. The monitor receiver is designed for sensitivity of better than 5mv, weight, 12 lb. Wilkinson.

Intercom System

710

A ten station completely solid-state intercom is introduced which has provision for modular ad-on sections of up to 70 stations. The all metal cabinet is covered with a walnut wood-grain vinyl finish. The intercom provides a mixed service communication feature which allows master station to remote, remote to



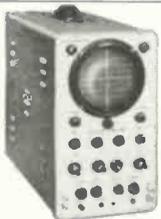
master and master to master calls; all with volume controls. Provision is made for phonograph, tape or radio sound distribution from master stations. Among accessories available are: a busy signal kit, an annunciator kit which lights each push button, a chime assembly and a privacy relay kit which provides lights at remote stations to show when those stations have been selected. Dukane Corp.

Precision Apparatus

hallmark of quality in test equipment

For over three decades, knowledgeable professionals in industry, service, laboratory and educational fields have relied on Precision Apparatus Test Equipment. Today, through the experience and marketing know-how of Dynascan Corporation, Precision Apparatus offers greater reliability and performance—maximum versatility—in all applications. Today, the Precision Apparatus line represents the industry's outstanding values in test equipment.

Each Precision Apparatus instrument is designed, engineered and built to meet your most critical needs of accuracy, versatility, reliability. By every standard, they are the hallmark of quality in test equipment.



ES-550B WIDE BAND OSCILLOSCOPE

Rugged, dependable performance. Automatic horizontal sweep synchronization. Wide-band 5 MHz vertical amplifier. Extra-high 10 Mv RMS/inch sensitivity allows measurement as low as 2 Mv. Wide-band vertical amplifier. \$279.95



120 VOLT-OHM-MILLIAMMETER

2% DC accuracy. Exclusive extra-low ohm scale for accurate readings to 0.1 ohm, extremely important for solid state measurements. Mirrored scale. Solid state protected meter movement. Transit meter movement protection. \$51.95



E-310 SINE & SQUARE WAVE GENERATOR

Only moderate cost, low distortion generator with both sine and square-wave coverage from 5 Hz to 600 KHz. Pre-aged tubes provide long-term stability. Over 7' of logarithmic scales for more accurate settings. \$199.95



V75 VACUUM TUBE VOLTMETER

Special built-in battery eliminator assures ohm-meter accuracy. Rugged uni-probe speeds operation. Special calibration on 1.5 VAC and 5 VAC scales assures maximum accuracy. \$59.95



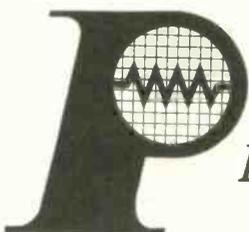
E-200C MULTI-BAND SIGNAL GENERATOR

Unique! AVC substitution voltage system permits accurate alignment. Over 7' of etched dial scale from 88 KHz to 440 MHz with FM and TV band channels indicated. Each unit individually hand-calibrated on all bands. \$119.95



120M VOLT-OHM-MILLIAMMETER

Offers all of the convenience features of the 120 plus the extremely high accuracy of 1½% on DC and 3% on AC. \$61.95



PRECISION APPARATUS

Division of Dynascan Corporation
1801 W. Belle Plaine Avenue
Chicago, Illinois 60613

Where Electronic Innovation Is A Way Of Life

... for more details circle 144 on postcard

How "saving" 50¢ can ruin a \$700 color TV system!

The coupler is probably the least expensive item in a home TV system . . . yet the wrong coupler can send the investment in a top-quality distribution system and TV set right down the drain.

At Blonder-Tongue, the same engineering skill and meticulous quality control goes into couplers that goes into our professional MATV products. The result: high isolation between sets, extremely low insertion loss and sharp pictures (they're backmatched).

Blonder-Tongue gives you variety, too . . . the widest variety of color-approved, all-channel coupler models in the industry:

A-102U/V—deluxe 300-ohm model connects 2 sets to one download.

A-104/UV—similar to A-102U/V except for 4 sets.

MDC-2VU—connects two coax (75-ohm) cables from TV sets to a single coax download.

TV-2—economy indoor model. Connects two sets to a single 300-ohm twin-lead. Not recommended for weak signal areas.

Quality combiners and splitters are also essential to a good all-channel color TV system. When you specify Blonder-Tongue, you get high quality, low loss and high isolation.

UVF-1—deluxe 300-ohm weatherproof model. Provides separate UHF, VHF and FM outlets from download carrying all three signals or feeds a single download from separate UHF, VHF and FM antennas.

UVF-C/S—a lower priced version of the UVF-1.

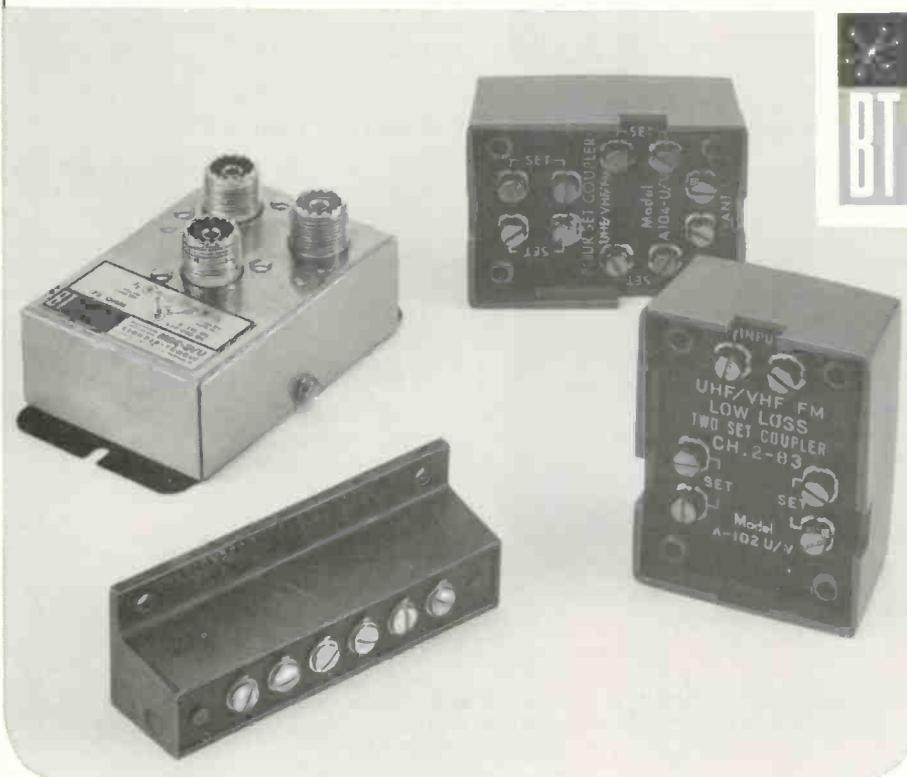
A-107—deluxe, weatherproof unit combines UHF and VHF antennas to one 300-ohm download or provides separate UHF and VHF output at set.

UV-C/S—indoor unit provides separate UHF and VHF outputs from a single 300-ohm cable carrying both signals, for connection to converter or TV set with separate UHF and VHF inputs.

Write for free catalog #74.

Blonder-Tongue Laboratories, Inc., 9 Alling Street, Newark, N.J.

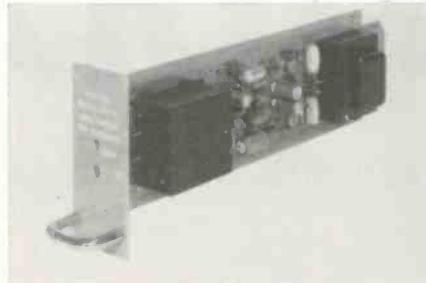
Blonder-Tongue, the name to remember, for TV reception you'll never forget



NEW PRODUCTS

Tape/Phono Preamp. 711

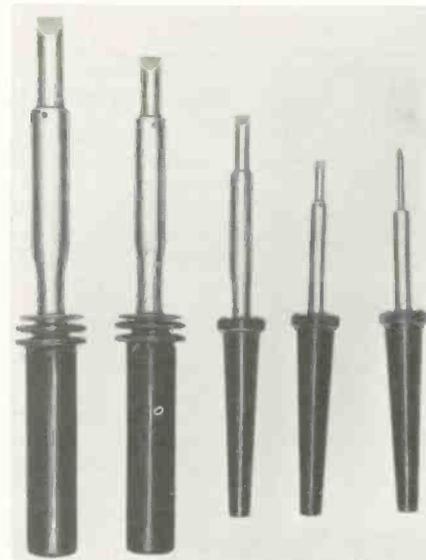
A solid-state tape/phono preamp is said to feature a noise level 6db below inherent noise generated by un-recorded tape. A high frequency



equalization control is provided to compensate for tape head response variations. The output impedance is reportedly less than 10% of normal load with 20Hz to 20kHz power bandwidth. Weight, 18oz. Dimensions, 1.6 x 3-15/32 x 11in. Melcore.

Soldering Irons 712

A broad line of 5 soldering pencils and irons is introduced. The line includes 25w, 40w, and 80w pencil



style irons. In addition, two larger general types of 120w and 175w are offered. The entire line features stainless steel barrels, heat and impact resistant handles and light weights. Weller.

For more information on these

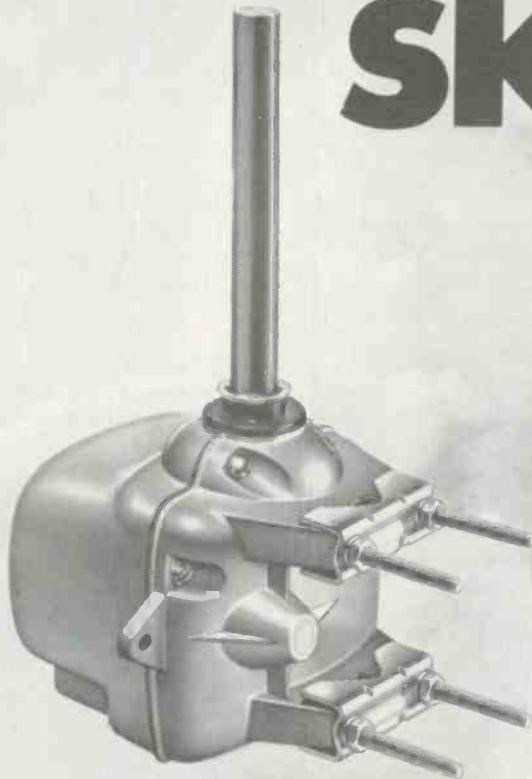
NEW PRODUCTS

See pages 111 and 112

READERS SERVICE

. . . for more details circle 113 on postcard

Help stamp out green sky



CDE's Ten Series Rotor Helps Give The Truest Urban/Suburban Color TV Reception!

Green sky, purple people and brown water...help your customers avoid these with CDE's 10 series rotor. The 10 is the most rugged lightweight on the market...the first rotor system designed specifically for metro-suburban areas.

It's *dependable*...because of a weatherproof die-cast housing. *Bet-*

ter-performing...because of a high-torque motor with heavy wormgear drive. *Longer-lasting*...because of heavier-than-average construction throughout.

And see the built-in antenna mounting mast? It's there to prevent mistakes: the 10 series can *only* be fitted to antennas it can control.

Available in both automatic and manual forms, the 10 series rotor means the very best in color and black and white TV reception. Goes great with FM rigs, too!

CDE **CORNELL-DUBILIER**

The most experienced all-channel amplifiers keep getting better and better

Blonder-Tongue pioneered and developed the industry's first all-channel, all-transistor TV signal amplifier. That was more than two years ago. During that period this top-rated original design has brought superior all-channel and color reception to homes located in all areas.

Now, we are employing the better performing silicon transistor in these amplifiers. The result: 40% more gain in the lowband, 100% more in the highband, greater ability to handle strong signals without overloading and better signal to noise ratio. Color or black-and-white TV reception on any and all channels from 2 to 83 is better than ever.

Only Blonder-Tongue gives you a choice of all-channel, color-approved amplifiers:

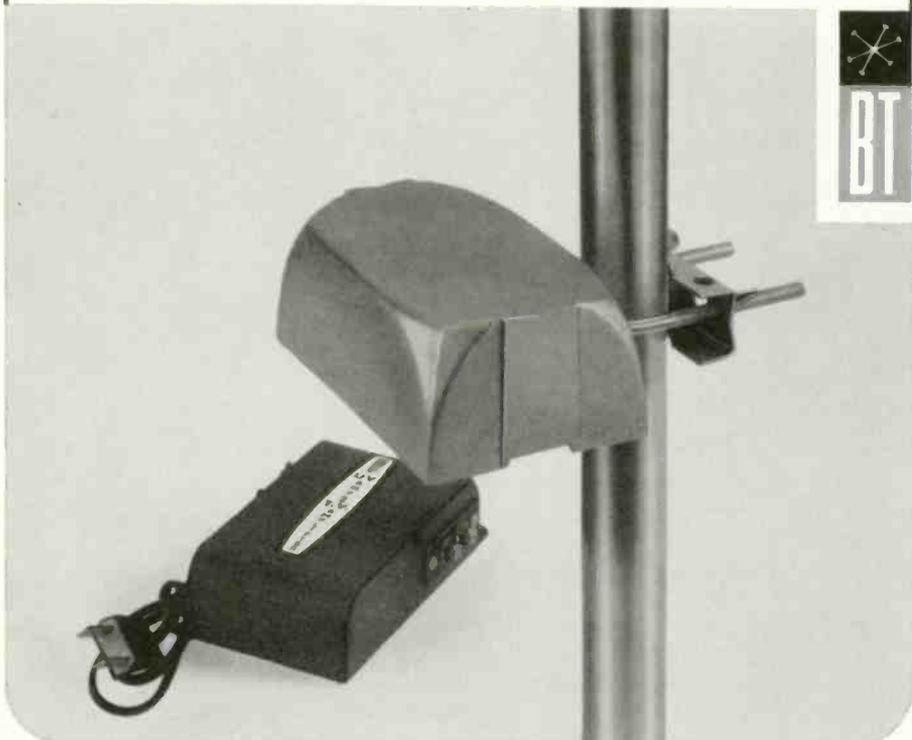
U/Vamp-2—mast-mounted, deluxe 2-transistor UHF/VHF amplifier. Weatherproof housing. Remote power supply. AC operated. Separate UHF and VHF 300-ohm inputs and outputs. Ideal for separate UHF and VHF antennas.

Coloramp-U/V—same as the U/Vamp-2 except it has a single UHF/VHF input. Matches the new all-channel antennas.

V/U-All-2 — deluxe 2-transistor indoor UHF/VHF amplifier. Can drive up to 4 TV sets. Has built-in 2-way splitter with excellent impedance match and isolation for interference and ghost-free reception.

These UHF/VHF amplifiers are just one more reason to go all-channel from antenna to TV set with color-approved Blonder-Tongue TV products. Of course, we also have a full line of top quality VHF, VHF/FM and UHF-only amplifiers. Write for free catalog #74.

