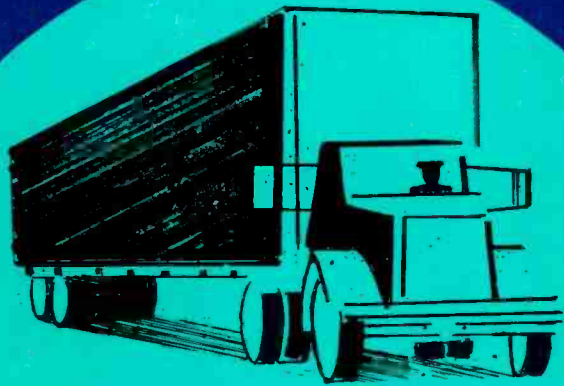


# PF Reporter®

PHOTOFACT

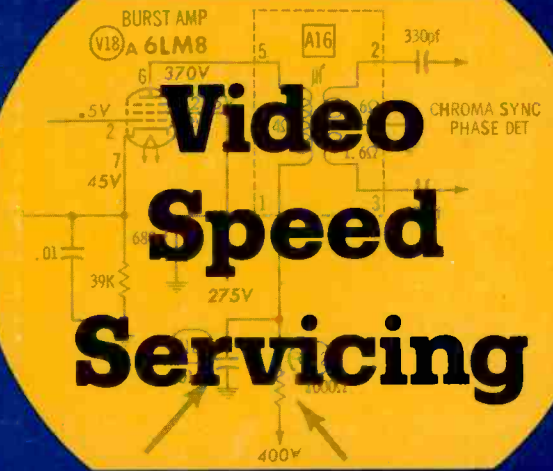
*the magazine of electronic servicing*

## Time to Move?



## Color Tv Service Training

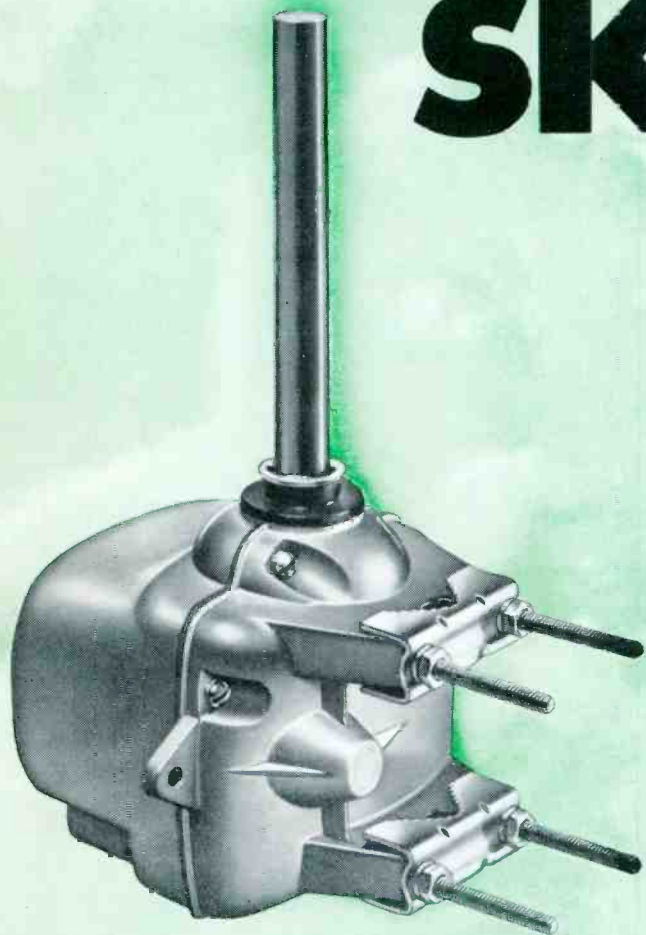
## Video Speed Servicing



IA 7J 117 570  
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- Annual Index
- The Troubleshooter
- Color Countermeasures
- Notes on Test Equipment
- Tube Substitution Supplement

# Help stamp out green sky



**CDE's Skyline series rotor helps give the truest urban/suburban color TV reception!**

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Available for automatic operation, the Skyline series rotor means the very best in color and black and white TV reception. Goes great with FM rigs, too!



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Circle 1 on literature card

# ANNUAL INDEX

The following code of symbols is used to identify regular department locations in the subject page listings: CCM, Color Countermeasures; Sym, Symfact®; TE, Notes on Test Equipment; TS The Troubleshooter; and VSS, Video Speed Servicing.

## AGC

- Color receiver, circuitry in .....Sep 51
- Filter capacitor, shorted causes video overload, Admiral Chassis G-1263-1 .....VSS Feb 6
- Forward keyed transistor system, analysis of ..... Oct 4
- Keyed systems ..... Dec 30
  - hybrid designs ..... Dec 33
  - noise-cancelling effects ..... Dec 31
  - servicing procedures ..... Dec 31
  - transistor circuits ..... Dec 33
- Overload picture on strong signal, Motorola Chassis TS-912 .....VSS Jul 14
- Transistor TV, employed in ..... Jun 62

## ANTENNAS

- Installing for color ..... Apr 60
- Lead-in ..... Feb 24
- Selling ..... Apr 58

## AUDIO SYSTEMS

- Equipment for servicing ..... Mar 20
  - AC VTVM ..... Mar 20
  - books concerning ..... Mar 22
  - distortion analyzers ..... Mar 21
  - phase checker ..... Mar 22
  - signal generator ..... Mar 20
  - wattmeter ..... Mar 22
- High-quality systems, servicing ..... Aug 32
  - components ..... Aug 32
  - distortion measurement ..... Aug 38
  - frequency response ..... Aug 58
  - sensitivity measurement ..... Aug 38
  - separation measurement ..... Aug 58
  - system analysis ..... Aug 33
  - tuner bandpass measurement ..... Aug 38
  - turntable tests ..... Aug 60
- Intercom and music distortion systems, installing ..... Dec 24

## AUTO RADIOS

- High end of band inoperative when receiver installed in car, Pontiac Model 983873 .....TS Jun 56

## BOOK REVIEWS

- Audio Amplifier Design ..... Dec 62
- Communications Electronics Circuits ..... Jan 37
- Directory of Electronic Circuits ..... Jun 54
- Electricity One through Electricity Seven ..... May 60
- Electron Tubes ..... Feb 18
- FET Circuits ..... Dec 36
- How to Build Speaker Enclosures ..... Mar 77
- Power Supplies for Electronic Equip-

- ment ..... Jul 53
- Single Sideband: Theory and Practice ..... Oct 41
- Transistor Basics: A short course Aug 72
- Understanding UHF Equipment ..... Sep 42

## BUSINESS

- Advertising, measuring the results of ..... Aug 44
  - attitude advertising, testing ..... Aug 49
  - immediate response ads, tests for ..... Aug 47
  - information concerning ..... Aug 51
  - planning ..... Aug 45
  - repeat ..... Aug 49
  - results expected ..... Aug 45
  - using several media ..... Aug 50
- Credit procedures, proper handling of ..... Oct 52
- Depreciation reserves for equipment, computing ..... Jan 26
- Electronic service shop, operating a typical ..... Sep 37
- Legal services ..... Feb 30
  - antitrust problems ..... Feb 52
  - credit problems ..... Feb 54
  - disposing of business ..... Feb 54
  - inventory and other financing ..... Feb 48
  - laws affecting employees ..... Feb 50
  - litigation ..... Feb 54
  - organization of business ..... Feb 30
  - sources of information ..... Feb 56

## CAPACITORS

- Electrolytics in TV ..... May 27
  - defects and testing ..... May 27
  - filter defects ..... May 32
  - picture symptoms ..... May 32
  - primary filter circuits, in ..... May 28
  - scoping ..... May 32
  - secondary circuit applications ..... May 29

## CITIZENS BAND

- Shop, visit to ..... Apr 38

## COLOR COUNTERMEASURES

- Buzz in audio, Philco Chassis 16QT85 ..... Feb 58
- Color missing or intermittent, RCA Chassis CTC12, 15 ..... Nov 66
- Color sync critical, Magnavox Chassis T-918 ..... Sep 64
- Color sync poor, Sylvania Chassis D01 and D02 ..... Oct 62
- Color weak, indicator light goes out when color control turned up (Motorola Chassis TS-914) ..... Jan 68

- Contrast missing, raster and color signals remain on screen (RCA CTC11 chassis) ..... Mar 62
- Diathermy interference on high channels, Zenith Chassis 26KC20 Jan 68
- Extension cables for Zenith convergence panels, constructing ..... Apr 71
- Ghosts, evenly spaced, multiple ..... Oct 62
- Green screen on color, b-w normal (Zenith Chassis 24NC312 and 25NC38) ..... Oct 61
- Height lost, RCA Chassis CTC24 ..... Nov 66
- Horizontal and vertical sync intermittent, RCA Chassis CTC22 ..... Dec 53
- Horizontal bars of color on b-w and color programs, RCA Chassis CTC16, 17 ..... Nov 67
- Horizontal overscan of blue raster, Zenith Chassis 23XC36, 38 ..... Apr 71
- Hue changes when color level control is rotated, Zenith Chassis 23XC36, 38 ..... Apr 71
- Hue control action reversed, Zenith Chassis ..... Oct 62
- Ringling lines, diagonal (Philco Chassis 16M91) ..... Feb 58
- Screen temperature shifts to predominate hue after warmup, RCA Chassis CTC22 ..... Dec 54
- Tinted screen, varies with hue control setting (Magnavox Chassis T-918) ..... Sep 64
- Vertical jitter, RCA Chassis CTC24 ..... Nov 66
- Vertical retrace lines, Zenith Chassis 23XC38 ..... Feb 58
- Width insufficient
  - General Electric CB chassis ..... Jan 68
  - RCA Chassis CTC15 ..... Dec 53

## COLOR GENERATORS

- B & K Model 1242 ..... TE Jun 50
- Hickock Model GC660 ..... TE May 47
- Mercury Model 1900 ..... TE Mar 38
- RCA Model WR-64B ..... Sym Feb 37
  - normal operation ..... Sym Feb 37
  - troubles ..... Sym Feb 38
- Unijunction transistor employed in multivibrator circuit ..... TE May 46

## COLOR TV

- Bar of color creeps up screen, RCA Chassis CTC15 ..... May 23
- Blobs of color, sync unstable (Sylvania DO5 Chassis) ..... May 55
- Blooming, Emerson Chassis 120699 ..... VSS Feb 8
- Blue and yellow fringing on

- horizontal edges of b-w picture .....Sym Mar 48
- Blue and yellow fringing on horizontal edges of b-w picture information .....Sym Mar 46
- Brightness missing, Emerson Chassis 120699 .....VSS Feb 8
- Brightness reduced  
—Emerson Chassis 120699 VSS Feb 8  
—Motorola Chassis TS-908 .....VSS May 10  
—screen control operation reversed, Motorola Chassis TS-908 .....VSS May 9
- Buzz in audio, Philco Chassis 16QT85 .....CCM Feb 48
- Chroma circuitry, new for 68 .....Nov 8
- Chroma oscillator, operation of .....Sym Apr 51
- Color in b-w program, off-channel snow is confetti .....Sym Jun 32
- Color intermittent, b-w normal  
—Admiral Chassis G1263-1 .....VSS Feb 5  
—Olympic Chassis CTC-15/U .....VSS May 12
- Color killer, operation of .....Sym Jun 31
- Color level control must be advanced when switching from strong to weak station ..Sym Jun 34
- Color missing  
—generator produces 10 green bars .....Sym Apr 52  
—misadjusting color killer produces out-of-sync color .....Sym Apr 53  
—Motorola Chassis TS-912 .....VSS Jul 13  
—or intermittent, RCA Chassis CTC12, 15 .....CCM Nov 66  
—or weak, Motorola Chassis TS-912 .....VSS Jul 13  
—poor vertical sync, Admiral Chassis 25D6 .....TS Jul 52
- Color missing, b-w normal  
—Admiral Chassis G1263-1 .....VSS Feb 6  
—indicator light on at all times, Motorola Chassis TS-908 .....VSS May 10  
—Magnavox Chassis C/U45-01-00 .....VSS Mar 5  
—Magnavox Chassis C/U45-01-00 .....VSS Mar 6  
—Olympic Chassis CTC-15/U .....VSS May 11  
—Zenith Chassis, 24MC32, 42 .....VSS Mar 7  
.....Sym Apr 52  
.....Sym Jun 32
- Color signal, developing the  
Color sync  
—critical, Magnavox Chassis T-918 .....CCM Sep 64  
—intermittent, Magnavox Chassis C/U45-01-00 .....VSS Mar 6  
—intermittent, Zenith Chassis 24MC32, 42 .....VSS Mar 7  
—lost during commercials, Curtis Mathes Chassis CMC15 .....TS Aug 54  
—poor, Sylvania Chassis D01, D02 .....CCM Oct 62  
—troubles .....Jan 22  
—unstable, Truetone Model 2DC/663A .....VSS Jul 16
- Color temperature changes, Sylvania D03 chassis .....Apr 47
- Color weak  
—indicator light goes out when color control turned up, Motorola, Chassis TS-914 .....CCM Jan 68  
—on weak stations, sync unstable .....Sym Apr 54  
—or missing, hue control has no effect .....Sym Jun 33
- Colors incorrect due to phase error .....Sep 32  
—symptoms .....Sep 32  
—troubleshooting .....Sep 33
- Contrast lost, raster and color remain (RCA Chassis CTC11) .....CCM Oct 61
- Contrast missing, RCA Chassis CTC11 .....CCM Mar 62
- Convergence assembly .....Sym Mar 45
- CRT troubles .....Apr 20
- Diathermy interference, Zenith Chassis 26KC20 .....CCM Jan 68
- Extension cables for Zenith convergence panels, constructing .....CCM Apr 71
- Fine tuning control does not function correctly, Motorola Chassis TS-912 .....VSS Jul 14
- Focus poor, brightness low, width reduced (Motorola Chassis TS-908) .....VSS May 10
- Generator signal produces color but phase changes until sync or color is lost .....Sym Apr 54
- Ghosts, evenly spaced, multiple .....CCM Oct 62
- Green flashes on screen, intermittent, (RCA Chassis CTC 12) .....Apr 22
- Green screen on color, b-w normal (Zenith Chassis 24NC312) .....CCM Oct 61
- Green tint on b-w program, disappears after set warms up (Zenith Chassis) .....Apr 22
- Height lost, RCA Chassis CTC24 .....CCM Nov 66
- Horizontal and vertical sync intermittent, RCA Chassis CTC22 .....CCM Dec 53
- Horizontal bars of color on b-w and color programs, RCA Chassis CTC16, 17 .....CCM Nov 67
- Horizontal bars of wrong color drift through color picture, b-w normal .....Sym Apr 53
- Horizontal sync  
—drifts, Admiral Chassis G1263-1 .....VSS Feb 5  
—poor or intermittent raster, Motorola Chassis TS-912 .....VSS Jul 13  
—weak, RCA Chassis CTC25X .....TS Nov 59
- Horizontal tear and drift, Truetone Model 2DC1663A .....VSS Jul 16
- Horizontal tearing, vertical roll, Channel 3 beat (RCA Chassis CTC11D) .....TS Feb 66
- Hue changes with rotation of color level control, Zenith Chassis 23XC36, 38 .....CCM Apr 71
- Hue control action reversed, Zenith Chassis .....CCM Oct 62
- Hues unstable, Olympic Chassis CTC-15/U .....VSS May 12
- Killer control inoperative color weak .....Sym Jun 34
- Left side of raster purple, Motorola Chassis TS-908 .....VSS May 9
- Overloaded picture  
—Olympic Chassis CTC-15/U .....VSS May 11  
—on strong signal, Motorola Chassis TS-912 .....VSS Jul 14
- Overscan of blue raster, Zenith Chassis 23XC36, 38 .....CCM Apr 71
- Picture missing  
—both color and b-w, Zenith Chassis 24MC32, 42 .....VSS Mar 8  
—Truetone Model 2DC1663A .....VSS Jul 15
- Raster black, retrace lines, creeping bar of color (RCA Chassis CTC15) .....May 23
- Red and green vertical lines not converged on left of screen .....Sym Mar 74
- Red color component missing in b-w and color, Admiral Chassis G1263-1 .....VSS Feb 5
- Red excessive in color and b-w picture, Truetone Model 2DC1663A .....VSS Jul 15
- Red vertical fringing on b-w picture information .....Sym Mar 46
- Ringing lines, Philco Chassis 16M91 .....CCM Feb 58
- Ringing on left side of raster, Motorola Chassis TS-912 .....VSS Jul 14
- Screen temperature shifts to pre-dominate hue after warmup, RCA Chassis CTC22 .....CCM Dec 54
- Shadows superimposed on picture, increased contrast (RCA Chassis CTC11D) .....TS Jan 57
- Sheet-beam demodulator, operation of .....Jul 28
- 68 circuitry .....Dec 12  
—chroma circuitry .....Nov 8  
—CRT control circuits .....Dec 12  
—luminance circuits .....Dec 16  
—models and CRT sizes .....Nov 6  
—sound circuits .....Dec 23  
—sweep and high voltage .....Dec 20  
—tuning and indicator circuits Dec 44
- Smeared and out of focus picture, Olympic Chassis CTC-15/U .....VSS May 12
- Solid-state receivers, introduction to Motorola Chassis TS-915 and TS-919 .....Aug 40
- Sound and picture missing, Emerson Chassis 120699 .....VSS Feb 7
- Sweep alignment of color IF amplifiers .....Nov 41  
—double-tuned, two IF system Nov 52  
—input and detector pads .....Nov 44  
—stagger-tuned system .....Nov 50
- Tearing and overload of pictures, brightness reduced (Motorola Chassis TS-908) .....VSS May 9
- Tint control inoperative, b-w picture normal (Truetone Model 2DC1663A) .....VSS Jul 16
- Tinted rasters, defects causing .....Jul 44
- Tinted screen, varies with hue control setting (Magnavox Chassis T-918) .....CCM Sep 64
- Tuner AFC defects, symptoms associated with .....Sym May 42
- Vertical and horizontal hold poor, Magnavox Chassis C/U45-01-00 .....VSS Mar 6
- Vertical and horizontal sync missing, Emerson Chassis 120699 .....VSS Feb 7