Blonder-Tongue Laboratories, Inc., 9 Alling Street, Newark, N. J. *Blonder-Tongue, the name to remember, for TV reception you'll never forget*



... for more details circle 114 on postcard

NEW PRODUCTS

Cable Slitters 713

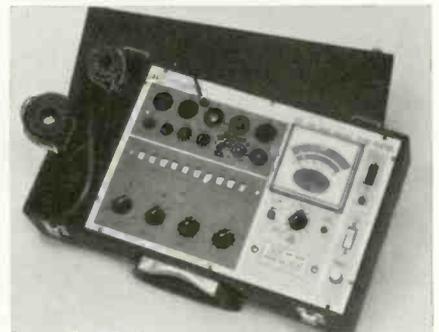
Tools for slitting, stripping and "ring" cutting, inside and outside types of plastic, fabric and rubber covered cable are announced. They are



used for slitting most types of cable jackets, especially the outdoor heavy-duty types; stripping the jacket from all sizes of inside types of plastic and fabric covered cable; and "ring" cutting the sheathing of inside types plastic, fabric or rubber covered cable. The cut through the sheathing is limited to 1/32 in. for protecting the wires. P. K. Neuses, Inc.

Tube Tester 714

Announced is a tube tester featuring VTVM circuitry for grid circuit emission and gas checks on receiving tubes, and a 10-circuit switching design for checking all new tube types that have elements with multiple pin connections. It checks all picture tubes



for proportionate screen brightness by qualitative measurement of the electron beam. The central area of the picture tube cathode is checked in addition to the controlling action of the first grid. The instrument weighs 8lb and measures 16 x 9 x 4¾ in. Net price \$92.95. Precise.



Insist on Genuine RCA
Replacement Parts...

the only look-alikes that perform alike

and help eliminate costly call-backs.

Only genuine RCA replacement parts assure the quality performance originally engineered into RCA equipment. Every material, every electrical value, every mechanical tolerance—all have been precisely balanced to deliver 100% of the performance RCA specified in the original part. Good reasons why genuine RCA parts prevent the costly call-backs you gamble on when using substitutes.

Want extra proof of the high performance standards you get in genuine RCA parts? See how those RCA parts with universal application upgrade performance wherever you use them.

Your RCA Distributor can supply you with all the genuine RCA replacement parts you need, competitively priced—and readily available. Call him. And while you're ordering, ask for cross-reference and application literature on RCA replacement parts.

RCA PARTS AND ACCESSORIES, DEPTFORD, NEW JERSEY



The Most Trusted Name in Electronics

Genuine RCA replacement parts are available for all these categories of equipment. Color TV, Black and White TV, Radios, Hi-Fi's, Tape Recorders, Electronic Language Laboratories, Broadcast transmitting, Radiomarine, Microwave Communications, Mobile Communications, Servicemen's Test Equipment, Citizens' Band Transceivers, and Scientific Instruments.

Why professional MATV installers are fussy about matching transformers

The purpose of a matching transformer is to match 300- to 75-ohm, or 75- to 300-ohm impedance... and match it precisely! Otherwise you get all the problems of mismatch—poor color, smear, ghosting, snow. And installers of coax systems know that Blonder-Tongue is famous for its honest-to-goodness UHF/VHF/FM matching transformers that offer really precise match at all frequencies.

Next time try one of these all-channel, color-approved matching transformers:

MT-283—Deluxe indoor or outdoor UHF/VHF/FM network. Great for matching all-band antennas to coaxial downlead, or 300-ohm set impedance to 75-ohm coax downlead. Mast-mounting hardware and mating male coax connector supplied.

Cablematch U/V — Indoor model. The same unit used in all-channel MATV systems! Features spade lugs for easy connection to 300-ohm TV set terminals. Mating Autoplug for coax supplied.

In addition to these all-channel models, B-T offers a wide choice of VHF/FM matching transformers to meet any need.

Quality matching transformers like these are just one more reason why you should go Blonder-Tongue from antenna to TV set terminals. Write for free catalog #74.

Blonder-Tongue Laboratories, Inc., 9 Alling Street, Newark, N.J.

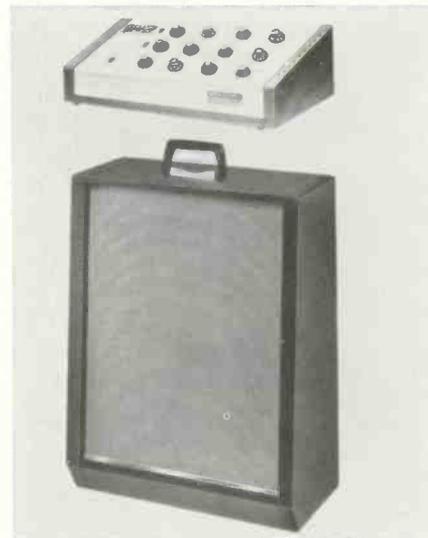
Blonder-Tongue—the name to remember, for TV reception you'll never forget



NEW PRODUCTS

Musical Instrument Amplifier 715

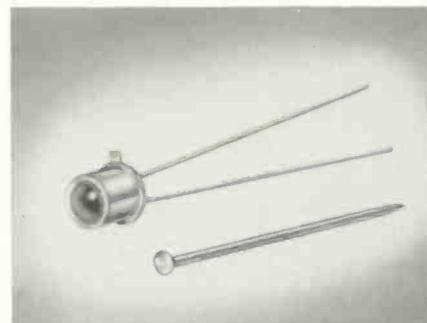
An 80w amplifier built into a cabinet containing two 12 in. speakers and a tweeter has been introduced in conjunction with a control panel designed to accommodate up to six musical instruments. The combined unit gives a leader complete flexibility and con-



trol over all members of the group. Reverb may be added to one channel while tremolo is added to another and volume of any member of the group may be increased or reduced at will. Any single member of the group or all members of the group may use the entire power of one or many such amplifiers — as opposed to the use of individual amplifiers. Price of control panel \$99.95. Amplifier \$229.95. Gregory.

Silicon Photodiode 716

A silicon photodiode is designed to operate with bias conditions required by low cost silicon transistors. Typical reverse dark current with $-1.0v$ at $55^{\circ}C$ is $0.4\mu a$. Typical short-circuit



current output at 500 footcandles is $180\mu a$. The spectral response peak is at 0.85 microns. Speed of response, $1\mu s$. Temperature range, $-60^{\circ}C$ to $+125^{\circ}C$. Price \$2.25. National.

... for more details circle 115 on postcard

A million miles a day!



Your packages go wherever Greyhound goes when you ship by Greyhound Package Express

Greyhound goes over a million miles a day, over more than 100,000 miles of routes, serving more than twenty-five thousand cities, towns and villages throughout the U.S.A. Your shipments go wherever Greyhound goes, aboard regular Greyhound buses, when you

specify Greyhound Package Express. Ship anytime at your convenience—24 hours a day, 7 days a week, weekends and holidays, too. Schedules are fast and frequent. Your shipments get there faster, (often in a matter of hours) because they get moving sooner. Save time!

Save money! Save trouble! Ship C.O.D., Collect, Prepaid, or open a Greyhound Package Express Charge Account. For information on service, rates and routes, call Greyhound, or write: Greyhound Package Express, Dept. 53-J, 140 S. Dearborn St., Chicago, Ill. 60603.

It's there in hours and costs you less

For Example	Buses Daily	Running Time	20 lbs.	30 lbs.	40 lbs.*
LOS ANGELES— SAN FRANCISCO	25	9 hrs. 15 mins.	\$2.10	\$2.45	\$2.80
DALLAS— SAN ANTONIO	10	7 hrs. mins.	1.90	2.15	2.45
CINCINNATI— LOUISVILLE	14	2 hrs. 20 mins.	1.65	1.90	2.15
CLEVELAND— COLUMBUS	10	2 hrs. 55 mins.	1.80	2.05	2.40

*Other low rates up to 100 lbs. Lot shipments, too.



One of a series of messages depicting another growing service of The Greyhound Corporation.

... for more details circle 127 on postcard

This tool solders faster, better, at lower cost



Weller®

temperature-controlled low voltage soldering pencil does the work of several irons

Extremely versatile. Use it for all your bench soldering, including heavy-duty chassis work.

Improves quality of soldered connections. Tip temperature remains constant. No peaks or lows to cause component damage or cold soldered joints.

Lightweight, highly efficient. Weighs only 2½ ounces, cord included. Yet it does the work of irons that weigh much more and have much higher wattage. Reduces fatigue and downtime.

Faster soldering. You make more soldered connections a minute. Tool has tremendous capacity, rapid recovery. Handle remains cool.

Does the work of several irons. Temperature control is in the tip. Interchangeable tips are available in 500°F, 600°F, 700°F and 800°F controlled temperatures, and in ½³²" , ¼¹⁶" , ⅜³²" , ⅛⁸" and ⅜¹⁶" screwdriver types. Merely interchange tips to change the controlled temperature of the iron.

Low cost operation. 24-volt operation provides more efficient heat transfer, and long life inherent in low voltage elements. Tips are alloy plated, low in cost, last long, won't freeze.

Saves working space. Compact transformer has soldering pencil holder and tip cleaning sponge attached. Transformer is rated at 60 watts, 120 volts or 220 volts, 50/60 cycles.

Special trade-in offer. See your Electronic Parts Distributor now about the soldering tool trade-in deal on the Weller Temperature-Controlled Low Voltage Soldering Pencil-Model W-TCP.

WELLER ELECTRIC CORP., EASTON, PA.

In Canada: Kingston, Ontario. In England: Horsham, Sussex
WORLD LEADER IN SOLDERING TECHNOLOGY

... for more details circle 167 on postcard

NEW PRODUCTS

Solid State Stereo 717

A stereo phonograph with integrated solid state amplifiers is announced. It has controls for balance, bass, treble, mode and function selectors; inputs for tape recorder, tape deck, tuner



and auxiliary; and reportedly 30w of music power. The system uses a high compliance moving coil cartridge and silicon transistors. Two speakers mounted in sealed enclosures and a Garrard 4-speed automatic turntable are included. Price \$275. Sony.

Soldering Tip Cleaner 718

A device for cleaning soldering iron tips is now being marketed. It is designed to eliminate the problems of linting, stray solder pellets and tip-

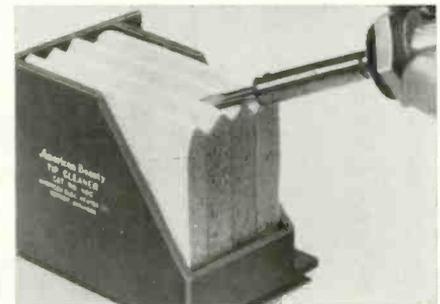


plate damage with the passage of iron tips between its two wet cellulose sponges. Equipped with a high-impact styrene holder, it measures 2½ x 2¾ x 3½ in. and contains a ¾ in. deep water well. American Beauty.

Wow & Flutter Meter 719

Announced is a fully transistorized wow and flutter meter designed for



production testing and service work. The instrument is designed to read tone fluctuations from ± 0.02 to $\pm 2.5\%$ or from ± 0.01 to $\pm 0.75\%$. A "drift" indicator measures up to $\pm 4.5\%$ frequency deviation of the recorded tone from 3150Hz. The unit measures 7 x 8 x 11 $\frac{3}{4}$ in., weighs 11 lb. Prices range from \$375 to \$395. Gotham.

FM Two-Way Radio 720

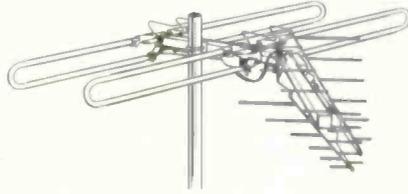
A mobile FM two-way radio covering the 136-174MHz band is introduced which features a completely transistorized receiver, power supply and exciter. The transmitter driver and power amplifier use industrial type tubes. The receiver is rated at 80db intermodulation rejection with 0.35mv sensitivity and $\pm 5 \times 10^{-6}$ stability or with optional equipment 0.175mv sen-



sitivity and $\pm 2 \times 10^{-6}$ stability. The transmitter has an RF output of 110w. Radios with one, two or up to four-frequency capability can be provided for individual systems. Motorola.

TV Antennas 721

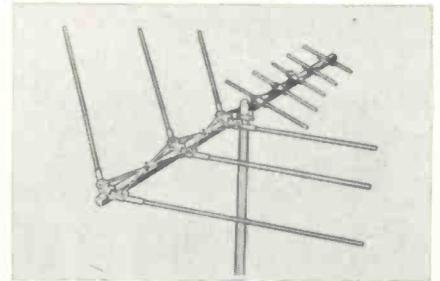
Two antennas designed specifically to wipe out color ghosts in metropolitan areas are announced. The antennas feature a hybrid coupler phasing harness for a very high front-to-back ratio



to minimize ghosts by rejecting reflected signals. Also, the antennas are matched for shielded cable to reduce interference and prevent line ghosts. The 300 Ω front and rear dipoles are 70 in. and 60 in. long respectively. VHF only, list \$16.95; all-channel, list \$29.95. Jerrold.

VHF/UHF/FM Antenna 722

A VHF/UHF/FM log periodic type antenna is announced for city



dwellers. It has three driven V dipoles that cover both VHF bands and three active dipoles plus three directors for UHF gain. The frequency response is flat within 1/2db on any channel and a sharp forward lobe in the polar pattern assures unidirectional pickup with high front-to-back ratio on all channels, the announcement said. An indoor VHF/UHF splitter divides the signals for the TV set from the single download. Price \$17.50. JFD.

MOVING?

Be sure to let us know your new address. Please enclose a complete address label from one of your recent issues.

BIG PROFITS

IN A SMALL PACKAGE!

ALL SOLID STATE



CB TWO-WAY RADIO
Companion III

**SIX
FIXED
CHANNELS
PLUS
P.A.**

New "TOUCH-TAP" TUNING for instant channel selection. Push the button and channel changes automatically. Solid state—lowest power drain.

OUTSTANDING FEATURES:

- "Touch-tap" tuning • Electronic switching • Compact size and front panel speaker permits dash mounting where no other radio can fit (Dim: 2 $\frac{1}{4}$ " H. x 8 $\frac{1}{2}$ " W. x 6 $\frac{3}{8}$ " D.—Wt. 3 lbs.) • Push-pull audio • L-C filter
- 2 RF stages in receiver • Modern design—heavy chrome plate front panel

FREE! Send for profit-packed dealer kit

\$13990

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P. O. Box 800 — Biscayne Annex
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CB DEALERS!**
Win a FREE week's vacation for 2 at the fabulous EDEN ROC HOTEL, Cabana and Yacht Club, Miami Beach. For details, contact your factory rep. NOW!

... for more details circle 139 on postcard

NEW

"Tray biens" most versatile of all nutdriver sets

Handy "Tray Bien" sets lie flat or sit up on a bench, hang securely on a wall, pack neatly in a tool caddy.

Lightweight, durable, molded plastic trays feature fold-away stands, wall mounting holes, and a snap lock arrangement that holds tools firmly, yet permits easy removal.

Professional quality Xcelite nutdrivers have color coded, shockproof, breakproof, plastic (UL) handles; precision fit, case-hardened sockets.

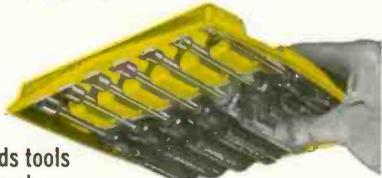
Hangs up



Stands up



Holds tools
securely



No. 127TB "Tray Bien" set — 7 solid shaft nutdrivers (3/16" thru 3/8" hex openings)

No. 137TB "Tray Bien" set — 5 solid shaft nutdrivers (3/16" thru 3/8" hex openings) and 2 hollow shaft nutdrivers (1/2" and 9/16" hex openings)

No. 147TB "Tray Bien" set — 7 hollow shaft nutdrivers (1/4" thru 1/2" hex openings)

WRITE FOR BULLETIN N666

XCELITE

XCELITE, INC., 14 Bank St., Orchard Park, N. Y. 14127
In Canada contact Charles W. Pointon, Ltd.