Vertical defects ..... Nov 33	measurement of ..... Sep 13	Sync coupling, analysis of ..... Jul 40
—case histories ..... Nov 34		Tear and drift, Truetone Model
—height insufficient ..... Nov 33	<b>FILMENT CIRCUITS</b>	2DC1663A ..... VSS Jul 16
—horizontal white line ..... Nov 33	Thermistors, application of ..... Jul 30	Tearout caused by defective filter Jan 18
—intermittent troubles ..... Nov 34	<b>FM RADIO</b>	Twist, post-video (Trav-ler Chassis
—rolling ..... Nov 34	FM reception noisy, AM and phono	740-78) ..... TS Aug 54
Vertical drift, Magnavox Chassis	normal, (RCA Chassis	Unstable ..... Sep 16
C/U45-01-00 ..... VSS Mar 5	RC-1227B) ..... Oct 34	Weak, RCA Chassis CTC25X TS Nov 59
Vertical jitter	Color coding of oscillator and IF	<b>HUM</b>
—Admiral Chassis	transformer adjustments ..TS Apr 65	Until raster appears, Zenith Chassis
G1263-1 ..... VSS Feb 6	Hissing sound on FM, AM normal	15L22 ..... TS May 58
—RCA Chassis CTC24 CCM Nov 66	(Truetone Model	<b>IF SECTION OF TV</b>
Vertical red and green edging	4DC-5665A) ..... Oct 32	Troubleshooting with oscilloscope Apr 4
over entire screen during	Troubleshooting methods ..... Jun 40	—ground circuit difficulties ..... Apr 6
b-w program ..... Sym Mar 47	—case histories ..... Jun 44	—hum in IF signal ..... Apr 5
Vertical red lines displaced to	—noise generators ..... Jun 40	—low contrast versus stage gain Apr 5
right on sides, left in	—signal generators ..... Jun 40	—picture pulling or loss of sync Apr 5
middle ..... Sym Mar 48	—transistor checking ..... Jun 41	—poor picture quality ..... Apr 4
Vertical retrace lines, Zenith	<b>GUIDES</b>	<b>INDUSTRIAL ELECTRONICS</b>
Chassis 23XC38 ..... CCM Feb 58	Source guide to imports ..... Feb 28	Basic circuits ..... Jan 45
Vertical roll, intermittent,	TV Tube Stock Guide ..... Apr 24	—anti-chatter relay ..... Jan 45
(Olympic Chassis	<b>HIGH VOLTAGE</b>	—dual primary transformer ..... Jan 45
CTC-15/U) ..... VSS May 11	Color TV, circuitry employed in ..Oct 22	—load positioning control ..... Jan 48
Vertical sweep insufficient,	Missing, along with boost and raster	—manual/automatic control
bottom compressed (Zenith	(Zenith Chassis 14M20) ..TS Oct 48	circuits ..... Jan 45
Chassis 24MC32, 42) ... VSS Mar 8	Solid-state	—modulated-light photorelay ..... Jan 46
Vertical sweep missing, Magnavox	—operational analysis ..... Sep 9	—self-latching relay ..... Jan 50
Chassis C/U45-01-00 ..... VSS Mar 5	—symptom analysis ..... Sep 12	—shockover capacitor ..... Jan 46
Vertical sync poor	—troubleshooting procedure ..... Sep 11	—thermocouple break
—foldover and retrace lines at	<b>HORIZONTAL OUTPUT TRANSFORMERS</b>	protection ..... Jan 49
top, Emerson Chassis	Arcing from secondary to iron	—voltage regulation ..... Jan 46
120699 ..... VSS Feb 7	core ..... TS Mar 60	Circuit descriptions and functions Apr 28
—Zenith Chassis 24MC32,	Overheating, Zenith Chassis	—bin-level control ..... Apr 32
42 ..... VSS Mar 8	16E25 ..... TS Jun 56	—chopper amplifier ..... Apr 36
Video amplifier defects, effects	<b>HORIZONTAL SWEEP</b>	—conductivity meter ..... Apr 32
on color ..... May 23	Circuit action, sequence of ..... Sep 11	—differential transformer ..... Apr 28
Width reduced	Flyback overheating, Zenith	—energy-storage welding ..... Apr 30
—after set operates for extended	Chassis 16E25 ..... TS Jun 56	—flame-failure safeguard ..... Apr 33
period, Truetone Model	Horizontal output tube overheats,	—infrared pyrometer ..... Apr 36
2DC1663A ..... VSS Jul 15	Admiral Chassis 1601 ..... TS Feb 66	—nixie readout ..... Apr 32
—General Electric CB	Output circuit employed in color	—phase-controlled rectifier ..... Apr 28
chassis ..... CCM Jan 68	receivers ..... Oct 22	—photomultiplier ..... Apr 56
—RCA Chassis CTC15 ..CCM Dec 53	Solid-state	—saturable reactor ..... Apr 30
<b>COLOR TV SERVICE TRAINING</b>	—operational analysis ..... Sep 9	—ultrasonic sensor ..... Apr 33
AGC and sync ..... Sep 51	—symptom analysis ..... Sep 12	<b>INTERFERENCE</b>
Bandpass, receiver ..... Sep 46	—troubleshooting procedure ..... Sep 11	Diathermy on higher channels,
Chroma circuits ..... Nov 20	Transistor TV, employed in ..... Jun 39	Zenith Chassis
—ACC ..... Nov 31	Reduced	26KC20 ..... CCM Jan 68
—bandpass amplifier ..... Nov 24	—brightness low, focus poor	TVI traps, setting ..... TS Jun 56
—chroma demodulation ..... Nov 24	(Motorola Chassis	<b>INTERMITTENT TROUBLES</b>
—color difference amplifiers ..... Nov 28	TS-908) ..... VSS May 10	Collapsed raster, Admiral Chassis
—color killer ..... Nov 31	—General Electric CB	G13 ..... Nov 35
—reference oscillator ..... Nov 28	Chassis ..... CCM Jan 68	Color intermittent, b-w normal
Developing the color signal ..... Aug 23	—RCA Chassis CTC15 ..CCM Dec 53	—Admiral Chassis
—chrominance signal ..... Aug 24	—solid-state circuitry, in ..... Sep 14	G1263-1 ..... VSS Feb 5
—composite color signal ..... Aug 25	—Truetone Model	—Olympic Chassis
—luminance signal ..... Aug 23	2DC1663A ..... VSS Jul 15	CTC-15/U ..... VSS May 12
—video spectrum ..... Aug 27	<b>HORIZONTAL SYNC</b>	Color, RCA Chassis
Horizontal AFC and oscillator ..... Oct 20	Color TV, circuits employed in ..... Oct 19	CTC12, 15 ..... CCM Nov 66
Horizontal output and high-voltage	Drift, Admiral Chassis	Color sync
circuits ..... Oct 22	G1263-1 ..... VSS Feb 5	—Magnavox Chassis C/U45-
Horizontal phase detector ..... Oct 19	Poor, or intermittent raster	01-00 ..... VSS Mar 6
Luminance circuits ..... Sep 51	(Motorola Chassis	—Zenith Chassis
Power supply ..... Sep 54	TS-912) ..... VSS Jul 13	24MC32, 42 ..... VSS Mar 7
Sound IF and audio ..... Sep 49	Quivers, Westinghouse Chassis	Green flashes on screen, RCA
Tuners ..... Sep 46	V-2233-4 ..... Jan 17	Chassis CTC12 ..... Apr 22
Vertical deflection circuitry ..... Oct 17	Servicing, general information ..... Jul 42	Height, Admiral Chassis D11 ..... Nov 37
Video IF amplifiers and detector ..... Sep 47	Solid-state circuitry ..... Aug 11	Horizontal and vertical sync, RCA
<b>CRT TESTERS</b>	—common troubles ..... Aug 12	Chassis CTC22 ..... CCM Dec 53
B & K Model 465 ..... TE Jul 49	—DC voltage distribution ..... Aug 11	Horizontal quiver, Westinghouse
Hickock Model CR 35 ..... TE Sep 58		Chassis V-2233-4 ..... Jan 17
SENCORE Model CR 13 ..... TE Dec 40		
SENCORE Model CR 143 ..... TE Aug 52		
<b>DIODES</b>		
Forward and reverse resistances,		

Raster intermittent or poor horizontal sync, Motorola Chassis TS-912	VSS Jul 13
Reduced raster, RCA Chassis CTC19	Nov 34
Vertical roll	
—caused by video signal distortion	Jan 20
—Crosley Model 487	Jan 19
—Olympic Chassis CTC 15/U	VSS May 11
—Philco Chassis 17MT80	Nov 37
Vertical sweep, Admiral Chassis 21B1	TS May 58
Vertical sync, RCA Chassis KCS68	Jan 18
Volume weak on right channel, RCA Model VGP82	Jun 47

#### MISCELLANEOUS

Adapting extension cable to fit octal plug	May 39
Electronic cables	Feb 19
—characteristics	Feb 19
—handling techniques	Feb 21
—high fidelity	Feb 23
—installation techniques	Feb 22
—television lead-in	Feb 24
Organ servicing, getting started in	May 25
Symbol standardization	Jan 1

#### NOTES ON TEST EQUIPMENT

Amphenol Model 870 FET Voltmeter	Oct 28
B & K Model 465 CRT Tester	Jul 49
B & K Model 1242 Color Generator	Jun 50
Hickock Model CR 35 CRT Tester	Sep 58
Hickock Model GC 660 Color Generator	May 47
Hickock Model 860 Injecto-Tracer	Aug 52
Lectrotech Model TT-250 Transistor Analyzer	Nov 39
Mercury Model 1900 Color Generator	Mar 38
Precision Model E-200-C RF Generator	Feb 34
Seco Model HC8 In-Circuit Current Checker	Nov 40
Seco Model 107-C Tube Tester	Jul 50
Semitron Model 1000 Transistor Tester and Set Analyzer	Mar 39
SENORE Model CR13 CRT Tester/Rejuvenator	Dec 40
SENORE Model CR 143 CRT Tester	Aug 52
SENORE Model MP-140 Tube Tester	Apr 44
Triplett Model 600 FET Meter	Dec 44
Unijunction transistor multivibrator used in color generators	May 46

#### OSCILLOSCOPES

Advantages and limitations of IF section, using to signal trace in	Apr 4
Probes used with	Mar 28
—applications	Mar 59
—capacitance divider	Mar 56
—combination isolating and direct	Mar 30
—demodulator probe	Mar 44
—direct probe	Mar 28
—low-capacitance probes	Mar 42

TV tuner, using to troubleshoot	Apr 1
Video amplifier, using to signal trace in	Apr 7

#### PICTURE SYMPTOMS

Barkhausen line	Sep 16
Blobs of color on screen, sync unstable (Sylvania Chassis DO5)	May 55
Blue and yellow fringing on horizontal edges of b-w picture information	Sym Mar 46
Brightness missing, Emerson Chassis 120699	VSS Feb 8
Brightness reduced	
—Emerson Chassis 120699	VSS Feb 8
—Motorola Chassis TS-908	VSS May 10
—screen control operation reversed, Motorola Chassis TS-908	VSS May 9
Color bar creeps up screen, no color on rest of screen (RCA Chassis CTC15)	May 23
Color in b-w program, off-channel snow is confetti	Sym Jun 32
Color intermittent, b-w normal	
—Admiral Chassis G1263-1	VSS Feb 5
—Olympic Chassis CTC-15/U	VSS May 12
Color missing	
—misadjusting color killer produces out of sync color	Sym Apr 53
—Motorola Chassis TS-912	VSS Jul 13
—on station signal, generator produces 10 green bars	Sym Apr 52
—or intermittent, RCA Chassis CTC12, 15	CCM Nov 66
—or weak, Motorola Chassis TS-912	VSS Jul 13
—poor vertical sync, Admiral Chassis 25D6	TS Jul 52
Color missing, b-w normal	
—Admiral Chassis G1263-1	VSS Feb 6
—indicator light on at all times, Motorola Chassis TS-908	VSS May 10
—Magnavox Chassis C/U45-01-00	VSS Mar 5
—Magnavox Chassis C/U45-01-00	VSS Mar 6
—Olympic Chassis CTC-15/U	VSS May 11
—Zenith Chassis 24MC32, 42	VSS Mar 7
	Sym Apr 52
	Sym Jun 32
Color overloads when switching from weak to strong station	SYM Jun 34
Color sync	
—critical, Magnavox Chassis T-918	CCM Sep 64
—intermittent, Magnavox Chassis C/U45-01-00	VSS Mar 6
—intermittent, Zenith Chassis 24MC32, 42	VSS Mar 7
—lost during commercials, Curtis Mathes Chassis CMC15	TS Aug 54
—poor, Sylvania Chassis D01 and D02	CCM Oct 62
—unstable, Truetone Model	

2DC1663A	VSS Jul 16
Color temperature shifts, Sylvania D03 chassis	Apr 47
Color weak, killer control inoperative	Sym Jun 34
Color weak, Motorola Chassis TS914	CCM Jan 68
Color weak on weak stations, sync unstable	Sym Apr 54
Color weak or missing, hue control has no effect	Sym Jun 33
Colors incorrect, b-w normal	Sep 32
Contrast lost	
—raster and color remain, RCA Chassis CTC11	CCM Oct 61
—RCA Chassis CTC11	CCM Mar 62
Contrast low	Apr 5
Definition poor, caused by defect in video amplifier	Apr 8
Electrolytic capacitor failures, caused by	May 30
Focus lost when antenna disconnected or brightness control adjusted from 3/4 to maximum, Admiral Chassis 1G1155-1	TS Aug 55
Focus poor, brightness low, width reduced (Motorola Chassis TS-908)	VSS May 10
Ghosts, evenly spaced, multiple	CCM Oct 62
Green flashes on screen, intermittent, (RCA Chassis CTC12)	Apr 22
Green screen on color, b-w normal (Zenith Chassis 24NC31,Z)	CCM Oct 61
Green tint on b-w program disappears after set warms up (Zenith Chassis)	Apr 22
Horizontal bars of color on b-w and color programs, RCA Chassis, CTC16, 17	CCM Nov 67
Horizontal bars of wrong color drift through color picture, b-w normal	Sym Apr 53
Hue changes with rotation of color level control, Zenith Chassis 23XC36, 38	CCM Apr 71
Hue control action reversed, Zenith Chassis	CCM Oct 62
Hue unstable, Olympic Chassis CTC-15/U	VSS May 12
Hum bar	Apr 5
Left side of raster purple, Motorola Chassis TS-908	VSS May 9
Muddy and filled up, caused by defect in video amplifier	Apr 7
Overload on strong signal, Motorola Chassis TS-912	VSS Jul 14
Overloaded picture, Olympic Chassis CTC-15/U	VSS May 11
Picture and sound missing, Emerson Chassis 120699	VSS Feb 7
Picture missing	
—both b-w and color, Zenith Chassis 24MC32, 42	VSS Mar 8
—Truetone Model 2DC1663A	VSS Jul 15
Poor picture quality	Apr 4
Ringling and circuit ghosts caused by defects in video amplifier	Apr 8
Red and green vertical lines not converged on left of screen	Sym Mar 47
Red color component missing in	

b-w and color, Admiral Chassis  
G1263-1 ..... VSS Feb 5

Red excessive in color and b-w  
picture, Truetone Model  
2DC1663A ..... VSS Jul 15