... for more details circle 163 on postcard

NEW PRODUCTS

Fork and Reamer

723



This very small size soldering aid is designed for sub-miniature work in the electronics field. The blades are made of a non-magnetic steel to which solder will not adhere and are set firmly into a hex shaped turquoise plastic handle. The over-all length is 6 in. with a handle 1/4 in. dia. by 3 in. long. Net price 75¢. Hunter.

Wireless Cuing

724



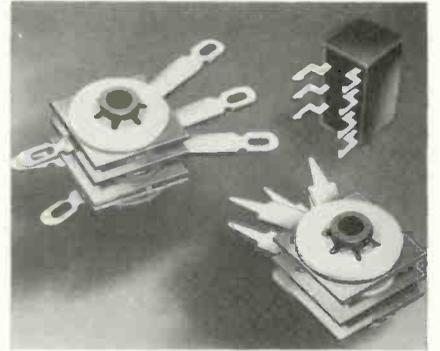
A 27MHz wireless cuing system for TV and radio studios is now available. The transmitter includes a simple 3ft whip antenna, covers up to 8000 sq. ft. studio areas and can be remotely operated with a

microphone located in the control room or other part of the studio. The receivers are approximately the size of a cigarette package, fit easily into a coat or shirt pocket, are fully transistorized, and do not require any external antenna. Transmitter price \$400. Receiver price \$39.95. Round Hill Assoc.

Color TV Rectifiers

725

Four new exact replacement selenium convergence rectifiers for color TV have been announced. These con-



vergence rectifiers are exact replacements for many makes and models. Both electrical and mechanical specifications are exact, for fastest installation with no mounting or wiring changes. Tarzian.

2 Complete Tube Testers In 1 Instrument

1. RECEIVING TUBE TESTER

plus:

2. TV PICTURE TUBE TESTER

SAVE MORE THAN \$50!

(compared to buying two separate testers)

Precise's New 'GREEN LINE' Model 115

\$9295 Net

1. RECEIVING TUBE TESTING

Eliminates Obsolescence Problem! A unique 10-circuit switching design allows testing of all the new type tubes that have elements with multiple pin connections—the Model 115 is the first and only obsolete-proof receiving tube tester in the speed-type class. ■ Grid emission test provides a sensitive grid emission and gas check by the use of built-in balanced VTVM circuitry. This all-important feature provides a revealing and significant tube condition test. ■ Basic dynamic cathode emission test is supplemented by a hot cathode shorts and leakage check. ■ Includes all latest type sockets, plus pin straighteners.

2. TV PICTURE TUBE TESTING & REJUVENATION (B&W and COLOR)

The basic picture tube test (for each gun of color picture tubes, and the single gun of B&W tubes) is picture-producing beam current (not total cathode emission which is rarely indicative of picture brightness). The beam current test checks all picture tubes for proportionate screen brightness. The critical central area of the picture tube cathode is checked in addition to the controlling action of the first grid. ■ Rejuvenation of picture tubes is accomplished by a unique capacitor discharge circuit which welds most intermittent elements, and redistributes cathode oxide over the beam-producing central cathode area. Meter directly indicates increase in brightness after each rejuvenation "shot".

GENERAL DATA

Wide visibility, 2% accuracy meter includes separate scales for quality test, grid emission, and picture tube beam current. ■ Complete up-to-date data book supplied. New data constantly available. ■ Size 16" x 9" x 4 3/4". Weight 8 pounds. ■ ACCESSORIES AVAILABLE: Model CTA Color Tube Socket Adapter, \$6.50 Net.

See the complete "GREEN LINE"—power supplies, scopes, VTVMs, signal generators, tube testers, decade boxes, probes—at your local distributor, or write direct for full information and specs.



PRECISE ELECTRONICS

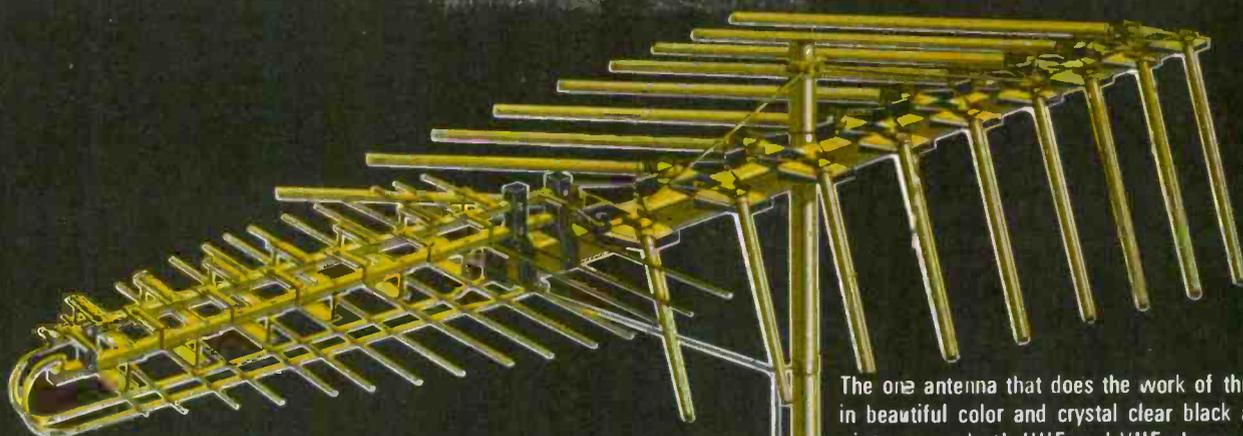
Division of Designatronics Incorporated

76 East Second Street, Mineola, L. I., New York

ENGINEERED EXCELLENCE IN TEST EQUIPMENT

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ELECTRONIC TECHNICIAN



FINCO ALL-BAND UHF-VHF-FM ANTENNA
75 OHM Model CX-UVF-24 \$72.10 List

FINCO ALL-BAND UHF-VHF-FM ANTENNA
300 OHM Model UVF-24 \$59.95 List

The one antenna that does the work of three! Falls in beautiful color and crystal clear black and white pictures on both UHF and VHF channels... plus the finest stereophonic and monophonic FM sound reproduction.

300-ohm models for normal reception areas from \$18.50 to \$59.95

75-ohm models for poor reception areas from \$42.65 to \$72.10

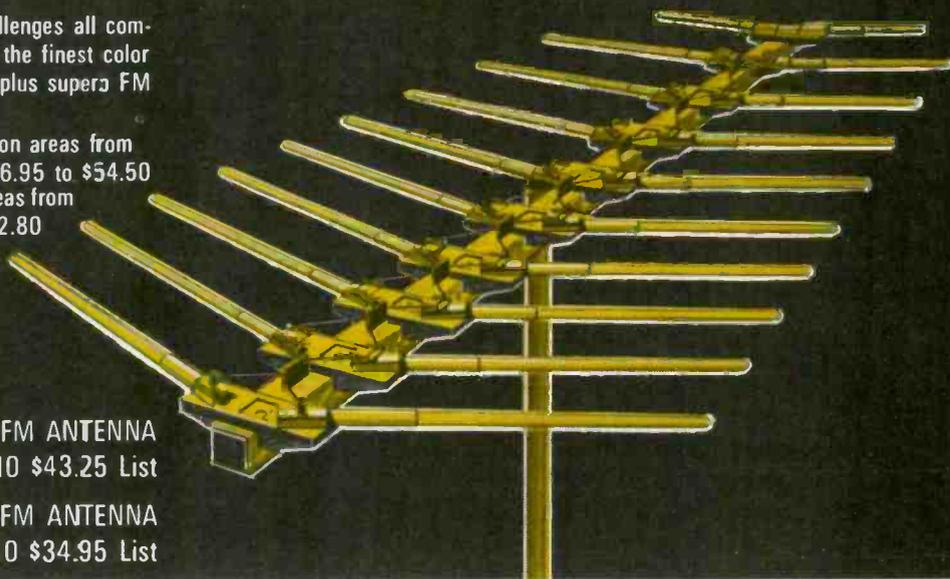
FINCO

introduces / 75-ohm COLOR VE-LOG ANTENNAS
FOR UHF-VHF-FM RECEPTION

Finco's Swept-Element Antenna challenges all competition. Its unique design assures the finest color and black and white TV reception—plus superb FM and FM Stereo tone quality.

300-ohm models for normal reception areas from \$16.95 to \$54.50

75-ohm models for poor reception areas from \$18.55 to \$62.80



FINCO SWEPT-ELEMENT VHF-FM ANTENNA
75 OHM Model CXVL-10 \$43.25 List

FINCO SWEPT-ELEMENT VHF-FM ANTENNA
300 OHM Model VL-10 \$34.95 List

FREE! ALL FINCO CX-VL, CX-UVF AND UVF ANTENNAS COME WITH A FREE INDOOR SET-MOUNTED TRANSFORMER, VHF-UHF TRANSFORMER SPLITTER OR VHF-UHF SPLITTER.



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Type	Asst'd.* 50 or More	Type	Asst'd.* 50 or More	Type	Asst'd.* 50 or More
024	.68	6DM6	.86	6SL7GT	.96
1B3/1G3GT	.79	6BN8	.90	6SN7GT	.70
1C3GT	.79	6B05/EL84	.66	6S07GT	1.02
1K3	.79	6B06GA/		6TR8	.91
1R5	.91	6CU6	1.17	6U8A	.88
1U4	.87	6B06GTB/		6V6GTA	.59
1U5	.76	6CU6	1.17	6W4GT	.66
1V2	.63	6B07A	1.07	6W6GT	.77
1X2B	.83	6BR8A/		6X4	.46
2AF4B	1.08	6FV8A	1.10	6X5GT	.60
2B4A4	.79	6B58	1.07	6Y8A	.86
2CY5	.87	6BU8	.77	7AU7	.70
3A3/3AW3	.91	6BY8	.77	8AW8A	1.00
3AU6	.63	6B26	.60	8C7	.67
3AW3	.91	6B27	1.07	8F07	.67
3BC5/3CE5	.70	6C4	.50	10DE7	.91
3BN6	1.03	6CB6A	.60	12AD6/	
3BZ6	.62	6CD6GA	1.57	12G6	.74
3CB6	.62	6CE5	.65	12AT6	.50
3CE5	.70	6CF6	.79	12AT7	.57
3CY5	1.07	6CG7	.67	12AU6	.82
3DG4	1.17	6CG8A	.88	12AU7/	
3DT6A	.67	6CL6	1.08	ECC82	.68
3GK5	1.10	6CL8A	1.07	12AV5GA	1.28
3V4	.74	6CM7	.79	12AV6	.46
4BC5	1.10	6CN7	1.14	12AV7	.97
4BQ7	1.19	6CO8	.94	12AX4GTB	.73
4BZ6	.60	6CS6	.70	12AX7/ECC83	.68
5AM8	1.16	6CS7	.80	12AX7A	.68
5AN8	1.27	6CUS	.77	12AZ7A	.82
5AQ5	.68	6CU6	1.17	12B4A	.87
5AT8	1.08	6CU8	1.25	12BA6	.46
5BR8A	1.20	6CW4	1.25	12BE6	.48
5CB8	.90	6CX8	1.22	12BH7A	.83
5CL8A	1.10	6CY5	.79	12BL6	.82
5T8	1.20	6CY7	.87	12B06GTB/	
5U4GB	.56	6CZ5	1.17	12CU6	1.20
5U8	.88	6DA4A	.87	12BY7A	.87
5X8	1.07	6DE4	.87	12CS/12CU5	.79
5Y3GT	.46	6DE6	.68	12CA5	.82
6AB4	.70	6DE7	.96	12CU5	.79
6AF3	.88	6DK6	.65	12CU6	1.20
6AF4	1.07	6DN7	.94	12D0B8	1.13
6AF4A	1.07	6D05	2.24	12D15	.88
6AG5	.82	6D06B	1.11	12CA6	.74
6AH4GT	.93	6DR7	1.17	12SA7GT	1.25
6AH6	1.25	6DT6A	.59	12SK7GT	1.14
6AK5	1.28	6DW4A	1.00	12SN7GT	.73
6AK6	.85	6EA7	1.48	12SO7GT	1.07
6ALS	.50	6E8B	.86	12V6GT	1.07
6AMS8A	.93	6EB8	1.25	12W6GT	1.07
6AN8A	1.07	6E17/EF184	1.02	13EM7/	
6AQA5A	.57	6EMS	.91	15EA7	1.39
6A55	.79	6EM7	1.37	15EA7	1.39
6A58	1.14	6ERS	1.02	16AQ3	.77
6AT8A	1.14	6EV5	.82	17AX4GTA	.87
6AU4GTA	.97	6EW6	.67	17D4A	.87
6AU6A*	.56	6FG7	1.02	17D06B	1.13
6AU8A	1.25	6FHS	.90	17J28	1.02
6AV6	.46	6F07	.67	19AU4GTA	1.02
6AW8A	1.00	6FV8A	1.10	19T8	1.05
6AX3	.73	6GF7	1.39	22DE4	.92
6AX4GTB	.71	6GH8A	.86	25R06GTB/	
6AY3A	.83	6GK5	1.10	25CU6	1.25
6B10	.96	6GM6	.79	25CD6GT	1.64
6BA6	.54	6GN8	1.17	25CU6	1.25
6BB8A	1.14	6GU7	.91	25D06	1.70
6BC5/6CE5	.65	6GT6	.74	25L6GT	.79
6BC8	1.07	6H5B/6KF8	1.02	35C5	.37
6BE6	.60	6J5GT	1.05	35L6GT	.70
6BG6GA	1.74	6J6A	.76	35W4	.50
6BH6	.79	6JB6	1.67	35Z5GT	.56
6BH8	1.14	6JE6	2.42	50C5	.57
6BJ6	.79	6JH6	.70	50EHS	.63
6BK4A	2.16	6JH8	.96	50L6GT	.73
6BK5	1.00	6K6GT	.70	ECC82	.67
6BK7B	1.02	6KF8	1.02	ECC83	.68
6BL7GTA	1.25	6L6CC	1.77	ECC80	1.02
6BL8/ECF80	1.07	654A	.68	EF184	1.02
6BN4A	.97	65J7GT	1.11	EL84	.66

*Less than 50 assorted, 60% off list.

TERMS: Minimum order \$5.00 exclusive of postage. Orders for 200 or more tubes shipped prepaid.

FREE: Send for special list of private brand, fully guaranteed new tubes at special discounts up to 80% off Mar. '66 suggested list.

CHECK OR MONEY ORDER — NO C.D.D.

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POPULAR NAME BRAND AC-DC KIT	3 — 35W4 3 — 50C5 2 — 12BE6 1 — 12AV6 1 — 12BA6	ONLY \$3.45
TOTAL 10 TUBES		

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NEW PRODUCTS

Solid-State Color Generator 726

A solid-state color generator designed for the seven signal sources so vital for color convergence, sync



adjustments, gray-scale-tracking and troubleshooting color-TV circuits is announced. Crystal-controlled circuitry and stable counters are designed to insure locked-in, trouble-free displays. Precise Electronics.