Red vertical fringing on b-w  
picture information ..... Sym Mar 46

Ringing caused by IF regen-  
eration ..... Apr 4

Screen temperature shifts to pre-  
dominate hue after warmup,  
RCA Chassis CTC22 ..... CCM Dec 54

Shadows filter across screen, in-  
creased contrast (RCA  
Chassis CTC11D) ..... TS Jan 57

Single 2" bar of color, rest of  
screen black (RCA Chassis  
CTC 15) ..... May 23

Smearred and out of focus,  
Olympic Chassis  
CTC-15/U ..... VSS May 12

Sweep alignment, indicating need  
for ..... June 5

Tearing and overload, brightness  
reduced (Motorola Chassis  
TS-908) ..... VSS May 9

Tinted screen, varies with hue  
control setting (Magnavox  
Chassis T-918) ..... CCM Sep 64

Trap off frequency in video IF,  
effect of ..... Jun 10

Tuner AFC defects, associated  
with ..... Sym May 42

Twist and bends caused by elec-  
trolytic filter defects ..... May 30

Twist, post video (Trav-ler Chassis  
740-78) ..... TS Aug 54

Vertical red and green edging  
over entire screen during b-w  
program ..... Sym Mar 47

Vertical red lines displaced to  
right on sides, left in  
middle ..... Sym Mar 48

Video and audio disappear, Philco  
Chassis 14N50 ..... TS Dec 55

Video missing, sound poor  
(General Electric Chassis  
AY) ..... TS May 57

Video overload on strong signals,  
Admiral Chassis  
G1263-1 ..... VSS Feb 6

Weak reception on all channels,  
heavy snow, distorted sound  
(Motorola Chassis  
TS-408A) ..... TS Apr 63

#### PICTURE TUBES

Arcing at anode connection, Olympic  
Model 6P25 ..... TS Apr 65

Defects, pinpointing ..... Apr 20

Filament burned open, Motorola  
Chassis 534D-13 ..... TS May 59

Green tint on b-w program dis-  
appears after set warms up  
(Zenith Chassis) ..... Apr 22

Heater to cathode short causes loss  
of contrast, RCA Chassis  
CTC11 ..... CCM Mar 62

Impurities, permanent ..... Apr 22

Intermittent green flashes on screen  
caused by bad CRT, RCA  
CTC12 chassis ..... Apr 22

Spot elimination circuit employed  
in Admiral H5 chassis ..... Oct 6

Substitution, RCA Chassis  
72A ..... TS Apr 63

#### POWER SUPPLIES

Color receivers, used in ..... Sep 54

Electrolytic capacitor applica-  
tions ..... May 28

Twists and bends, defects causing May 31

#### PREVIEWS OF NEW SETS

Admiral Model LKS6511M, Chassis  
1H1298-2 ..... Mar 1

Airline Model GHJ7537B, Chassis  
913-179466 ..... May 5

Emerson Model 23T02, Chassis  
120844A ..... Mar 2

General Electric Model M980CWD,  
Chassis KC ..... May 6

Magnavox Model 30U505K, Chassis  
V918-01-BB ..... Feb 1

Motorola Model CTC606CN, Chassis  
20TS-918A-00 ..... Feb 2

Motorola Model XP201CU, Chassis  
9TS-460A-09 ..... Jul 9

Packard Bell Model CSW-606,  
Chassis 98C15 ..... Mar 3

Philco-Ford Model 85506SEA,  
Chassis 17MT80B ..... Mar 4

Pilot Model C309 ..... May 7

RCA Model AJ-00E, Chassis  
KCS157A ..... Jul 10

RCA Model GH784H, Chassis  
CTC21C ..... Feb 3

Sears Model 7160, Chassis  
562.10220 ..... Jul 11

Sylvania Model 19TC14-1, Chassis  
D05-1 ..... May 8

Zenith Model X4541W, Chassis  
20X1C36 ..... Jul 12

Zenith Model 25X6547M, Chassis  
23XC36 ..... Feb 4

#### RADIO

Sound reduced on lower frequencies,  
General Electric Model  
C403G ..... TS Feb 66

#### RASTER (FAULTS)

Barkhausen lines ..... Sep 16

Black raster, retrace lines, small  
creeping bar of color (RCA  
Chassis CTC15) ..... May 23

Blooming  
—causes of in solid-state  
circuits ..... Sep 15  
—Emerson Chassis 120699 ..... VSS Feb 8

Boost, high voltage, and raster  
missing (Zenith Chassis  
14M20) ..... TS Oct 48

Brightness reduced  
—Motorola Chassis  
TS-908 ..... VSS May 10  
—screen control operation  
reversed, Motorola Chassis  
TS-908 ..... VSS May 9  
—tearing and overload, Motorola  
Chassis TS-908 ..... VSS May 9

Collapsed raster, Admiral  
Chassis G13 ..... Nov 35

Delayed height, Motorola Chassis  
WKTS-584 ..... TS Jan 59

Foldover, vertical (Sylvania  
Chassis D03) ..... Nov 36

Height insufficient, Motorola Chassis  
TS-586/Y ..... TS Dec 57

Height intermittent, Admiral  
Chassis D11 ..... Nov 37

Height reduced, RCA Chassis  
CTC16XL ..... Nov 34

Horizontal foldover, causes of in  
solid-state circuits ..... Sep 15

Horizontal nonlinearity, causes of in  
solid-state circuits ..... Sep 16

Horizontal sync drifts, Admiral  
Chassis G1263-1 ..... VSS Feb 5

Horizontal sync unstable ..... Sep 16

Intermittent raster or poor hori-  
zontal sync, Motorola Chassis  
TS-912 ..... VSS Jul 13

Intermittent reduced raster, RCA  
Chassis CTC19 ..... Nov 34

Jitter and bounce, RCA Chassis  
CTC15 ..... Nov 37

Keystoning ..... Sep 16

Overscan of blue raster, Zenith Chassis  
23XC36, 38 ..... CCM Apr 71

Purple tint on left of raster,  
Motorola Chassis  
TS-908 ..... VSS May 9

Missing  
—causes of in solid-state  
circuits ..... Sep 12  
—sound normal, General Electric  
MW chassis ..... TS Feb 65

Reduced  
—at top, RCA Chassis  
KCS151 ..... Mar 75  
—Motorola Chassis TS-912 ..... Nov 36  
—top only, RCA Chassis  
CTC20A ..... Nov 38

Ringing lines, Philco Chassis  
16M91 ..... CCM Feb 58

Ringing on left side of raster,  
Motorola Chassis  
TS-912 ..... VSS Jul 14

Tinted raster, defects that cause ..... Jul 44

Vertical drift, Magnavox Chassis  
C/U45-01-00 ..... VSS Mar 5

Vertical jitter, Admiral Chassis  
G1263-1 ..... VSS Feb 6

Vertical retrace lines, Zenith  
Chassis 23XC38 ..... CCM Feb 58

Vertical roll  
—caused by defective VDR,  
Admiral Chassis 25H6 ..... Nov 38  
—intermittent, Olympic Chassis  
CTC-15/U ..... VSS May 11  
—intermittent, Philco Chassis  
17MT80 ..... Nov 37  
—RCA Chassis CTC20 ..... Nov 38

Vertical sweep  
—insufficient, bottom compressed  
(Zenith Chassis  
24MC32, 42) ..... VSS Mar 8  
—intermittent, Admiral Chassis  
21B1 ..... TS May 58  
—missing, Magnavox Chassis  
C/U45-01-00 ..... VSS Mar 5

Width reduced  
—brightness low, focus poor  
(Motorola Chassis  
TS-908) ..... VSS May 10  
—causes of in solid-state  
circuits ..... Sep 14  
—RCA Chassis CTC15 ..... CCM Dec 53  
—Truetone Model  
2DC1663A ..... VSS Jul 15

Yoke ringing ..... Sep 16

#### RESISTORS

Thermistors ..... Jul 30  
—deflection circuits, in ..... Jul 31  
—filament strings, in ..... Jul 30  
—servicing ..... Jul 32  
—typical resistance ..... Jul 30

Varistors ..... Jul 32  
—deflection circuits, in ..... Jul 34  
—servicing ..... Jul 34  
—voltage/resistance, typical ..... Jul 34

#### SIGNAL GENERATORS, RF

Precision Model E-200-C ..... TE Feb 34

RCA Model WR-50B .....Jan 39

## SOUND SECTION OF TV

Alignment, symptoms indicating  
need for .....Jun 6  
Buzz, Philco Chassis  
16QT85 .....CCM Feb 58  
Color receivers, used in .....Sep 49  
Distortion, heavy snow on screen  
(Motorola Chassis  
TS-408A) .....TS Apr 63  
Electrolytic capacitor  
applications .....May 29  
Grid leakage in output tube, de Forest  
Model DKW .....TS Sep 68  
Hum until raster appears, Zenith  
Chassis 15L22 .....TS May 58  
Integrated circuit, sound system  
employing .....Oct 8