Shielded Indicating Fuse 727

Announced is a front-panel mount indicating fuse holder designed with shielding to eliminate RFI signals from passing through or coming out of the fuse post opening in the chassis of electronic equipment. The shielding is accomplished by a special mesh im-



pregnated see-through molded plastic lens and a mesh imbedded silicon gasket that fits between the lens and the mounting surface of the chassis panel. When the fuse blows, under overload conditions the indicating light in the ember lens goes on alerting the user of the equipment. Price \$5. Littelfuse, Inc.

For more information on these
NEW PRODUCTS
See pages 111 & 112
READERS SERVICE



Two New Products FROM RAWN!



* THE TUNER-CONTACT
CLEANER
and
FREEZE-IT CIRCUIT COOLER

The maker of Plas-T-Pair, famous for quick, effective plastic repair for anything from TV Sets to dentures, announces two great new products.

SPACE

Tuner and Control Cleaner contains silicone will not detune

COLOR TUNERS

Not harmful to plastics
6 oz can \$.99
16 oz can \$1.59



If you want the best for less, buy RAWN'S, for when a better tuner cleaner or circuit cooler is made, RAWN will make it.

RAWN MANUFACTURING CO.

Write for free detailed instruction sheets or see your local distributor.

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ELECTRONIC TECHNICIAN

Sencore has done it again—introduced the right instrument at the right time at the right price. FM-Stereo Multiplex is here, now, and growing as fast as Color TV. This new field is just waiting for qualified men. All you need to start “channelizing” profits your way is the new Sencore Econoline MX11 Channelizer Multiplex Generator. So light and compact you take it with you on your TV service calls, and when in the home suggest an alignment on that FM-Stereo hi-fi in the corner.

So simple to operate, you need no other instrument. Just hook up the RF output cable to the receiver antenna terminals; connect the two speaker leads in place of the speakers; then read the channel separation directly on the meters. Two meters with built-in loads substitute directly in place of speakers. When you flick on the left channel switch you have left channel output; now flip on the right channel switch and you have both. That's all there is to it.

All solid state circuitry—battery operated. Feature for feature, dollar for dollar, the Sencore MX11 Channelizer is your No. 1 buy in multiplex generators. Sencore has paved the way—so take the quickest road to your distributor. In stock now for only

\$99⁵⁰

(Less than the price of a kit.)

CHANNELIZER

PAVES THE WAY TO ADDED PROFITS

With Simplified FM-Multiplex Servicing



SENCORE MX129 FM STEREO MULTIPLEX GENERATOR AND ANALYZER

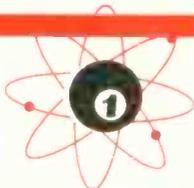
A Complete FM Stereo Service Center

The ultimate in multiplex generators for this field that's growing as fast as color TV. Like having your own FM stereo transmitter on your bench or service truck.

The MX129 produces all signals needed for trouble-shooting and aligning the stereo portion of the FM multiplex receiver. It is a complete trouble-shooting analyzer with a sensitive transistorized AC voltmeter calibrated in peak to peak volts and decibels. It can be used as a stereo demonstrator even when no stereo program is being broadcast. With the MX129 you can use external sources to modulate the carrier, re-balance the system at any time, and adjust the crystal controlled pilot signal to any level. Instantaneous warm-up—all solid state, A.C. powered.

The Sencore MX129 gives you features comparable to equipment costing up to \$350.00, yet its priced at only

\$169⁵⁰



SENCORE

NO. 1 MANUFACTURER OF ELECTRONIC MAINTENANCE EQUIPMENT

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for the best
electronic guitar sound ...
you need the best speaker

OXFORD

PROFESSIONAL MUSICAL
INSTRUMENT SERIES

For replacement, nothing quite measures up to Oxford guitar speakers. For richest bass tones at highest volumes, Oxford guitar speakers are engineered and constructed to give outstanding performance under conditions of severe overload. Each is designed for the faithful reproduction of the characteristic wave forms of the electronic guitar. Oxford guitar speakers are designed and produced to original equipment specifications. They are without equal as either new or replacement units that bring out the finest in every instrument.

Manufacturers:
Standardize
on Oxford
Leading
electronic



manufacturers recognize Oxford's superiority by incorporating the Oxford speaker in their own product. To realize the maximum potential of your own instrument, combine it with an Oxford electronic guitar speaker.

Whether you're interested in Oxford guitar speakers as a replacement or for an O.E.M. application, write for special bulletin HF 104 today!



**OXFORD TRANSDUCER
COMPANY**

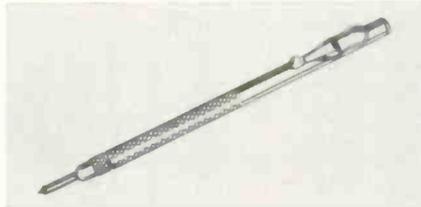
A Division of
Oxford Electric Corporation

3911 S. Michigan Ave.
Chicago, Ill. 60653

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NEW PRODUCTS

Pocket Scriber 728
A carbide pocket scriber and magnet with clip is announced, which fea-



tures a reversible tip for safety when not in use. Its knurled barrel is designed to eliminate finger slippage. Moody.

Frequency Meter 729

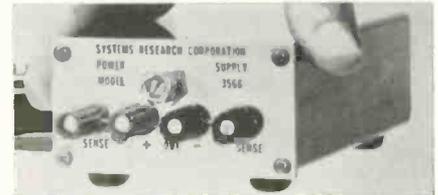
A new solid-state digital frequency meter is announced for servicing two-way mobile radios. The meter not only checks frequency, but is said to also measure deviation, provide aural monitoring and produce a highly stable signal output for setting receivers to the exact assigned frequency, in the 25-50MHz, 136-175MHz, and 405-475MHz ranges. The meter dis-



plays a seven digit in-line read-out with four automatic decimal points and indicates whether the read-out is in Hz, kHz or MHz. Motorola.

Regulated Power Supply 730

An all silicon, regulated, isolated power supply small enough to slip into a pocket is announced. The output



voltage is adjustable at the front panel from 4 to 25v at 200 ma. Price \$79. Systems Research.

The message is
clearer with . . .



Antennas

By LAMONT V. BLAKE, *Consultant, Search Radar Branch, U.S. Naval Research Laboratory.* Here's a complete, practical book on antennas that gives you professional treatment without requiring a knowledge of calculus. It not only covers all aspects of antennas, but offers related material on electromagnetic wave, transmission lines and antenna measurement methods. Up-to-date information on such recent developments as log-periodic broad-bandwidth antennas and low-noise space-communication antennas is provided, and ten problems at the end of each chapter help you check your progress. 1966. 415 pages. Paper: \$3.95. Cloth: \$6.95.

—————

Antennas is a volume in the WILEY SERIES IN ELECTRONIC ENGINEERING TECHNOLOGY — a group of books containing basic theory, mathematical exposition, worked-out examples, and problems in specific areas of electronics. The books can be used either in electronics courses or by individuals studying at home.

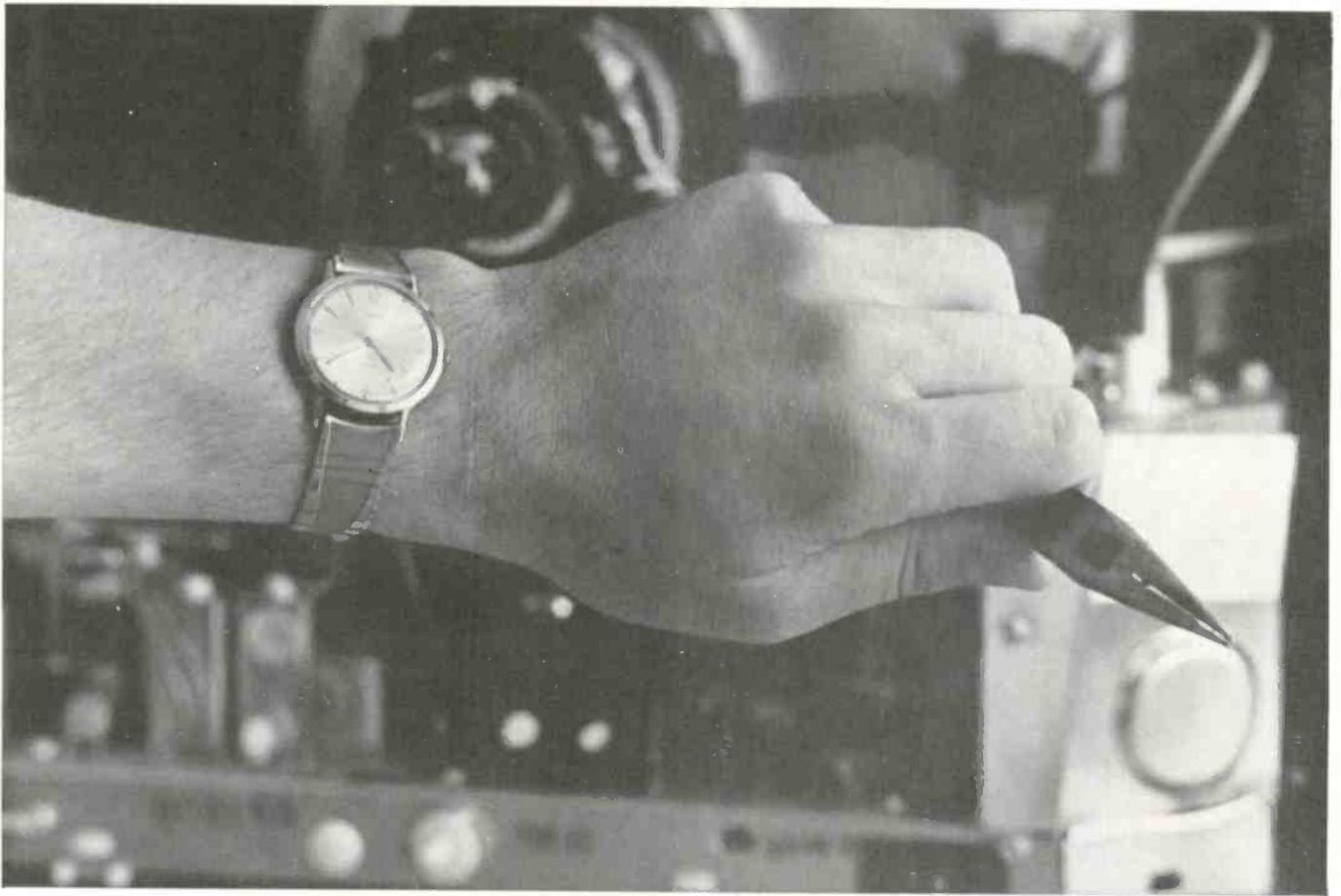
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ELECTRONIC TECHNICIAN



Are you a watch watcher?

If not, you should be.

After all, your time is what you're selling. So when it runs short, you feel it first in the pocketbook.

That's where Amphenol comes in. Our test equipment can't put more hours in your day, but it can help you handle more jobs every working hour—in the home or in the shop.

Take our Color Commander, for example. It cuts color alignment time by 40%. Here's how:

1. An exclusive three-color bar test pattern means you don't have to waste time counting unnecessary color bars. You check only the three bars required for color alignment.
2. Squares, not rectangles, give instant vertical and horizontal linearity adjustments.
3. Another Amphenol exclusive: A single dot provides fast static convergence. You don't have to guess which is the center dot.
4. Single cross bar centers the raster quickly, conveniently.

These are the kinds of time-saving features you can expect from Amphenol's exciting line of test equipment—including the revolutionary CRT Commander and the hand-held Signal Commander.

If your time is important, you're ready for Amphenol. For a brochure on the complete Amphenol line, call your Amphenol distributor. Or write to Amphenol, Box 134, Broadview, Illinois 60653.

BE ON THE LOOKOUT . . . for an exciting addition to the Amphenol line.

Completely solid state, the Amphenol Color Commander is available with battery power or built-in 117 VAC. Only 3½ lbs, it has RF and video output plus easy-to-use gun killers.



TM

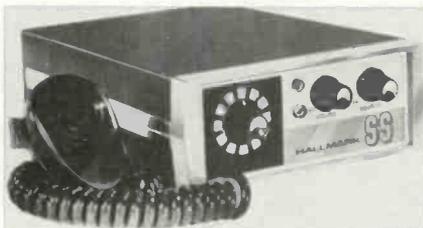
AMPHENOL

. . . for more details circle 104 on postcard

NEW PRODUCTS

CB Transceiver 731

A solid-state, 12-channel, crystal-controlled CB transceiver utilizes pre-aligned, plug-in circuit modules which reportedly virtually eliminate field maintenance problems. The receiver is a high-gain, double conversion, superheterodyne type, using low-noise germanium transistors. The 3.7w RF power output is 95 to 100% modulated for maximum "talk power." An



accessory socket is provided for tone-coded and public address systems. Hallmark Industries.

Portable Power Source 732

A 12v portable rechargeable power source complete with built-in charger



is now being marketed. The power pack reportedly has a power loss of less than 3% per month and after two and a half years of storage still has power left in the battery — it can then be readily re-charged to its full original capacity, the report said. The unit is designed for camping equipment, boating equipment, two-way communications devices and a broad range of portable television sets, tape recorders, portable tools, etc. Centrab.

Photoelectric Control 733

A photoelectric control utilizing ten silicon transistors to provide increased sensitivity and improved stability is



announced. All components are mounted on a single printed circuit board, thus reducing costs but retaining circuit efficiency. Photomation.

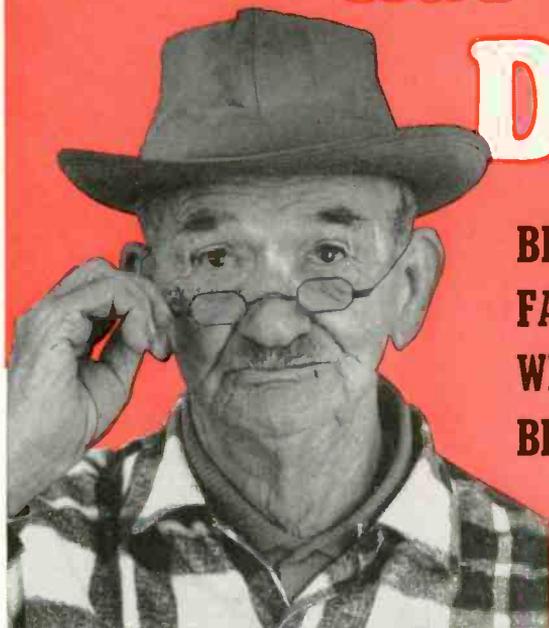
Engine Analyzer 734

An all-solid-state self powered engine analyzer is announced which is said to permit the layman to electronically tune up and troubleshoot



all automotive and boat engines. The comprehensive manual lists the idle speeds and the dwell angles for both manual and automatic transmissions. The analyzer is useful for all 6 or 12v; 4, 6, or 8-cylinder engines with negative or positive ground. Eico.

who says an old picture tube has to be DULL?



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FADING PICTURES
WITH PERMA-POWER
BRITENERS!**



Handsomely packaged for customer acceptance, color coded by base type for instant selection.

SQUINTING customers are unhappy customers. When aging picture tubes get dull, it's time for Tu-Brite. Tu-Brite instantly brings back like-new sparkle, and builds good will for you, even with the grouchiest old curmudgeon. The right voltage is a cinch. If the base is right, the boost is right. No other britener gives you this assurance or ease of selection.

Make sure you have all three models in stock.

Model C-202 for duodecal base CRT's.	Net \$2.25 each
Model C-212 for 110° button base CRT's.	
Model C-222 for 110° shell base CRT's.	

Write for free Britener Selector Chart, your guide to the base type of every picture tube now in the field.