## STEREO FM

Audio weak on stereo and monaural,  
no separation on stereo ..Sym Jan 43  
Audio weak on stereo and monaural,  
separation poor, but indicator  
lights .....Sym Jan 44  
Audio weak on stereo and monaural,  
stereo indicator  
illuminated .....Sym Jan 43  
Distortion and weak, garbled  
volume in left channel (Elec-  
trohome Model TR30M) .....Oct 37  
Distortion in right channel, Magnavox  
Chassis R204-10 .....Oct 36  
FM and AM reception missing,  
phono normal (RCA Chassis  
RC1223A) .....Oct 33  
FM reception noisy, AM and phono  
normal (RCA Chassis  
RC-1227B) .....Oct 34  
FM reception poor, rushing sound  
in speaker (Admiral 20C4A  
chassis) .....Jun 47  
High-quality systems, servicing .....Aug 32  
—components .....Aug 32  
—distortion measurement .....Aug 38  
—frequency response .....Aug 58  
—sensitivity measurement .....Aug 38  
—separation measurement .....Aug 58  
—system analysis .....Aug 33  
—tuner bandpass  
measurement .....Aug 38  
—turntable tests .....Aug 60  
Hissing sound on FM, AM normal  
(Tru-tone Model  
4DC-5665A) .....Oct 32  
Left channel intermittent on radio  
and phono positions, General  
Electric Chassis .....Jun 44  
Motorboating in left channel, RCA  
Chassis .....Jun 47  
Noise during stereo reception,  
separation poor .....Sym Jan 44  
No stereo reception, Silvertone  
Chassis 528.63310 .....Oct 34  
Separation missing on stereo  
FM .....Sym Jan 42  
Separation poor on strong signal,  
missing on weak .....Sym Jan 42  
Troubleshooting procedures  
—audio stages .....Oct 36  
—circuit analysis .....Oct 32  
—multiplex stages, in .....Oct 34  
—noise generators, with .....Jun 40  
—signal generators, with .....Jun 40  
—signal injection .....Oct 33  
—transistor checking .....Jun 41  
—VTVM or VOM tests .....Oct 33

Volume intermittently weak on right  
channel, RCA Model VGP82 Jun 47  
Volume low on right channel, RCA  
Model VFP 32E .....Jun 44  
Warm up slow, Silvertone Chassis  
528.63430 .....Jun 48

## SYMFACT

Chroma oscillator .....Apr 51  
Color Generator, RCA Model  
WR-64B .....Feb 37  
Color killer .....Jun 31  
Convergence Assembly .....Mar 45  
Multiplex amplifier and doubler ..Jan 41  
Tuner AFC, RCA Chassis  
CTC21C .....May 41

## SYNC (Also see horizontal and vertical)

Analysis of .....Jul 35  
—horizontal sync coupling .....Jul 40  
—servicing procedures .....Jul 42  
—sync separator .....Jul 35  
—vertical sync coupling .....Jul 35  
Color receiver, circuitry in .....Sep 51  
Horizontal and vertical intermittent,  
RCA Chassis  
CTC22 .....CCM Dec 53  
Horizontal tearing, vertical roll,  
Channel 3 beat (RCA  
Chassis CTC11D) .....TS Feb 66  
Intermittent and time-lapse  
troubles .....Jan 17  
Solid-state circuitry .....Aug 7  
—horizontal AFC and  
oscillator .....Aug 11  
—vertical sweep .....Aug 7  
Vertical and horizontal hold  
poor .....VSS Mar 6  
Vertical and horizontal sync  
missing, Emerson Chassis  
120699 .....VSS Feb 7

## TELEVISION

AGC, keyed .....Dec 30  
Color models for 68 .....Nov 6  
Electrolytic capacitors used in .....May 27  
Lead-in .....Feb 24  
—coaxial type .....Feb 26  
—installation tips .....Feb 60  
—losses .....Feb 24  
—shielded twin-lead .....Feb 60  
1968 TV lines, models and features  
of .....Oct 4  
Station test signal .....TS Feb 66  
Sweep alignment .....Jun 5  
—difficulties and precautions .....Jun 8  
—misaligned traps, effects of .....Jun 9  
—peak alignment .....Jun 11  
—response curves, interpreting .....Jun 6  
—RF-IF response, checking .....Jun 10  
—step-sweep IF alignment .....Jun 11  
—symptoms indicating need for .....Jun 5  
—traps, aligning .....Jun 10  
Transistor, servicing .....Jun 36

## TEST EQUIPMENT

CRT Testers  
—B & K Model 465 .....TE Jul 49  
—Hickok Model CR 35 .....TE Sep 58  
—SENCORE Model CR 13 .....TE Dec 40  
—SENCORE Model CR 143 .....TE Aug 52  
Color generators  
—B & K Model 1242 .....TE Jun 50  
—Hickok Model GC 660 .....TE May 47  
—Mercury Model 1900 .....TE Mar 38  
—RCA Model WR-64B .....Sym Feb 37  
Electronic Organs, for repairing ..May 52  
FET Voltmeters  
—Amphenol Model 870 .....TE Oct 28

—Triplet Model 600 .....TE Dec 41  
In-circuit current checker, Seco  
Model HC8 .....TE Nov 40  
Meters (VTVM and VOM)  
—application of .....Jun 25  
—frequency response .....Jun 26  
—input capacitance .....Jun 26  
—waveform errors .....Jun 28  
Ohms and AC functions defective,  
Olson TE-168 VOM .....TS Mar 60  
Oscilloscopes, advantages and  
limitations of .....Jun 28  
RF signal generators  
—Precision Model E-200-C .....TE Feb 34  
—RCA Model WR-50B .....Jan 39  
Scope or meter, deciding  
which .....Jun 25  
Signal tracer, Hickok Model 860  
Injector-Tracer .....TE Aug 52  
Transistor analyzer, Lectrotech  
Model TT-250 .....TE Nov 39  
Transistor Tester and Set analyzer,  
Semitron Model 1000 .....TE Mar 39  
Tube testers  
—Mercury Model 2000 .....Jan 38  
—Seco Model 107-C .....TE Jul 50  
—SENCORE Model MP-140 .....TE Apr 44

## THEORY

Color signal, development of .....Aug 23  
Field effect transistors .....Sep 34  
Ohm's law for AC .....Jan 28  
Organs .....May 26  
RC Circuits .....Oct 38  
Sheet-beam demodulator .....Jul 28  
Symbol standardization .....Jan 1  
Sync, horizontal and vertical .....Jul 35

## TRANSISTORS

Beta and leakage readings in AM-FM  
chassis .....Oct 33  
DC voltage distribution .....Dec 4  
—bias circuits .....Dec 56  
—collector junction leakage .....Dec 4  
—common base circuits .....Dec 6  
—common collector circuits .....Dec 56  
—cutoff test .....Dec 5  
—open and shorted collector  
junctions .....Dec 5  
—voltage indications,  
comparative .....Dec 6  
FET used in voltmeter .....TE Oct 28  
Field effect transistors, introduction  
to .....Sep 34  
—basic theory .....Sep 34  
—features of .....Sep 34  
—precautions .....Sep 44  
—test procedures .....Sep 36  
Replacement table for AM-FM  
chassis .....Oct 32  
Testing .....Jun 41  
—beta .....Mar 25  
—characteristics .....Jun 41  
—in-circuit .....Jun 37  
—leakage .....Mar 25  
—symptom association .....Jun 43  
Testers, typical .....Mar 26  
Unijunction transistor employed  
in vertical oscillator .....Oct 7  
Unijunction transistor multivibrator  
used in color  
generators .....TE May 46  
Lectrotech Model TT-250 .....TE Nov 39

## TRANSISTOR TESTERS

Operation of .....Mar 24  
—beta tests .....Mar 25  
—leakage tests .....Mar 25



—typical instruments ..... Mar 26  
 Semitron Model 1000 ..... TE Mar 39  
 Solid-state stereo, using to check  
 transistors in ..... Jun 41

**TRANSISTOR TV**

Deflection circuits  
 —horizontal AFC and  
 oscillator ..... Aug 11  
 —horizontal output and high  
 voltage ..... Sep 9  
 —horizontal troubles ..... Aug 12  
 —vertical sweep ..... Aug 7  
 —vertical troubles ..... Aug 9  
 Motorola all-transistor Chassis  
 TS-915 and TS-919, introduction  
 to ..... Aug 40  
 Troubleshooting techniques ..... Jun 36  
 —AGC circuits ..... Jun 62  
 —basics ..... Jun 36  
 —horizontal circuits ..... Jun 39  
 —in-circuit testing ..... Jun 37  
 —precautions ..... Jun 64  
 —special circuits ..... Jun 38  
 —vertical circuits ..... Jun 62

**TROUBLESHOOTER, THE**

Arcing at CRT anode connection,  
 Olympic Model 6P25 ..... Apr 65  
 Arcing from "S" winding of flyback  
 to iron core ..... Mar 60  
 CRT filament burnout, repeated  
 (Motorola Chassis  
 534D-13) ..... May 59  
 CRT substitution, RCA Chassis  
 72A ..... Apr 63  
 Color coding of oscillator and IF  
 transformer adjustments in  
 AM/FM radios ..... Apr 65  
 Color missing, poor vertical sync  
 (Admiral Chassis 25D6) ..... Jul 52  
 Color sync lost during commercials,  
 Curtis Mathes Chassis  
 CMC15 ..... Aug 54  
 Delayed height, Motorola Chassis  
 WKTS-584 ..... TS Jan 59  
 Focus lost when antenna disconnected  
 or brightness control adjusted  
 from 3/4 to maximum, Admiral  
 Chassis 1G1155-1 ..... Aug 55  
 Grid leakage in audio output tube,  
 de Forest Model DKW ..... Sep 68  
 Heavy snow on screen, distorted  
 sound (Motorola Chassis  
 TS-408A) ..... Apr 63  
 Height insufficient, Motorola  
 Chassis TS-586/Y ..... Dec 57  
 High end of band inoperative when  
 receiver installed in car, Pontiac  
 Model 983873 ..... Jun 56  
 Horizontal output transformer  
 overheating, Zenith Chassis  
 16E25 ..... Jun 56  
 Horizontal output tube overheats,  
 Admiral Chassis 1601 ..... Feb 66  
 Horizontal sync weak, RCA Chassis  
 CTC25X ..... Nov 59  
 Horizontal tearing, vertical roll,  
 Channel 3 beat (RCA  
 Chassis CTC11D) ..... Feb 66  
 Hot cabinet, Zenith Model  
 Z1511-BUZ ..... Nov 59  
 Hum until raster appears, Zenith  
 Chassis 15L22 ..... May 58  
 Ohms and AC functions defective,  
 Olson TE-168 VOM ..... Mar 60  
 Raster, boost, and high voltage  
 missing (Zenith Chassis

14M20) ..... Oct 48  
 Raster missing, sound normal  
 (General Electric Chassis  
 MW) ..... Feb 65  
 Shadows and increased contrast,  
 RCA Chassis CTC11D ..... TS Jan 57  
 Sound reduced on lower frequencies,  
 General Electric Model  
 C403G radio ..... Feb 66  
 Station test signal ..... Feb 66  
 TVI traps, setting ..... Jun 56  
 Twist, post video (Traveler  
 Chassis 740-78) ..... Aug 54  
 Vertical roll after one hour of  
 operation, Zenith Chassis  
 14L20 ..... Oct 47  
 Vertical sweep intermittent,  
 Admiral Chassis 21B1 ..... May 58  
 Vertical sync poor, Zenith  
 Chassis 14M21/X ..... Oct 45  
 Vertical sync weak  
 —Sears Model 9146B ..... Nov 60  
 —Zenith Chassis 14N33 ..... Nov 60  
 Video and audio disappear, Philco  
 Chassis 14N50 ..... Dec 55  
 Video and sound disappear when  
 contrast control is turned down,  
 Admiral Chassis 20B6CB ..... Sep 68  
 Video missing, sound poor (General  
 Electric Chassis AY) ..... May 57  
 Wavy pattern when tuning near  
 sound side, Setchell Carlson  
 receivers ..... Oct 47