PERMA-POWER COMPANY

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NEW
FROM
ALLIED

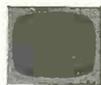
knight-kit® PORTABLE SOLID-STATE COLOR BAR/PATTERN GENERATOR



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GIVES YOU 7 ACCURATE, STABLE, CRYSTAL-CONTROLLED PATTERNS

for speedier, easier, more accurate convergence and color adjustments



Purity Adjustment



Ten Color Bars



Small Dot Pattern



Exclusive 6-Position Gray Scale



Horizontal Lines



Vertical Lines



Crosshatch Pattern

You get the most for your money—outstanding performance, rock-like stability, plus day-in, day-out solid-state reliability with this great new Knight-Kit Color Bar/Pattern Generator. It's the perfect choice for both on-the-bench and in-the-home color TV servicing.

Generates 7 patterns—all displays needed for complete color set adjustments. Special 2-volt output for Zenith color sets. Every display is well-defined with extremely low background noise. Pattern for purity adjustments does not require usual tube removal or other quieting "tricks." Unique gray scale pattern provides 6 discreet levels of brightness for gun tracking adjustments. Horizontal display elements are only one raster line thick for ultimate definition. Crystal-controlled patterns eliminate any need for synchronization with TV set. Lead-piercing clips on gun interrupters allow fast, safe connection to receiver under test. Solid-state design provides instant operation.

Shaded light source on 3-ft. cable has handy clip mount for service adjustments in darkened room. Highly polished service mirror conveniently stores under bottom of case. Special power transformer with extremely low external field eliminates magnetic effects on color CRT. Rugged steel case measures 4 5/8 x 9 5/8 x 12". All parts, cables, instructions and 32-page operator's manual for just **\$89.95**

MODEL KG-685 SPECIFICATIONS

7 Displays: purity, tracking, dots, crosshatch, vertical lines, horizontal lines, and color bars. **RF Output:** 10,000 microvolts minimum, tunable to channels 3, 4 or 5. **Composite Video Output:** ±2 volts peak-to-peak, tunable to channels 3, 4 or 5. **Master Oscillator:** 189 kc, crystal controlled. **Color Oscillator:** 3.56 mc, crystal controlled. **Sound Subcarrier Oscillator:** 4.5 mc, crystal controlled. **Front-Panel Controls and Jacks:** Display Selector Switch, Sound Carrier On/Off Switch; Power On/Off Switch; Service Light On/Off Switch; Gun Interruption On/Off Switches (3—red, blue and green); Color Level Control (off through high, continuously variable); Video Level/Polarity (continuously variable level and choice of polarity); 6 Pin Jacks (3 signal output and 3 CRT grids). **Rear Panel:** Channel Tuning; Vertical Intensity (screwdriver adj.); Timing (5 screwdriver adj.); 6-circuit Test Jack. **Cables:** RF Output, 4-ft. long with alligator clips; Gun Interrupter, 4-ft. with lead-piercing, color-coded, alligator clips and ground lead; Service Light, 3-ft. with insulated mtg. clip, hi-intensity lamp and shade; Composite Video and Sync, 4-ft. with alligator clips and ground. **Power Requirements:** 110-130 v., 60 cycle AC. **Fuse:** Internal, 1/4 amp quick blow. **Power Consumption:** approx. 10 watts.

COMPLETE KIT \$ 89⁹⁵
Including 32-page
Operator's Manual

Read this unique money-back guarantee... exclusive in the industry:

KNIGHT-KIT GUARANTEE

Build a Knight-Kit in accordance with our easy-to-follow instructions. When you have completely assembled the kit, you must be satisfied or we will return your money, less transportation charges, under the Allied guarantee of satisfaction.

ALLIED RADIO

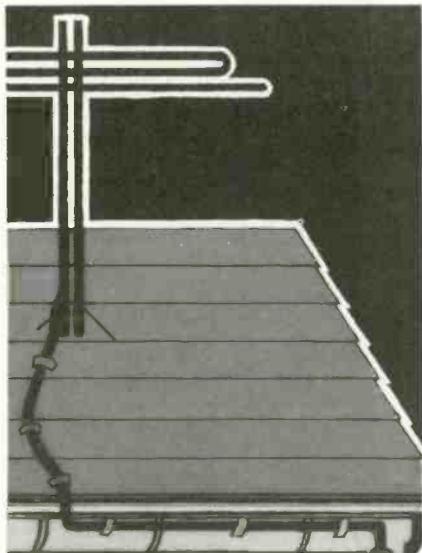
Rush the coupon below for full details and Special Introductory Offer on the KG-685

Allied Radio, Knight-Kit Div., Dept. 28-JJ
P.O. Box 4398, Chicago, Ill. 60680

Please rush full details and Introductory Offer on the new Knight-Kit Color Bar/Pattern Generator.

Name _____ PLEASE PRINT
Address _____
City _____ State _____ Zip _____

... for more details circle 103 on postcard



when the cable goes down the gutter... does the picture go down the drain?

Not with Columbia Wire's new ultra-low loss shielded Permafoam transmission cable! You can tape it to the antenna mast... run it along gutters... tape it to downspouts... lead it in by the quickest, easiest route... and there's never any pickup interference! And the antenna terminals are already installed for you... so you get the job done faster than you ever have before... easily terminated Shielded Permafoam cable makes set hookup more profitable. Ask for a spec sheet at your distributor.



Available in 50', 75' and 100' coils — 500' spools and 1000' reels.

Columbia
WIRE PRODUCTS COMPANY
2850 Irving Park Rd., Chicago, Ill. 60618

... for more details circle 121 on postcard

NEW PRODUCTS

AM/FM/SW Portable Radio 735

A 6¾ x 4⅞ x 2½ in. receiver is announced that tunes the standard AM and FM bands plus the SW spectrum



from 4.0MHz to 12.0MHz. The radio includes two antennas, ten transistors, four diodes and an earphone. List price \$49.95. Hallicrafters.

CB Power Pack 736

A rechargeable battery unit is now available to owners of transistorized CB equipment. The Power Pack plugs into the rear of the transceiver and



provides up to 8 hours of full power, portable operation before the nickel cadmium battery requires recharging. The unit adds 3 inches to the over-all length of the transceiver. Price is \$69.95. Johnson.

Microphones 737

Two unidirectional dynamic microphones have been announced which



reportedly offer a unique built-in protection against reproduction of explosion breath sounds ("pop") and wind-noise. Each of these microphones has a wire-mesh spherical front, which contains two filters. These filters are designed to enable the microphones to be used outdoors without separate windscreens. Cardioid pickup patterns are designed to provide practically complete exclusion of unwanted noises and also eliminate or minimize feedback and boominess. These microphones are rated at 50Hz to 12kHz or 50Hz to 15kHz with single or multiple impedances. Prices range from \$58 to \$95. Shure.

For more information on these

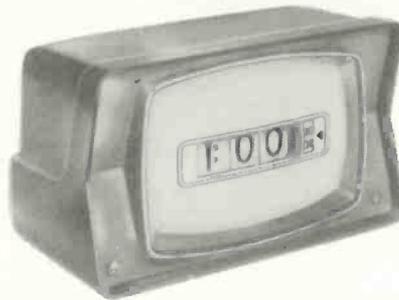
NEW PRODUCTS

See pages 111 and 112

READERS SERVICE

Discover the Unique
Experience of Correct
Time Telling . . . The New

TV[®] LAMP CLOCK



Model #765

12.95

Comforting night light for bedroom or nursery controlled by independent switch. Persimmon, Walnut or White plastic case with gold trimmed Persimmon video face. Self starting electric. 4" H, 7" W, 3⅞" D. 110V 60 cy. AC. Guaranteed one year. UL and CSA approved motor and cord.

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SNOW



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YOU NEED THE: • AD-
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SATILITY OF THE SPACE
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JFD COLOR-TELE-AMP

Buy 2 get 1 Free!

JFD® COLORTELE-AMP AMPLIFIER DEAL

NO—we haven't flipped our lid.

We just want to prove to you that JFD ColorTele-Amps are the best amplifiers you can use.

That's why we're giving away FREE one ColorTele-Amp with every two you buy from your distributor.

We know that when you see the amazing on-the-job performance our ColorTele-Amps deliver, you'll be coming back for more.

So clip out the coupon below, fill it out and take it to your favorite JFD distributor to get your FREE ColorTele-Amp. He has a wide selection of indoor and outdoor ColorTele-Amps to suit any and all of your reception requirements.

available in two models for

1. Outdoor installation on any antenna where highest possible noise-free gain is the primary need.

2. Indoor use anywhere in the home where convenience of single self-contained amplifier/power supply/signal splitter is preferred.



No. 1

Outdoor Amplifiers

VUT-3 VT-1
VUT-3TF UHT-2
VN-2 FT-1
VT-2 FT-175
VT-275



No. 2

Indoor Amplifiers

HVU-3 HU-2
HV-2 HF-1
HV-1 EV-1
EF-1

TAKE ME TO YOUR DISTRIBUTOR FOR FREE COLORTELE-AMP AMPLIFIER!
Attention: ColorTele-Amp Dept.

JFD Electronics Co.
15 Avenue at 62nd Street
Brooklyn, New York 11219

JFD® COLORTELE-AMP CERTIFICATE

GOOD ONLY AUGUST 1—SEPTEMBER 30, 1966

THIS SPACE MUST BE FILLED IN BY SERVICE-DEALER.

Store Name

Street

City Zip Code

State

Service-Dealer Signature

Distributor Counter-signature

NOTE TO SERVICE-DEALER

1. Fill in (please print) your name and address in space provided.
2. Present this certificate to your JFD distributor at time of purchase of two ColorTele-Amps—and get one FREE (of the same model).
3. Only one certificate may be applied to each purchase. Void where prohibited, taxed or otherwise restricted.

NOTE TO DISTRIBUTOR

TAKE ADVANTAGE OF OUR SPECIAL "ONE-FREE FOR TWO" COLORTELE-AMP OFFER TO DISTRIBUTORS.

1. Be sure you've got ColorTele-Amps in stock. Order 48 or more of any one or two of the models listed above and get 24 FREE. Call your JFD representative or write us direct for immediate delivery.
2. Countersign the filled out certificate when deemed by your dealer and mail to us so we can pay you 50 cents for handling.
3. Offer ends September 30, 1966.

... for more details circle 133 on postcard

NEW PRODUCTS

Pocket Pager

738



Underwriters' Laboratories has approved a pocket pager in Class I, Group D and Class II, Group G hazardous atmospheres. The 11½ oz. unit measures 5¼ x 2½ x 1 1/16 in. and

can be clipped in a pocket or to a belt. It is designed to be used in the 148-174MHz frequency band and will respond to signals as weak as 0.15µv. Calls may be originated by a central paging operator. When a call is made, the receiver will emit an alert tone to indicate that the user is being paged. A button on the top of the unit is then pressed and a voice message is heard. Motorola.

Regulated Power Supply 739

Announced is a new voltage regulated laboratory power supply with all-silicon circuitry. The unit is rated at



300ma over a range of 1.25 to 30vdc with a load regulation of ±0.5% or 50mv, whichever is greater; has a 10mv line regulation over a range of 105 to 125v and a full load ripple of 1mv RMS. It stands 5¾ in. high and weighs 3 lb. Acopian Corp.

Incomparable Excellence



The Super-Sharp TRAM TITAN BASE STATION

- *Multi-function meter reads: "S" units, SWR, and absolute power in watts into built-in dummy load. Measures power through the antenna.
- *Super-sharp selectivity with Collins mechanical filter—adjacent channel rejection is 90 db or better. *First class sensitivity. *All 23 transmit channels.
- *Transmitter delivers 3.5 watts minimum output; separate indicators for carrier on and modulation. *RF gain control. *Tone control. *Built-in low pass filter for minimum T.V.I. \$434.



The Magnificently Selective TRAM XL-100 C. B. Mobile

- *23 channel operation via synthesis.
- *Compact (main unit 4"x8"x8").
- *Built-in crystal filter achieves selectivity unmatched in any standard set—adjacent channel rejection is 95 db or better. *Sensitivity second to none.
- *Built-in low pass filter, minimizes T.V.I.
- *Hand wiring. *Teflon covered wire.
- *Locking switch makes rig tamper free.
- *Set padlocks to dash bracket. *Heavy duty, commercial type microphone.
- *High efficiency transmitter delivers 3.5 watts minimum output to antenna. \$318.

Microphone 740

A microphone designed to substantially reduce line loss problems is introduced. Any line loss can be compensated for by simply turning up the volume control that is located on the rear base deck of the microphone. A



two stage silicon transistor amplifier built into the base provides a dual output impedance of 150 or 600Ω. The microphone is rated at 60Hz to 10kHz with less than 1% distortion. List price \$75. Turner.

For full details write:

Tram Electronics, Inc.

Dept. No. C-9, Lower Bay Road, P.O. Box 187, Winnisquam, N. H. Phone 603-524-0622

All use must conform with Part 95 F.C.C. regulations. Hobby type communications or aimless small talk prohibited.

For information write directly to advertiser

MOVING?

Be sure to let us know your new address. Please enclose a complete address label from one of your recent issues.



CG138



CG10

It's time you too switched to Sencore and saved \$100 in the bargain. The new LO-BOY is a solid Sencore value — already selling at the rate of one every 8 minutes.

Small wonder. The LO-BOY outperforms the highest priced unit on the market . . . and gives you all this: • Ten standard RCA licensed color bars; NTSC phased colors. • All the patterns found on more expensive generators—crosshatch, individual vertical and horizontal lines, and adjustable white dots . . . all at the flick of a switch. No lines missing on crosshatch—14 horizontal and 10 vertical, same as our more expensive models. • Interlace control—a Sencore “first.” Stops dot bounce that varies from set to set. • Rugged all steel construction with tough scuff-resistant vinyl finish. • LO in silhouette—not much bigger than a cigar box. • LO in warm-up time. All solid state design. • LO in troubles. All new patent pending counting circuits using new silicon transistors. Crystal controlled timers for the utmost in stability.

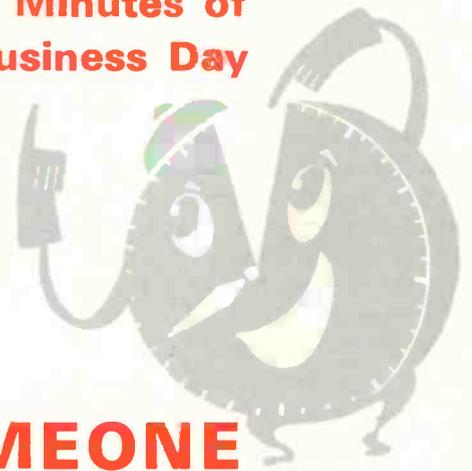
Timer controls brought right out on the front panel as simple operators controls. Adjusted as easily as the horizontal and vertical hold controls on a TV set, if they should ever jump. Absolutely eliminates timer instability.

Compare these features and you'll decide in less than 8 minutes that you need a new Sencore Lo-Boy.