**TUBES**

Heater to cathode shorts, effects on  
 raster and color ..... May 24  
 Sheet-beam chroma  
 demodulator ..... Jul 28  
 Stock Guide for TV ..... Apr 24  
 Substitution of 6GM6 for 6AU6  
 cures trouble ..... TS Jul 52

**TUBE TESTERS**

Mercury Model 2000 ..... Jan 38  
 Seco Model 107-C ..... TE Jul 50  
 SCORE Model MP-140 ..... TE Apr 44

**TUNERS, TV**

Automatic frequency control,  
 operation of ..... Sym May 41  
 Balun coil, rewinding ..... Jan 24  
 Color receivers, used in ..... Sep 46  
 Fine tuning control does not function  
 correctly, Motorola Chassis  
 TS-912 ..... VSS Jul 14  
 Troubleshooting with  
 oscilloscope ..... Apr 1

**VERTICAL SWEEP**

Collapsed raster, intermittent  
 (Admiral Chassis G13) ..... Nov 35  
 Color TV, circuits employed in ..... Oct 17  
 Delayed height, Motorola Chassis  
 WKTS-584 ..... TS Jan 59  
 Foldover, Sylvania Chassis D03 ..... Nov 36  
 Intermittent  
 —Admiral Chassis D11 ..... Nov 37  
 —Admiral Chassis 21B1 ..... TS May 58  
 Jitter, Admiral Chassis  
 G1263-1 ..... VSS Feb 6  
 Missing  
 —Magnavox Chassis  
 C/U45-01-00 ..... VSS Mar 5  
 —RCA Chassis CTC24 ..... CCM Nov 66  
 Reduced  
 —bottom compressed, Zenith  
 Chassis 24MC32, 42 ..... VSS Mar 8

—intermittent, RCA Chassis  
 CTC19 ..... Nov 34  
 —Motorola Chassis  
 TS-586/Y ..... TS Dec 57  
 —Motorola Chassis TS-912 ..... Nov 36  
 —RCA Chassis CTC16XL ..... Nov 34  
 Retrace lines, Zenith Chassis  
 23XC38 ..... CCM Feb 58  
 Solid-state circuitry ..... Aug 7  
 —common troubles ..... Aug 9  
 —output stage ..... Aug 8  
 —sawtooth generation ..... Aug 7  
 —two-stage system ..... Aug 8  
 Top reduced, RCA Chassis  
 CTC20A ..... Nov 38  
 Transistor TV, employed in ..... Jun 62  
 Unijunction transistor employed in  
 oscillator, Electrohome M5  
 Chassis ..... Oct 7  
 Vertical pulse contaminating  
 horizontal sweep, RCA  
 Chassis KCS151 ..... Mar 75

**VERTICAL SYNC**

Drift, Magnavox Chassis  
 C/U45-01-00 ..... VSS Mar 5  
 Instability resulting from difference  
 in b-w and color vertical  
 frequency ..... Jan 21  
 Intermittent with jitter, RCA  
 Chassis KCS68 ..... Jan 18  
 Jitter  
 —RCA Chassis CTC15 ..... Nov 37  
 —RCA Chassis CTC24 ..... CCM Nov 66  
 Poor  
 —color missing, Admiral  
 Chassis 25D6 ..... TS Jul 52  
 —foldover and retrace lines  
 at top, Emerson Chassis  
 120699 ..... VSS Feb 7  
 —Zenith Chassis  
 14M21/X ..... TS Oct 45  
 —Zenith Chassis  
 24MC32, 42 ..... VSS Mar 8

**Roll**

—after one hour of operation,  
 Zenith chassis 14L20 ..... TS Oct 47  
 —caused by defective VDR,  
 Admiral Chassis 25H6 ..... Nov 38  
 —intermittent, caused by video  
 signal distortion ..... Jan 20  
 —intermittent, Crosley Model  
 487 ..... Jan 19  
 —intermittent, Olympic Chassis  
 CTC-15/U ..... VSS May 11  
 —intermittent, Philco Chassis  
 17MT80 ..... Nov 37  
 —RCA Chassis CTC20 ..... Nov 38  
 —slow, Sylvania Chassis D02 ..... Nov 35  
 Servicing procedures ..... Jul 42  
 Sync coupling, analysis of ..... Jul 35  
 Weak  
 —Sears Model 9156B ..... TS Nov 60  
 —Zenith Chassis 14N33 ..... TS Nov 60

**VIDEO**

Amplifier defects, effects on  
 color ..... May 23  
 Amplifier, signal tracing in ..... Apr 7  
 Color missing, b-w pix normal  
 (Magnavox Chassis  
 C/U45-01-00) ..... VSS Mar 5  
 Color receiver, circuitry used in ..... Sep 47  
 Contrast low ..... Apr 5  
 Definition poor ..... Apr 8  
 Delay line causes loss of  
 brightness, Emerson

Chassis 120699	VSS Feb 8
Disappears along with audio, Philco Chassis 14N50	TS Dec 55
Hum in IF signal	Apr 5
IF amplifiers, sweep alignment of	Jun 5
Overload	
—Olympic Chassis CTC-15/U	VSS May 11
—on strong signals, Admiral Chassis G1263-1	VSS Feb 6
Picture and sound missing, Emerson Chassis 120699	VSS Feb 7
Picture missing	
—both b-w and color, Zenith Chassis 24MC32, 42	VSS Mar 8
—sound poor, General Electric AY chassis	TS May 57
—Truetone Model 2DC1663A	VSS Jul 15
Picture pulling or loss of sync	Apr 5
Poor picture quality	Apr 4
Ring and circuit ghosts	Apr 8
Smear and out of focus picture, Olympic Chassis CTC-15/U	VSS May 12
Twist, post video (Trav-ler Chassis 740-78)	TS Aug 54
Video and sound disappear when contrast control is turned down, Admiral Chassis 20B6CB	TS Sep 68
White compression	Apr 7

#### VIDEO SPEED SERVICING

Admiral Chassis G1263-1	Feb 5
Emerson Chassis 120699	Feb 7
Olympic Chassis CTC-15/U	May 11
Magnavox Chassis C/U45-01-00	Mar 5
Motorola Chassis TS-908/A,B,YA,YB	May 9
Motorola Chassis TS-912	Jul 13
Truetone Model 2DC1663A, 65A, 67A	Jul 15
Zenith Chassis 24MC32, Z and 24MC42, Z	Mar 7

#### VOM's

Application of	Jun 25
FET type, Amphenol Model 870	TE Oct 28
Frequency response	Jun 26
Input capacitance	Jun 26
Ohms and AC functions defective, Olson TE-168 VOM	TS Mar 60
Transistorized, Triplett Model 600	TE Dec 41
Waveform errors associated with	Jun 28

#### VIVM's

Application of	Jun 25
FET type, Amphenol Model 870	TE Oct 28
Frequency response	Jun 26
Input capacitance	Jun 26
Waveform errors associated with	Jun 28

#### WAVEFORMS

Bandpass amplifier response	Nov 21
Bandwidth of video IF, method used to measure	Apr 4
Chroma oscillator, in	Sym Apr 51
Color burst at phase detector	Jan 53
Color generator, in	Sym Feb 37
Color killer, in	Sym Jun 31

Color signal, expanded	Jun 60
Composite video showing sync defects	Jan 20
Convergence assembly, in	Sym Mar 45
Demodulator, chroma	Nov 28
Difference amplifier grids, at	Sep 33
Doubled-tuned color IF system, responses in	Nov 51
Hash on defective filter capacitors	Jan 21
Horizontal keying pulse at burst amplifier grid	Jan 53
Horizontal linearity poor, effects on waveform	Jun 28
Horizontal-output system, in	Sep 10
Horizontal sync and feedback pulses	Oct. 20
Horizontal sync pulse	Jan 18
Hum in video IF signal	Apr 5
IF and chroma response, overall	Nov 24
IF bandpass curve, in color receiver	Sep 47
Keyed-rainbow chroma signal	Nov 26
Low-voltage supply circuits, in	May 28
Musical notes, typical	May 26
Response curve of video IF peaked, associated with poor picture quality	Apr 4
Response curves, video IF in color receiver	Sep 48
Ring test, scope patterns obtained in	Sep 14
Rise time, measurement of	Jun 59
Secondary electrolytic applications, associated with	May 29
Sine and square waves, hybrid	Apr 7
Square wave with differentiation, ringing, and overshoot	Apr 8
Square wave with overshoot	Apr 8
Square wave with nonsymmetrical overshoot	Apr 8
Stagger-tuned color IF system, responses in	Nov 41
Sync circuits, in	Jul 37
Sync pulses compressed in video IF signal	Apr 5
Sync separator, at grid and plate of	Jan 19
Transient responses of lab- and service-type scopes	Jun 59
Tuner AFC, in (RCA Chassis CTC21C)	Sym May 41
Tuner signal observed when input is from AM signal generator	Apr 3
Tuner signal observed when input is from pattern generator	Apr 3
Vectorgram display of color receiver	Jun 59
Vertical sync defects	Jan 21
Vertical sync feedback pulse	Jan 17
Vertical sync pulse in sync separator	Jan 19
Vestigial sideband transmission, compensating for	Jun 7
Video amplifier responses, square and sweep	Apr 8
Video IF response	
—curves, typical	Jun 8
—effect of misaligned trap	Jun 9
—effects of misalignment	Jun 6
—effects of oscillation in video IF strip	Jun 9
—frequency increase graphs	Jun 8
—hash in	Jun 9
Video IF section, signal	

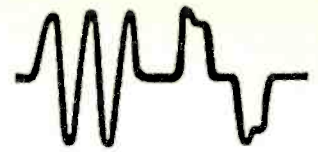
observed in	Apr 4
Video IF signal, undistorted	Apr 5
Video signals, normal and abnormal	Apr 7
White compression in video signal	Apr 7

#### YOKES

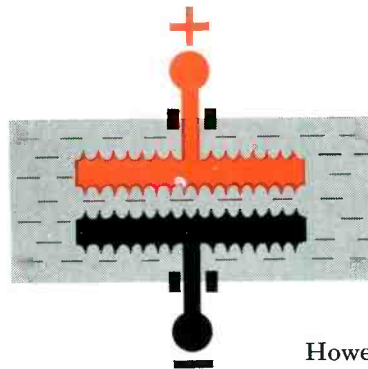
Ring	Sep 16
------	--------

#### INDEX OF TITLES

Annual TV Tube Stock Guide	Apr 24
Antennas Can Add Profits	Apr 58
Audio Equipment	Mar 20
DC Voltage Distribution in Transistor Circuitry	Dec 4
Depreciation Reserves for Equipment	Jan 26
Electronic Cables	Feb 19
Electrolytic Capacitors in TV Receivers	May 27
Electronic Service Shop	Sep 37
Getting Started in Electronic Organ Servicing	May 25
Great Blobs of Color	May 22
Highlights of 1968 B-W TV	Oct 4
Industrial Electronics Notebook —Part 2	Apr 28
Installing Intercom and Music Distribution Systems	Dec 24
Intermittent and Time Lapse Sync Troubles	Jan 17
Introduction to FET's	Sep 34
Keyed AGC—A Review	Dec 30
Know Your 68 Color Circuits— Part 1	Nov 6
Know Your 68 Color Circuits— Part 2	Dec 12
Legal Services for Small Retail And Service Firms	Feb 30
Many Hued Rasters—Part I	Jul 44
Many Hued Rasters—Part II	Sep 32
Measuring the Results of Advertising	Aug 44
Meet A CB Specialist	Apr 38
Ohm's Law for AC	Jan 28
Picture Tube or Chassis— Which?	Apr 20
Protect Your Business From These Credit Abuses	Oct 52
RC Circuits	Oct 38
Removing the Barber Pole	Jan 22
Repairing the Deluxe AM-FM Chassis	Oct 32
Scope or Meter—Which?	Jun 25
Scope Probes	Mar 28
Servicing High-Quality Audio	Aug 32
Sheet-Beam Demodulators	Jul 28
Solid-State Color is Here	Aug 40
Solid-State Deflection Circuits —Part 1	Aug 7
Solid-State Deflection Circuits —Part 2	Sep 9
Solid-State Stereo Revisited	Jun 40
Source Guide to Imported Sets	Feb 28
Sweep Alignment for TV	Jun 5
Sweeping Color IF Amplifiers	Nov 41
Sync from Video to Oscillators	Jul 35
Symbol Standardization	Jan 1
The Case of the Bifilar Balun	Jan 24
Thermistors and Varistors in TV	Jul 30
Transistor Testers	Mar 24
Transistor TV Techniques	Jun 36
Troubleshooting RF, IF, and Video With the Oscilloscope	Apr 1
Twelve Vertical Color Problems	Nov 33



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



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

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

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

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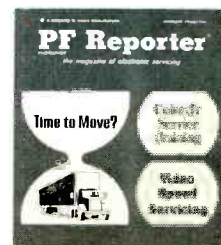
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## CONTENTS

Tube Substitution Supplement	a
Annual Index	1
Color TV Service Training	12
Part 5—Continuing analysis of the chroma circuits; including the burst amplifier, reference oscillator, color killer, and ACC circuits.	
Notes on Test Equipment	24
Lab report on Pomona Model 2900 High Voltage Probe and Seco Model 260 Transistor Analyzer. <i>T. T. Jones</i>	
The Electronic Scanner	31
Letters to the Editor	35
Time to Move Your Business?	36
A check list for determining the time to relocate. <i>Ernest W. Fair</i>	
PHOTOFACT BULLETIN	38
The Troubleshooter	42
Video Speed Servicing	49
Color Countermeasures	53
Product Report	57
Book Review	62
Free Catalog and Literature Service	64
Monthly Index on Free Literature Card	

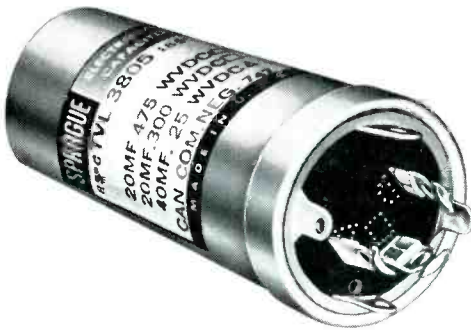
## ABOUT THE COVER

As any shop owner, manager, or service technician will agree, there are many facets to a successful service business. Some factors are business, or management, oriented; while others deal strictly with servicing problems. In any event, it must be conceded that both areas require attention if a business and those connected with it are to prosper. Our cover this month illustrates that the content of PF REPORTER follows this premise of double coverage—with, of course, greater emphasis placed on servicing.





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# COLOR TV

PART

5

# service training



# CHROMA CIRCUITS

## Burst Amplifier Reference Oscillator Difference Amplifier Demodulators Color Killer

Part 4 of this series included a detailed block-diagram analysis of the chroma circuits which are most often encountered in present-day color receivers. Following this discussion, a description of specific circuits currently in use was initiated. While space limitations make it impossible to analyze all of the circuits in use, representative circuits from popular sets will be discussed in detail. Part 5 continues the analysis of the burst amplifier, reference oscillator, color killer, and ACC circuits.

### RCA Closed-Loop ACC

In part 4 of this series, the final paragraphs were devoted to a discussion of the ACC (Automatic Chroma Control) used in RCA chassis CTC21, 28, and 30. This circuit is an *open loop* system. That is, the output of the ACC circuit is not used to control the gain of the amplifier which feeds it. By contrast, the ACC circuit used in the RCA CTC31 chassis is a *closed loop* system. The loop is from the grid of the first chroma amplifier, through the burst amplifier, through the ACC amplifier, and back to the grid of the first chroma amplifier. Fig. 1 is a simplified schematic of this circuit.

The color burst as well as the chrominance information are amplified by the first chroma bandpass amplifier. The plate load is the primary of the double-tuned transformer and one of the outputs from the secondary is fed to the burst amplifier. The burst amplifier amplifies the color burst and injects it into the reference oscillator circuit to control its phase.

First, consider the circuit with no burst signal present. The oscillator operates at its natural frequency and

develops approximately 3.5 volts of negative bias at its grid. This voltage is applied to the emitter of the ACC amplifier and a positive potential of about 35 volts is present at the collector. Because of the voltage drop across R739, the DC potential at the grid of the first chroma bandpass amplifier is about +5 volts. (This bias voltage may vary considerably from set to set.)

During color operation, the color burst from the first chroma bandpass amplifier is fed through the burst amplifier, which is gated on during horizontal retrace, to the grid of the oscillator. This signal increases the drive and causes the bias to increase to about -8 volts. This 5-volt change in voltage at the grid of the reference oscillator is amplified by the ACC amplifier transistor and causes a 31-volt swing at its collector. The normal collector voltage is about 4 volts when a nominal 80-volt burst signal is applied to the oscillator grid. The bias voltage at the grid of the first chroma amplifier is approximately -5 volts under these conditions. If the amplified color burst signal increases in am-

plitude, the grid of the reference oscillator becomes more negative and the emitter current increases. This, in turn, causes the collector current to increase and the collector potential to swing in a negative direction. Finally, this negative-going voltage is used to increase the bias of the first chroma amplifier and reduce its gain.

Conversely, if the amplified color burst decreases in amplitude for any reason, the emitter and collector voltages of the ACC amplifier become less negative, decreasing the bias on the first chroma amplifier and increasing its gain. Thus, the burst amplitude at the grid of the oscillator is maintained at a constant 80 volts. This is the optimum level to properly phase the reference oscillator. Since the first chroma bandpass amplifier also amplifies the chrominance signal, it, too, is maintained at its optimum level. This, of course, is the more important function of the ACC circuit.

The principal advantage of the closed-loop ACC circuit is its ability to maintain a more nearly constant level of chrominance signal. The

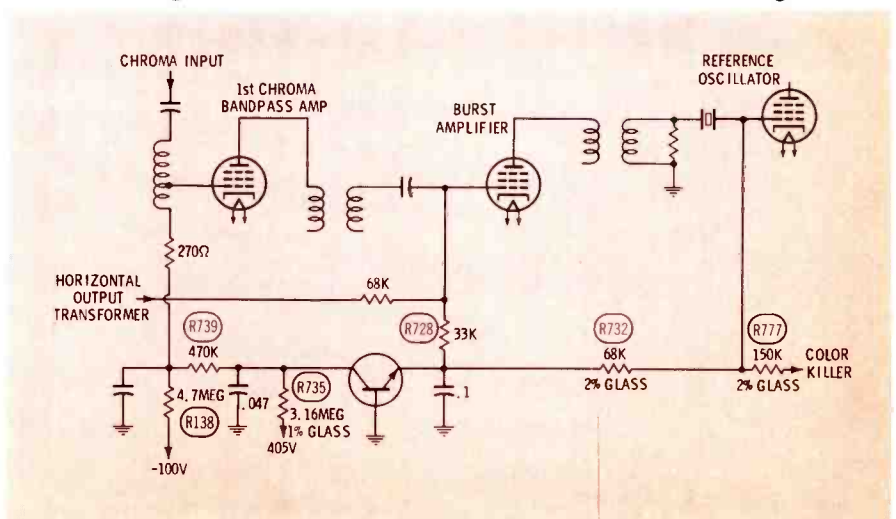
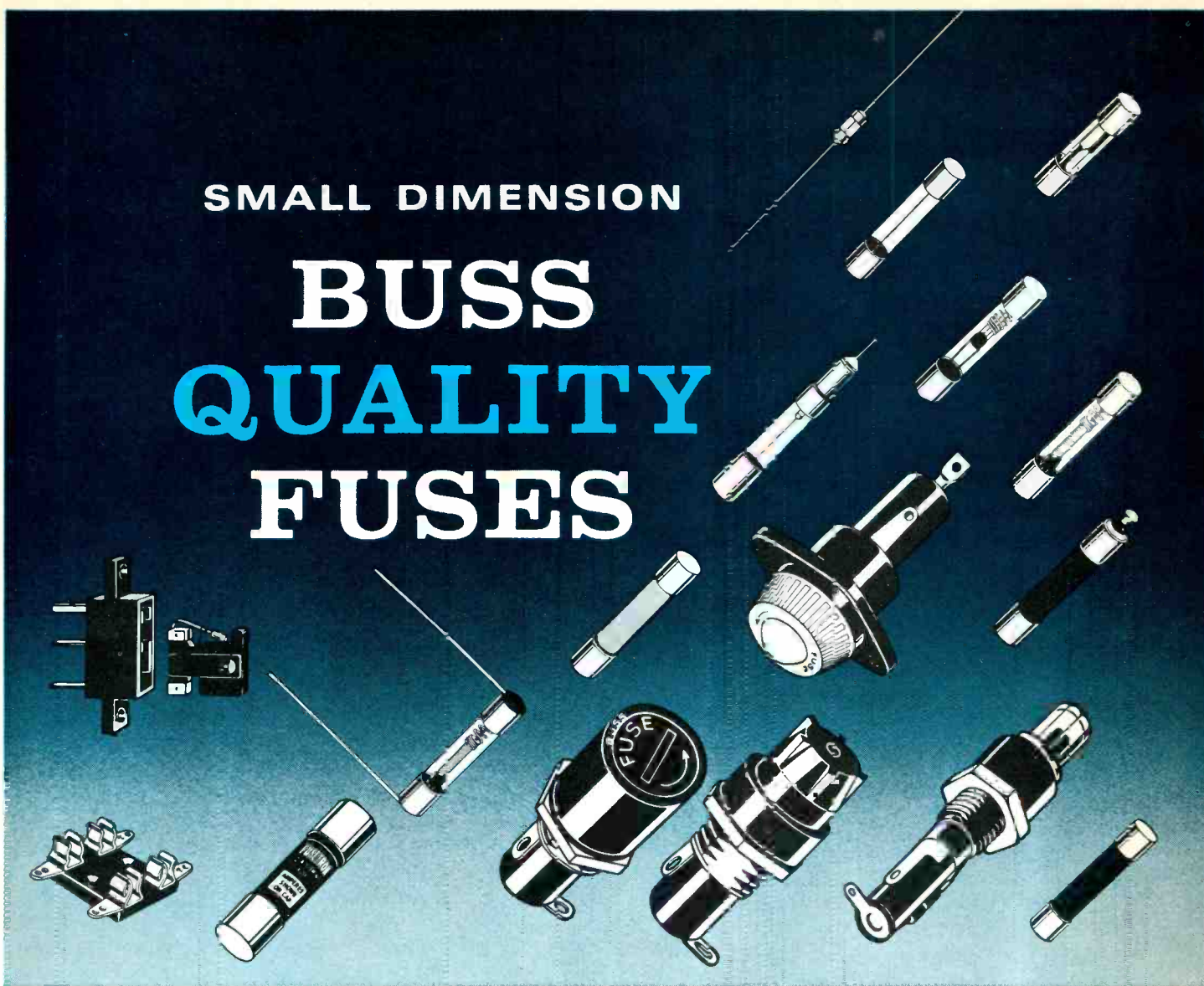