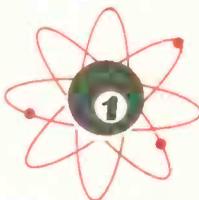
SENCORE CG10. All solid state. New zener regulated battery power supply with long life “C” cells. The 12 volt battery supply can wear down to nearly 9 volts before the circuits are affected. New leakproof battery holders permit easy battery replacement without dismantling the unit. You don't have to hunt for a place to plug it in. Priced at less than the cost of a kit.Only **\$89⁵⁰**

SENCORE CG138. A performance giant just like the CG10 except AC operated with a zener regulated power supply for added stability even with line voltage variations. Has 4.5 mc crystal controlled signal for fine tuning as recommended by color set manufacturers.Only **\$109⁵⁰**

Every 8 Minutes of Every Business Day



SOMEONE BUYS A NEW SENCORE LO-BOY STANDARD COLOR BAR GENERATOR



See America's most complete line of professional test instruments — at your Distributor's now.

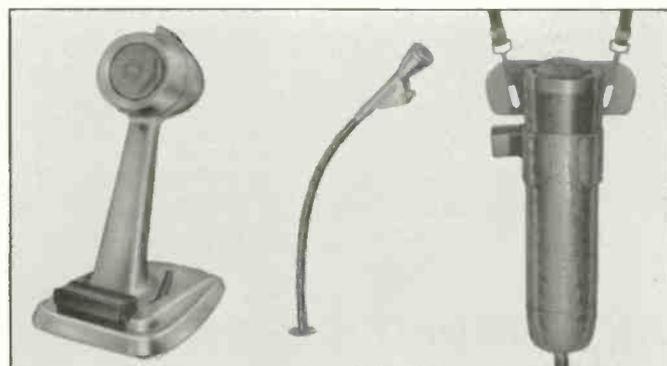
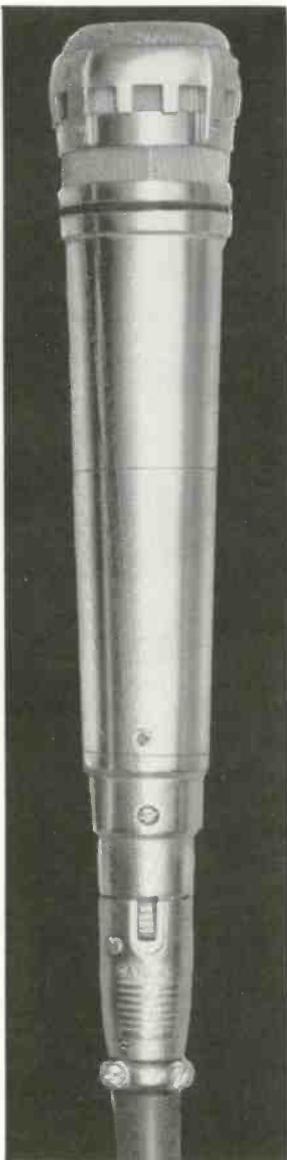
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RECOMMEND THE TURNER 500 CARDIOID

In your business, your reputation depends on your recommendation. Don't risk either — always recommend the high-performing, trouble-free Turner 500 Cardioid. Most problems in PA or sound applications — extraneous noises, poor acoustics, etc. — can be successfully solved by incorporating Turner 500's into the system. So before you make your next installation, check the Reader Service card for the complete Turner catalog. Get details on the Model 500 — list price \$84.00 — and the rest of the Turner line, including:



MODEL 251

Low cost, high performance paging microphone with Turner's unique lift-to-talk feature. List price \$49.50.

MODEL SR585D

Fixed mounted microphone conveniently mounted on a flexible 16" gooseneck. List price \$40.

MODEL 58

A natural for any application requiring freedom and mobility . . . does double-duty on desk stand. List price \$57.



In Canada: Tri-Tel Associates, Ltd.
Export: Ad Auriema Inc., 85 Broad Street, New York, N.Y. 10004

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NEWS OF THE INDUSTRY

Textron Acquires Bostitch

The directors of Bostitch, Inc. have agreed to the acquisition by Textron, Inc. of the assets of Bostitch, in exchange for approximately 1,300,000 shares of Textron common stock and the assumption by Textron of the liabilities of Bostitch. Bostitch will distribute the Textron shares to its stockholders so that each will receive 1¼ shares of Textron common stock for each share of Bostitch capital stock. A special meeting of Bostitch stockholders will be held as soon as possible for ratification of the directors' action. The acquisition will extend Textron's diversified manufacturing interests into the office supply, construction equipment and container machinery fields. Bostitch is a manufacturer of staplers and staples, stapling hammers and tackers and container machinery.

Admiral Dealers Visit Tokyo

Admiral Corp. is host to 1,500 TV-appliance dealers on nine jet-charter flights to Tokyo. The company's dealers qualified for the trips in a nationwide sales incentive program conducted earlier in the year. The week in the Japanese capital includes a visit to Fuji-Hakone National Park as well as key sites in the city.

The jet aircraft depart from Chicago, Memphis, Cincinnati, New York, Denver, Dallas, Atlanta, Baltimore and Los Angeles between August 20 and September 6. All flights are non-stop from Seattle. Last year Admiral transported 3000 dealers to Rio de Janeiro in South America.

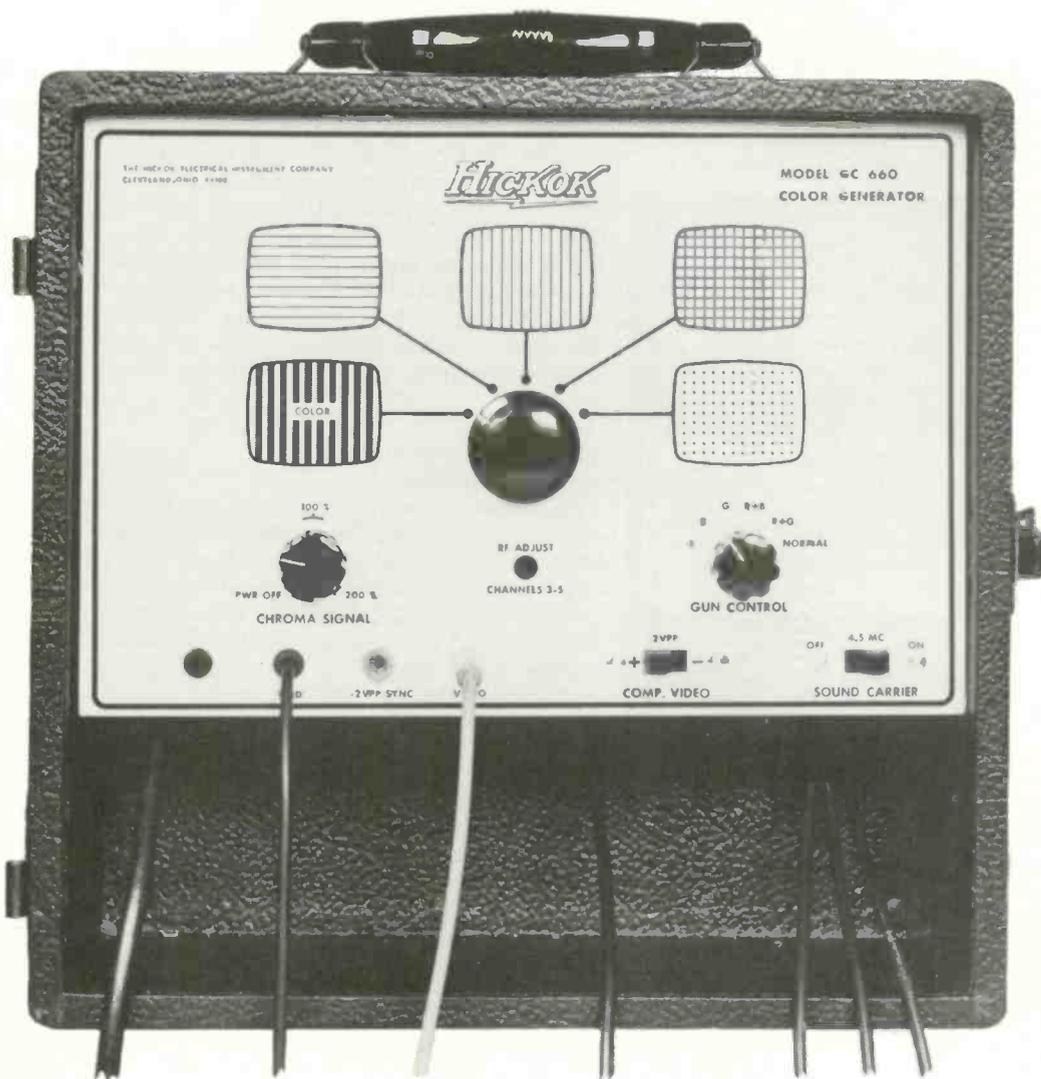
Global Patent System Urged

The Patent, Trademark and Copyright Research Institute of George Washington University presented David Sarnoff, chairman of the board of the Radio Corp. of America, with the ninth annual Charles F. Kettering Award for "meritorious work in patent, trademark and copyright research and education."

General Sarnoff said that the "fragmented array of national patent systems inhibits the swift and equitable worldwide distribution of patent benefits—through new technology, new industry and expanding markets." He stated that "it is ironic" that the patent structure designed to advance progress has failed to keep pace with the technological growth. "When we can transmit an idea around the world in less than one-seventh of a second, why must years elapse before that idea can be validated within or outside the country of origin? Why must an inventor still make separate application in every country where he wishes to protect his idea? Why should some countries make no provision at all for patent filings, or impose severely restrictive conditions proposed here and abroad, but a combination of political and technical problems has prevented its achievement. "Today, the mounting pressure of economic necessities may overcome the political obstacles. And a global patent system could now be accommodated technically in a worldwide communications service just as readily as global television, global weather reporting and global computer services."

Brand **NEW** FROM **HICKOK**

MODEL GC-660—COLOR BAR GENERATOR



A
GENERATOR
THAT
"STAYS PUT"

■ A proven, field-tested design ■ "Stays put"—designed for Alaskan cold and Florida heat and humidity* ■ 0.1 μ sec dots—plus a crosshatch pattern that doesn't "flicker" ■ Standard gated color bars at zero reference level—for *correct* color phasing adjustments.

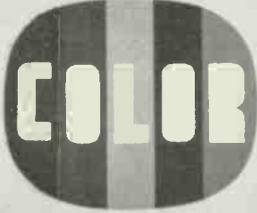
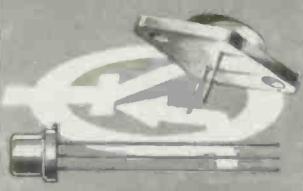
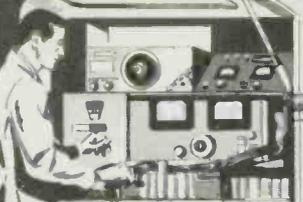
Let's face it, the biggest problem you've had in using *anybody's* color generator has been having it work right every time you turn it on—you can't get much use out of a generator that wastes your time while you wait for it to settle down, lock in, and *stay put*. *Hickok's new Model GC-660 has actually been tested for its ability to "stay put" not only in field tests but in a Military Standard Environmental Chamber. It's not *perfect* but we think it beats anybody else's. Why not ask your Hickok distributor for a demonstration and prove it to yourself?

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RCA Institutes, Inc. offers these four comprehensive home study courses especially designed to help build your income immediately!

 <p>COLOR TV Add Color TV Servicing to your skills with this up-to-the-minute home training course and take advantage of the growing profit potential in this area! Train under the direction of RCA...experts in Color TV.</p>	 <p>TRANSISTORS You get the necessary background for semiconductor technology including characteristics of tunnel diodes, rectifiers and other solid state devices. Transistor trainer also available.</p>
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Take advantage of RCA's Liberal Tuition Plan. You only pay for lessons you order; and have no long-term obligations. Licensed by New York State Education Department. Approved for Veterans.

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Without obligation, rush me free information on the following RCA Home Training Course: COLOR TV TRANSISTORS MOBILE COMMUNICATIONS AUTOMATION ELECTRONICS

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CANADIANS—Take advantage of these same RCA courses at no additional cost. No postage. No customs. No delay. Send coupon to: RCA Victor Company, Ltd., 5581 Royalmount Ave., Montreal 9, Quebec.

NEWS OF THE INDUSTRY

Comsat Training Program

An intensive training program for earth station technicians of the Communications Satellite Corp. (Comsat) is being conducted by Sylvania. The course includes antenna alignment and maintenance, tracking, computer operation, a Federal Communications Commission license refresher and use of the maser.

The program is part of a \$4.6 million contract awarded by Comsat to Sylvania to construct and install antenna systems at Brewster, Wash. and Paumalu, Oahu, Hawaii. When completed, the new stations will link the United States with Asia and Australia and other Pacific nations through commercial satellites which will be put in synchronous orbit 22,300 miles above the Pacific. Early Bird, the world's first commercial communications satellite, now connects North America and Europe through a Comsat-operated station at Andover, Me.

Mallory Battery Dedicates Mexican Facilities

The new Mexico City facility of the Mallory Battery Co. was dedicated June 24, 1966, with special ceremonies attended by company officials from the United States and representatives of the Mexican government. The new facility will specialize in the manufacture of Mallory DURACELL[®] mercury and alkaline batteries and mercury hearing aid batteries for distribution throughout Latin and South America. These batteries are used to power photographic equipment, portable radios, office machines and hearing aid devices.

Zenith Announces Sales Records

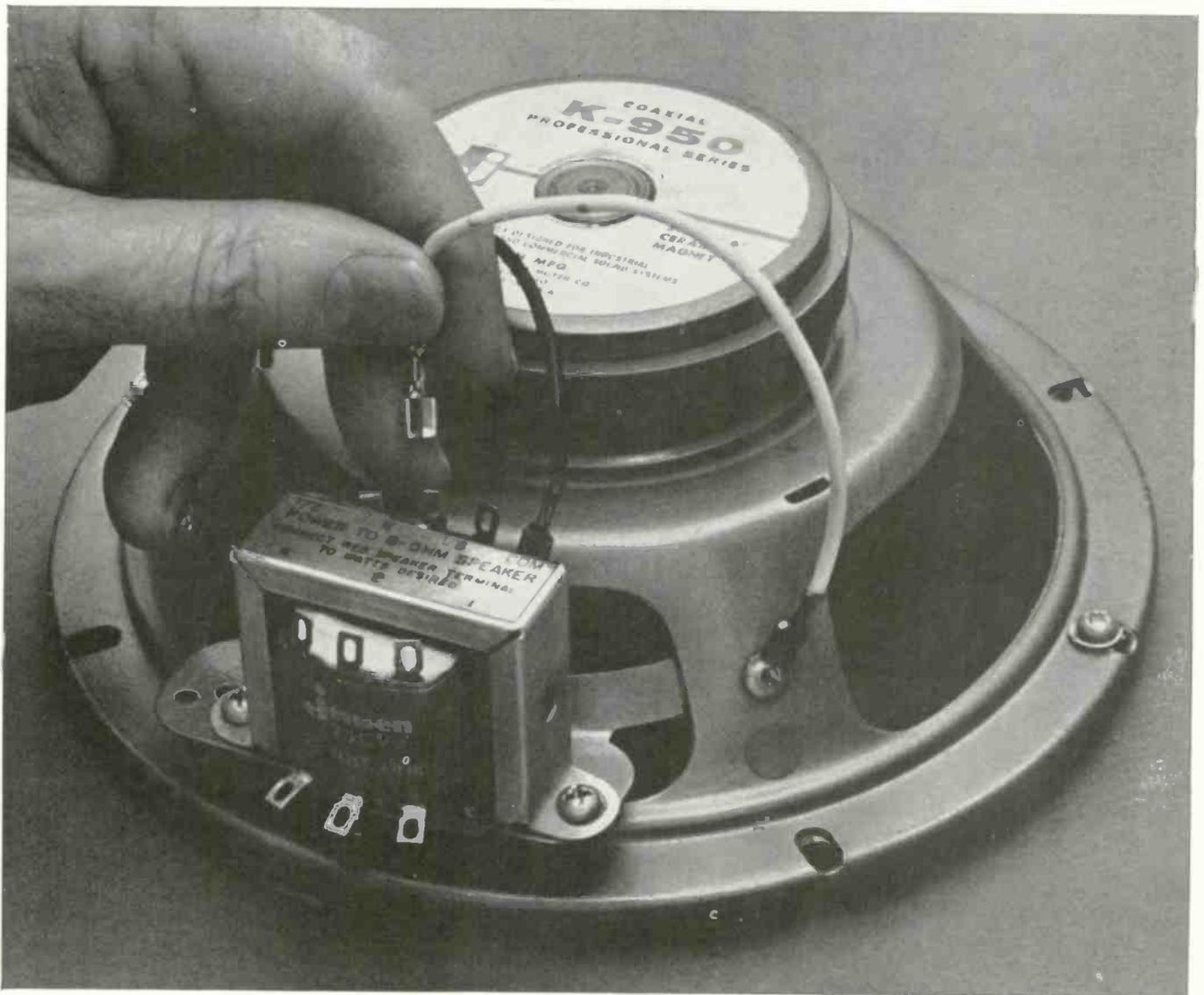
Zenith has announced that distributor orders have been the highest in company's history. Well over \$200 million worth of orders were placed for the period of June through August. The volume of color-TV receivers more than doubled the 1965 figure.

The company is also announcing the addition of three 25-in. color-TV models to its 1967 line, broadening the entire line to 40 basic models. The additional models include two table units and a furniture styled console.

New Printed Circuit Plant

Construction has begun on the N. R. Buck's new printed circuit facility near Lakeville, Minn. When completed, the plant will employ about 125 engineers, technicians and production personnel. It will contain 6000sq ft of clean room production space reportedly more sterile than many hospital operating rooms. The 20,000sq ft air-conditioned building, located in Airlake Industrial Airpark, Lakeville, will be in operation by approximately October 1.

Most of the equipment in the new plant will be "one of a kind," designed specifically for circuitry processing. Equipment will include a 50 by 72in. process camera, high speed roll-to-roll laminating, coating and etching systems, and a computer-operated coordinatograph for precisely laying out circuits.



Listen!

Save 50¢ or more per unit on installation

Labor and timesaving built-ins on Jensen's 8-inch Professional Series speakers add up to big savings when you're working on a big job.

You can save 50¢ or more per unit on installation with Jensen's exclusive KWIKON® instant connectors and pre-attached transformers. Installation is fast, simple, solderless.

And with the Jensen K-950 coaxial loudspeaker you need only half as many units to deliver smooth, dynamic sound to every corner. The K-950's 110° coverage angle and exceptional frequency range provide approximately twice the coverage area of an average 8-inch speaker.

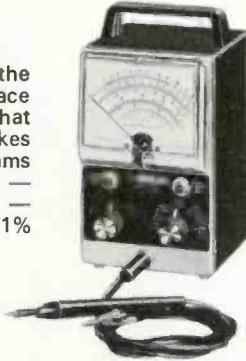
There's a lot to like about Jensen's Professional Series 8-inch loudspeakers and there are 40 different models to choose from. Spec your next job from the Jensen catalog. Write to Jensen Manufacturing Division, The Muter Company, 6601 South Laramie Avenue, Chicago, Ill. 60638.

Jensen

Here Are Four HEATHKIT® Professional Test Instruments You Don't Have To Build

World's Most Popular VTVM! ... the Heathkit IM-11 VTVM set the value pace in VTVM's for the industry, and it's held that pace for over 15 years. One probe makes all measurements — 7 AC, 7 DC, 7 Ohms ranges — 1.5 to 1500 volts full scale — On an easy-to-read 4½" 200 ua meter — Features RMS & peak-to-peak scales — 1% precision resistors.

Kit IM-11, 5 lbs. \$24.95
Wired IMW-11, 5 lbs. \$39.95



Complete Service / Laboratory Transistor Analyzer ... the Heathkit IM-30 provides thorough DC analysis of PNP & NPN transistors. Test for shorts, DC gain (Beta 0-300) (Alpha 0-0.9967), Leakage (Icbo, Iceo), and diode forward & reverse current. Requires 7 "D" cells for internal power — provisions for external power.

Kit IM-30, 9 lbs. \$54.88
Wired IMW-30, 10 lbs. \$84.95



Heathkit AC VTVM Measures Low-Level AC With 5% Accuracy ... features 10 ranges—0.01 to 300 volts RMS full scale. VU-type ballistic damping and calibrated db scale for audio measurements. The perfect instrument for hi-fi servicing!

Kit IM-21, 5 lbs. \$33.95
Wired IMW-21, 5 lbs. \$52.95



Gimbal-Mounted "Service Bench" VTVM Features Extended Accuracy Through Separate Low Voltage AC Scales ... includes single probe for all ranges and 1.5 to 1500 volts full scale sensitivity.

Kit IM-13, 7 lbs. \$32.95
Wired IMW-13, 7 lbs. \$49.95



FREE! World's Largest Electronic Kit Catalog

Includes these and over 250 other items for the service technician, engineer, ham, teacher, and hobbyist.



NEWS OF THE INDUSTRY

Color TV Booms

Color TV sales last April increased 166.3 percent over the April 1965 figures (up 185,145 sets) while there was a 10.4 percent decline in the sales of black-and-white TV sets (down 49,040 sets).

The year-to-date figures on January/April unit sales are as follows:

	1965	1966
Merchandise		
B/W TV Sets	2,428,720	2,458,597
Color TV Sets	592,437	1,238,469
Home Table, Clock and Portable Radios	3,386,290	4,074,467
Home FM Radios	729,941	1,160,039
Auto Radios	3,386,752	3,182,917
Portable & Table Phonographs	898,019	829,126
Console Phonographs	448,465	590,084
B/W TV Picture Tubes	2,943,538	3,011,043
Receiving Tubes	126,743,000	147,053,000

Harman-Kardon Commercial Sound Changes Name

The Harman-Kardon Commercial Sound Div. of Jerrold Corp. has changed its name to the Jerrold Commercial Sound Div. The change is not designed to affect Harman-Kardon's Hi Fi operation but is designed to provide it with marketing, advertising and sales experience of the parent company.

The announcement was accompanied by the introduction of a new line of all solid-state amplifiers. The new amplifiers reportedly achieve maximum reliability by converting the usual 117vac input power to 12 vdc. This design enables every new amplifier to be converted easily to battery operation for outdoor, mobile or emergency use.

Kay-Townes Antenna Co. Appoints Factory Representatives

The Kay-Townes Antenna Co. has announced the appointment of manufacturing representatives to service distributor sales in the following territories: Illinois and Wisconsin, The Mort Fields Co.; Metropolitan New York, Louis W. Keller and Assoc.; Southern New Jersey, Trenton and Southeastern Pennsylvania, The Ferrell S. Carmine Co.; Western Pennsylvania and West Virginia, Herb London; Indiana and Michigan, Gerald W. Perry; the Pacific Northwest, Ted Erickson Associates, Inc.

Sylvania Sales Boost

Sylvania announces that orders for home entertainment products taken at their recent National Dealers and Distributors Convention were 108 percent greater than a year ago. The demand for color-TV sets and stereophonic units contributed strongly to the increase.

Empire Appoints Southwest and Hawaiian Reps

The Empire Scientific Corp., has appointed I. R. Stern & Co. as its representatives in Southern California, Arizona, parts of Nevada and Hawaii for speakers, turntables and cartridges.

HEATHKIT

HEATH COMPANY, Dept. 24-9
 Benton Harbor, Mich. 49022

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Jerrold Metropolitan Antennas Debut

Jerrold Electronics has announced two new antennas which it says are designed specifically to wipe out color ghosts in metropolitan areas.

The new "Metrocolor" series antennas feature a hybrid coupler phasing harness which is said to result in a very high front-to-back ratio. The company said the new antennas minimize ghosts by rejecting reflected signals.

Dr. Lorne Armstrong Granted Patent

Dr. Lorne D. Armstrong director of research at The Micro State Electronics Corp., has been granted a patent on a method of making semiconductor diodes using gallium antimonide crystals. Dr. Armstrong holds a B.A. degree from the University of Saskatchewan and M.A. and Ph.D. degrees from the University of Toronto. He is a member of the Institute of Electrical and Electronics Engineers and the Chemical Society. He is the author of 20 technical papers and he has received ten other patents.

New 1500MHz Transistor

Amperex Electronic Corp. announces a new NPN silicon planar epitaxial transistor which has low noise, high gain and low intermodulation distortion throughout the UHF frequency spectrum. This capability has been achieved through advances in the design of etching masks and improved material and process controls.

The transistor has an f_T of 1.56Hz typically and h_{fe} of 100 at both 2 and 20 ma. These linear performance

characteristics provide intermodulation and cross modulation properties and permit the designer to optimize his circuit at an operating point of his choice while maintaining known gain. Typical applications for the transistor are in small signal RF amplifiers, telemetry, test instruments and any equipment requiring high gain and low noise.

Amphenol Appoints Test Instrument Specialist

Raymond E. Anthony has been appointed to the newly created post of test instrument specialists by the Amphenol Distributor Div., of Amphenol Corp. In this capacity, Mr. Anthony will plan and conduct dealer workshop sessions demonstrating their line of television servicing instruments to TV technicians and set dealers across the nation.

Lear Jet's Distributors Meet

The Stereo Div. of Lear Jet Industries, Inc., held the first national sales meeting for their distributors July 9, 1966, in the Crystal Ballroom of the Sheraton-Blackstone Hotel in Chicago.

Sixty-six distributor organizations were expected to attend the meeting. A large audience was expected for the preview of new products and programs.

Chancellor Electronics signed an order for \$1,204,000 of Lear Jet Stereo 8 Tape Players. This was the largest single order for these players ever signed by a distributor. The company felt that it was a significant indication of the expanding sales and acceptance of their equipment.

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RCA and Hoffman-LaRouche Collaborate on Medical Devices

An agreement to collaborate in the development, production, and marketing of medical devices has been announced by the Radio Corp. of America and Hoffmann-La Rouche, Inc. Under the agreement, the two companies will develop new electronic, electrochemical and electromechanical devices which will be manufactured and marketed in the United States and abroad for medical use.

The two executives called the agreement "a logical and desirable move to bring about collaboration between two organizations with complementing skills in an expanding market that serves a vital human need."

The initial stage of the effort will involve a study by scientists of both companies to formulate an effective program. The program will be designed to develop understanding of present and anticipated technology that can be applied to medical needs, to determine the feasibility and practicality of various types of products and to provide new devices that are safe, effective, and responsive to the demands of modern medical practice.

Oxford Appoints Anderson Sales

Anderson Sales Co. has been appointed sales representatives for the Oxford Transducer Co. line of speakers and affiliated electronic components. With nearly 20 years experience in the field, the company maintains headquarters in Boston and travels the New England territory of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut. A branch facility is maintained in Waterbury, Conn. In addition to distributors, the organization will also cover Oxford's O.E.M. market in the territory.

Zenith Awarded Basic Stereo-FM Patents

Zenith Radio Corp. has received basic patents on its FM/stereo system. The system, developed by a team of company research scientists and engineers and air-tested over Zenith's pioneer FM station, WEFM, was approved by the Federal Communications Commission, with minor modifications, for general use in 1961.

Since its introduction, FM/stereo broadcasting has grown from fewer than 60 stations at the end of 1961 to more than 470 in the U.S. alone, with an estimated 50 stations using the system in other countries. It is estimated that more than two million FM/stereo receivers will be sold this year. Virtually all console phonograph-radio combinations on the market today incorporate FM/stereo, compared to about one-third 4 years ago.

G-E Forms New Tape Recorder Section

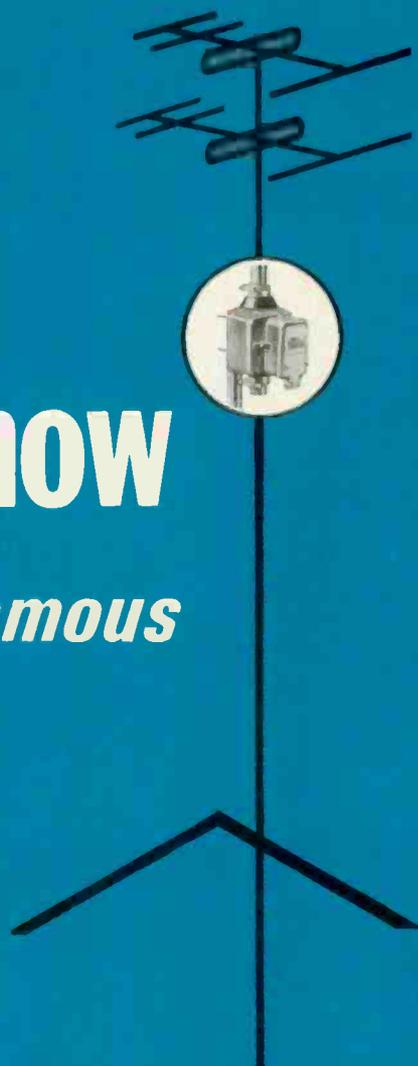
G-E's radio receiver department announces the formation of a new business section to manufacture and market audio tape recorders.

The company's audio products department, Decatur, Ill. will continue to manufacture and market tape recorders with suggested retail prices above \$100.

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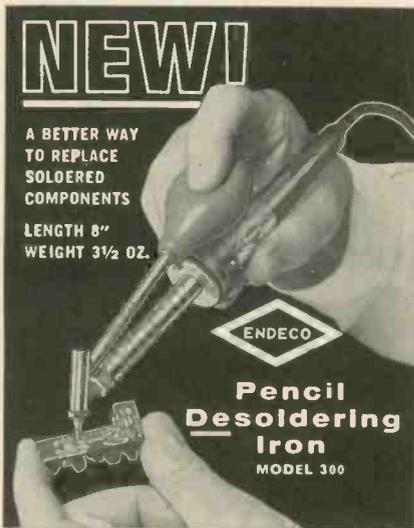
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CATALOGS AND BULLETINS

Test Instruments 400

Technical data about VTVMs, scopes, micro-testers and a VOM are included in a 16-page booklet that is now available. Simpson.

Magnets 401

A 4-page brochure describes permanent alnico and ceramic magnets, in rod and bar forms; plus horseshoe, channel, lifting and holding magnets. Maryland Magnet.

CB Crystals 402

A 32-page booklet is available to aid technicians in determining the correct identification of supplemental crystals for CB sets. The booklet contains a classification of crystal frequencies by channel number. It also cross references transceiver model numbers and crystal numbers. Shepherd Industries.

Fan Mockup 403

A three-dimensional actual-size mockup of a fan for cooling low-profile instrumentation is available. The

mockup can serve as a guide to the user of an existing instrument that requires cooling. Rotron.

Speakers 404

Dual-cone and three-way speakers are described in a 4-page bulletin. Pre-finished enclosure kits are also included Electro-Voice.

Photoelectric Equipment 405

Photoelectric equipment for an assortment of control applications is discussed in a 22-page booklet. Manufacturing techniques are also indicated. Photomation.

Photoelectric Components 406

Retro-reflective photo controls, miniature specular and retro-reflective scanner heads, sensitive transistor ON/OFF and time delay controls, photo-controls with solid state switching and high speed counting eyes are described in a 7-page catalog. Autotron.

Photoelectric Controls 407

A line of transistorized photoelectric controls are described in a 20-page catalog. Included are plug-in logic modules, photoelectric counters, retro-reflective scanners and conveyor controls. Farmer Electric.

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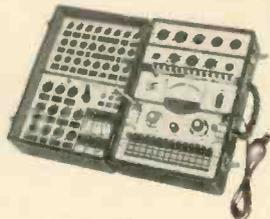


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ELECTRONIC TECHNICIAN



Photosensitive Components 408

Photosensitive devices for controlling exterior lighting is discussed in this bulletin. Precision Multiple.

Semiconductor Catalog 409

A 60-page illustrated catalog describes SCRs, triac ac switches, integrated and hybrid circuits, transistors, diodes, rectifiers, assemblies, injection lasers, light-activated SCRs, photo transistors, microphoto diodes, and light-emitting diodes. G-E.

Hand Tools 410

A 12-page catalog describes an assortment of pliers, nippers, scissors and tweezers for microelectronic use. Henry Mann.

Hi-Fi Merchandising 411

A brochure lists a line of fixtures, racks, stands, displays, and holders for properly presenting amplifiers, tuners, receivers, tape recorders, phonographs, speakers, microphones, TV, cabinets, antenna and other related Hi-Fi and music merchandise. Reflector Hardware.

Photoelectric Controls 412

Transistorized photoelectric controls are described in a 10-page catalog. A description of several accessory units for these controls are included. G-E.

Coils and Transformers 413

A 154-page replacement guide lists power transformers, reactors, audio transformers, RF and IF transformers and coils, chokes, flyback transformers and yokes. It lists these parts according to the make and model of the equipment being repaired. It also contains diagrams and specifications of some of the components. In addition, a 16-page competitive cross-reference guide is included. Merit.

TV Antennas 414

A 12-page catalog lists an assortment of antennas for UHF/VHF/FM reception. Antenna preamplifiers are also included. Winegard.

Color-TV Crystals 415

A line of replacement crystals for color-TV sets is described in this catalog. Each crystal in the line is produced to the specifications of the original set manufacturer, thus assuring technicians of an exact replacement in both physical and electrical specifications. International Rectifier.

Periodic Antenna 416

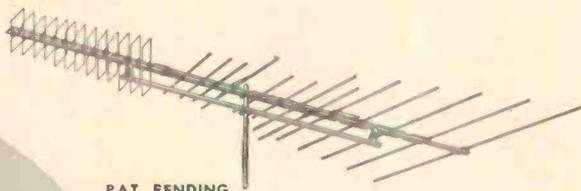
Log periodic design is discussed in a four-page bulletin describing a line of TV antennas. Blonder-Tongue.

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BOOK REVIEWS

TV TUBE SYMPTOMS AND TROUBLES. By Robert G. Middleton. Published by Howard W. Sams & Co., 96 pages, soft cover, \$1.95.

This book is based on the principle that defective tubes cause the majority of TV receiver troubles. The specific tube at fault can be detected by recognizing the picture and sound symptoms. Block diagrams show the functional arrangement of TV receivers to assist in locating tubes. A chart of symptoms and pages of photographs showing defective picture tube images assist in identifying the tube at fault. This book should be of value to technicians who are just learning TV servicing.

ALTERNATING CURRENT—CIRCUITS AND MEASUREMENTS. By Charles J. Anderson, Anthony Santanelli and Fred R. Kulis. Published by Prentice-Hall, Inc., 368 pages, hard cover. \$12.

This book is a companion volume to **DIRECT CURRENT CIRCUITS**

AND MEASUREMENTS also reviewed in this issue of **ELECTRONIC TECHNICIAN**. The volume begins with a discussion of magnetic materials—magnetic attraction, repulsion, flux density and reluctance. It then continues by discussing electromagnetism—the left-hand rule to determine polarity and the motion of a current-carrying conductor through a magnetic field. This leads into a discussion of the interaction of the primary and secondary flux in a transformer. The concept of self-inductance is developed from the concept of mutual inductance. The motion of a rotating conductor cutting flux lines of a magnetic field helps the reader to understand sinewaves. Following this is a discussion of inductive reactance to currents of various alternating frequencies. Vectors are used to determine phase shift of currents passing through circuits containing inductors and resistors. The reactance of capacitors to various alternating current frequencies is developed in a similar manner. This leads to a discussion of series and parallel resonance circuits. The book concludes with a discussion of resonant filter circuits. This programmed text should help both apprentice and advanced electronics technicians to obtain a more thorough understanding of the circuits they will

be working on. It should also prove to be an excellent review for experienced technicians who have forgotten some of the fundamentals or for those who wish to add depth to their understanding of circuits.

FUNDAMENTALS OF TRANSISTORS. By the Technical Training Staff, RCA Service Co. Published by Prentice-Hall, Inc., 223 pages, hard cover. \$10.00

This volume has the unusual feature of testing the reader at the end of each paragraph so he can determine if the material was skimmed too lightly. Though this method of writing does slow down the reading speed, it helps to prevent the reader from overlooking important information needed for the proper understanding of further explanations. The free electron-hole theory of transistors is discussed without going into the exact chemistry of semiconductor material. Even an uneven distribution of electrons and holes, as a result of applied voltages, are used to explain p-n junctions. This explanation seems easier to understand than the potential hill theory so frequently used by authors. Potential hills in p-n junctions are mentioned, however. Nonlinear volt ampere characteristics of p-n junctions are described

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and plotted for both forward and reverse biasing. The ability of currents to flow despite the reverse biasing of the base-to-collector junction is explained. Emitter, base and collector current relationships are discussed. The principles of transistor amplification are developed from this discussion. Biasing circuits and special circuits to compensate for temperature changes in transistors are included. This book should prove valuable to both the apprentice and experienced technician and provide them with a basic understanding of transistors.

DIRECT CURRENT CIRCUITS AND MEASUREMENTS. By Charles J. Anderson, Anthony Santanelli & Fred R. Kulis. Published by Prentice-Hall, Inc., 338 pages, hard cover. \$12.00.

This programed text covers the basic fundamentals of direct current and its measurement. Beginning with the attraction of static charges, the book progresses through electron valences, electromotive forces, charged dielectrics and free-electron current flow. Using the principles of Kirchhoff's First Law (At any point in a circuit, there is as much current flowing away from that point as flows toward it.) and Kirchhoff's Second

Law (In any closed circuit the applied voltage is equal to the sum of the voltage drops around the circuit.), the book discusses resistors and batteries in series and parallel circuits and the resulting currents that flow through these circuits. The book shows how to simplify such circuits and calculate circuit component values. Basic meter reading and resistor color codes are also covered. This book may be of value to the apprentice who does not know how to determine the values of resistors and currents encountered in basic circuits or why electricity flows through circuits.

SEMICONDUCTORS . . .

continued from page 65

sistor (R_1). The resistance of the thermistor decreases as the temperature increases. As its resistance decreases, it conducts more current (I_T) and causes a greater voltage drop to occur across the base resistor (R_B). This reduces the forward bias of the base (V_{EB}) and stabilizes the circuit. The thermo characteristics of the transistor and any one thermistor are similar over only a limited range of temperatures. The

selection of a thermistor must depend on the temperature range.

Since both transistors and diodes are made of PN junctions, their reaction to temperatures should be relatively similar and shift in the same direction and magnitude. A diode (D) has a slight resistance to a forward biasing current and can be substituted for the thermistor

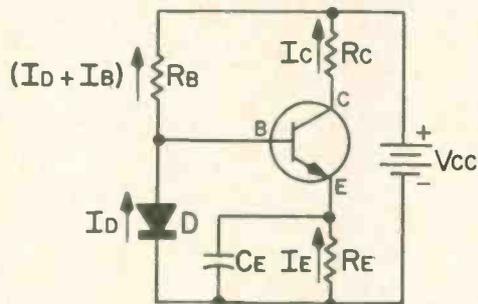
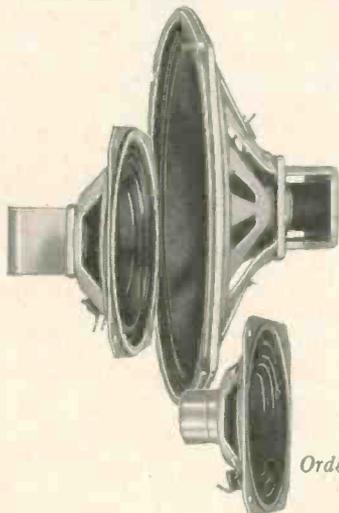


Fig. 11—Diodes compensate for relatively large temperature changes in transistors.

(R_T) in the circuit (Fig. 11) to determine the bias voltage (V_{EB}). As the temperature increases, the bias voltage decreases and stabilizes the circuit.

The next article will discuss specific transistors, voltages and component values in solid-state circuits. ■

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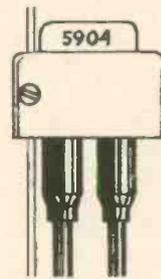
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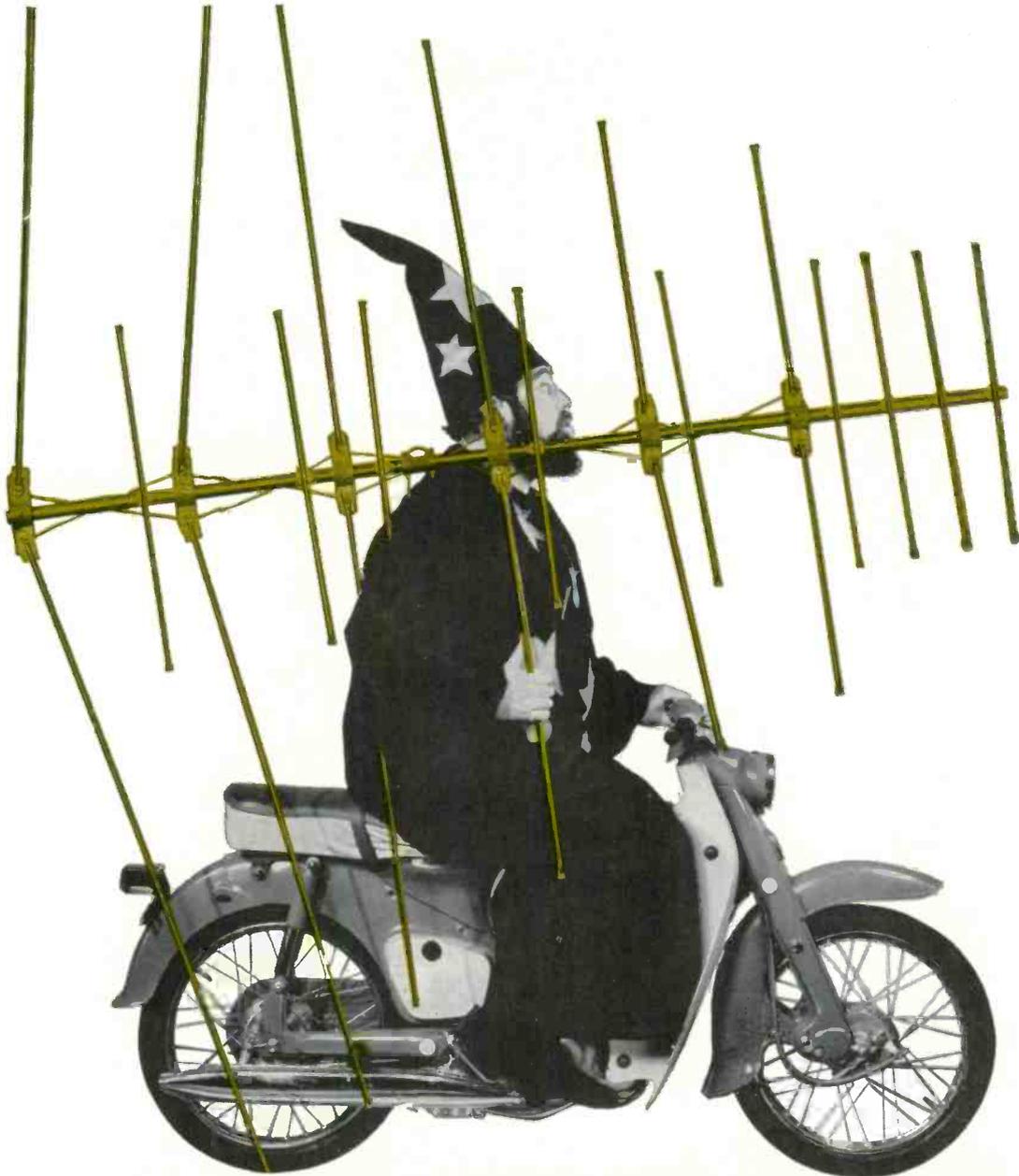
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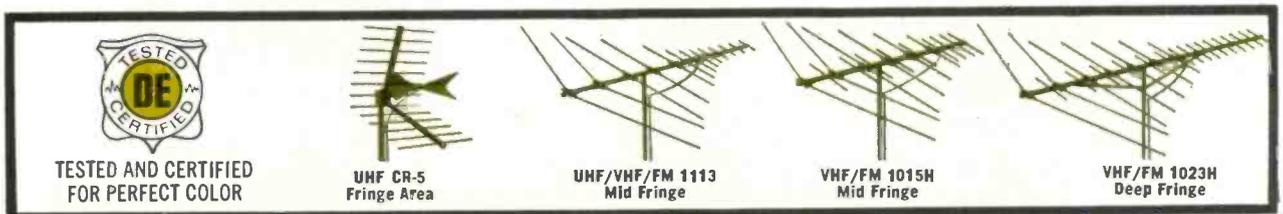
MULTICORE SALES CORP. WESTBURY, N.Y. 11591

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CHARGE INTO COLOR WITH GAVIN GOLD CREST

Concerned about color? Now Gavin conquers it. Captures it. With Color Antennas so new... so ahead of the rest... each bears a new, bold Gold Crest. Only Gavin tests and certifies each antenna for perfect color! For greatest gain. For best match. For lighter weight... with *five times* the strength. Charge into color with confidence. With the best. With new Gavin... Gold Crest.



TESTED AND CERTIFIED
FOR PERFECT COLOR

UHF CR-5
Fringe Area

UHF/VHF/FM 1113
Mid Fringe

VHF/FM 1015H
Mid Fringe

VHF/FM 1023H
Deep Fringe

PUT A RAINBOW ON ANY ROOF...ANYWHERE

DISTRIBUTORS: Write for franchise information



GAVIN INSTRUMENTS, INC. SOMERVILLE, N. J.

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Are you offering *today's color?*



RCA Hi-Lite color picture tubes bring OEM quality to your replacement tube customers

Odds are that when you're called to replace a customer's color picture tube and you replace it with an RCA Hi-Lite, you're giving him a better product than he had when his set was new.

● That's because RCA Hi-Lite picture tubes are RCA's best... the same quality... the same tubes... that go into today's original equipment sets. RCA Hi-Lites are all-new... glass, gun, the works! And incorporate the continued advancements in picture tube technology achieved by the world's leading color picture tube manufacturer. So you literally "up-date" your customer's color set when you install one.

Here's picture brightness and color fidelity at its finest, available for the service trade in 19-inch and 25-inch rectangular and 21-inch round tube types.

How about you? Are you offering your customers today's color?

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



The Most Trusted Name in Electronics