Fig. 1. Simplified ACC circuit of the RCA CTC31 chassis.

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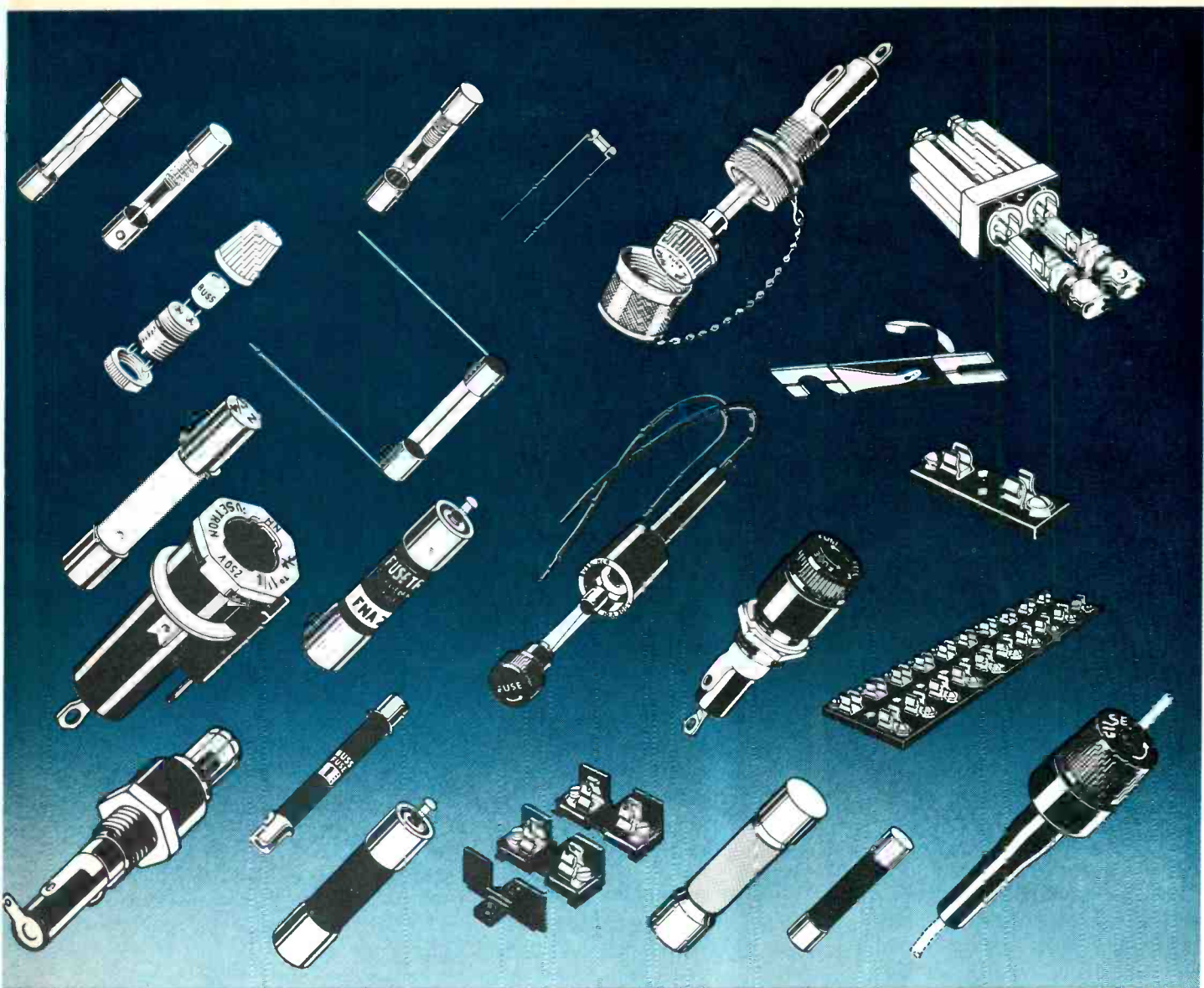
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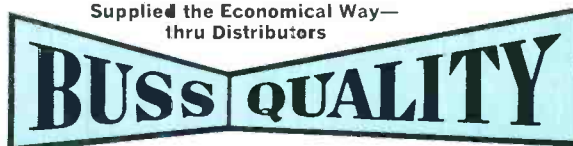
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curves shown in Fig. 2 demonstrate the characteristics of the two types of control, open-loop and closed-loop. Bear in mind that these curves illustrate the characteristics of the two basic systems and do not apply to any specific circuits.

Notice that R732, R777, and R735 are quite critical as to value, drift characteristics, and temperature coefficient. For this reason, glass resistors having close tolerance and low temperature coefficients are used.

### RCA Color Killer

Incorporation of closed-loop ACC made it necessary to revise several other circuits in the RCA chroma system. Since the color burst is amplified by the first chroma amplifier, color-killer bias had to be fed to a different stage; the demodulators were chosen. The use of transistors in the ACC and color killer is also a significant departure from earlier RCA designs.

A simplified schematic of the color-killer circuit used in the RCA CTC31 chassis is shown in Fig. 3. The base voltage of the killer transistor is established by the setting of the grid of the reference oscillator. Under no-color conditions, the base potential is about .5 volt positive with respect to the emitter and the transistor is cut off. Since the transistor is cut off, the collector voltage is determined by the voltage divider, R737 and R749, connected between the blanker grid and ground. Since the blanker grid is about -100

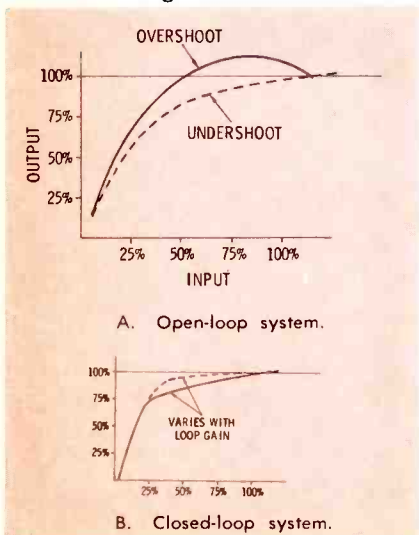


Fig. 2. Characteristics of open-loop and closed-loop control systems.

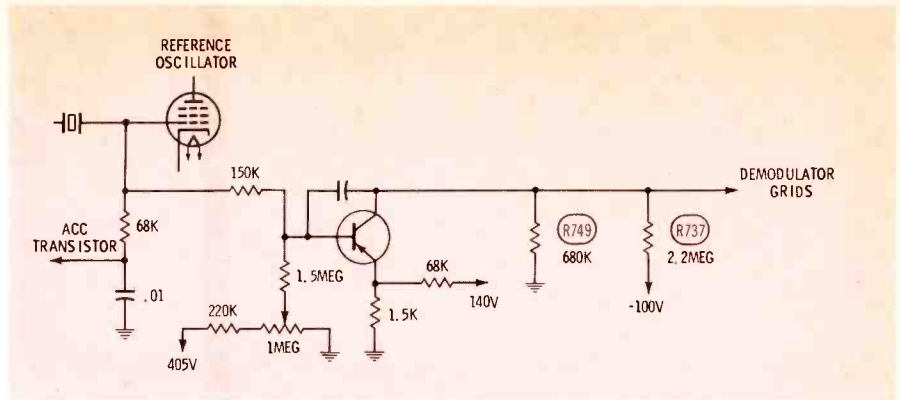


Fig. 3. Simplified color-killer circuit of the RCA CTC31 chassis.

volts, the collector voltage is about -25 volts. This voltage is also present on the screen grids of the demodulators and keeps these tubes below cutoff.

When a color burst is applied to the reference oscillator, the grid swings negative and the killer transistor is driven into saturation. This clamps the collector voltage to the emitter potential, raising the screen voltage of the demodulators to about 2 volts, well above cutoff. Notice that the color-killer transistor operates either at saturation or cutoff. Thus, variations in color-burst amplitude have no effect on the bias supplied to the demodulators.

### RCA Reference Oscillator

The RCA CTC31 chassis uses an injection type reference oscillator which is similar to the one used in the CTC18, CTC20 and CTC24 chassis. Fig. 4 is a simplified sche-

matic of the oscillator used in the CTC31. Basically, the oscillator is of the tuned-plate, tuned-grid, electron-coupled type. The frequency is determined by the crystal in conjunction with the small trimmer capacitor shunted across it.

As with any TPTG oscillator, the oscillator plate tank (L704) is tuned slightly above the oscillator frequency. In this circuit, it is adjusted so that the self-bias developed at the oscillator grid is -3.5 volts with no burst signal applied. In earlier models using the injection oscillator, the counterpart of L704 was not adjustable. In the absence of a color burst, the oscillator runs at the reference frequency, but with a random phase. When the burst is injected through T702, this signal pulls the oscillator into phase with it. The oscillator is stable enough to remain properly phased until the arrival of the next burst.

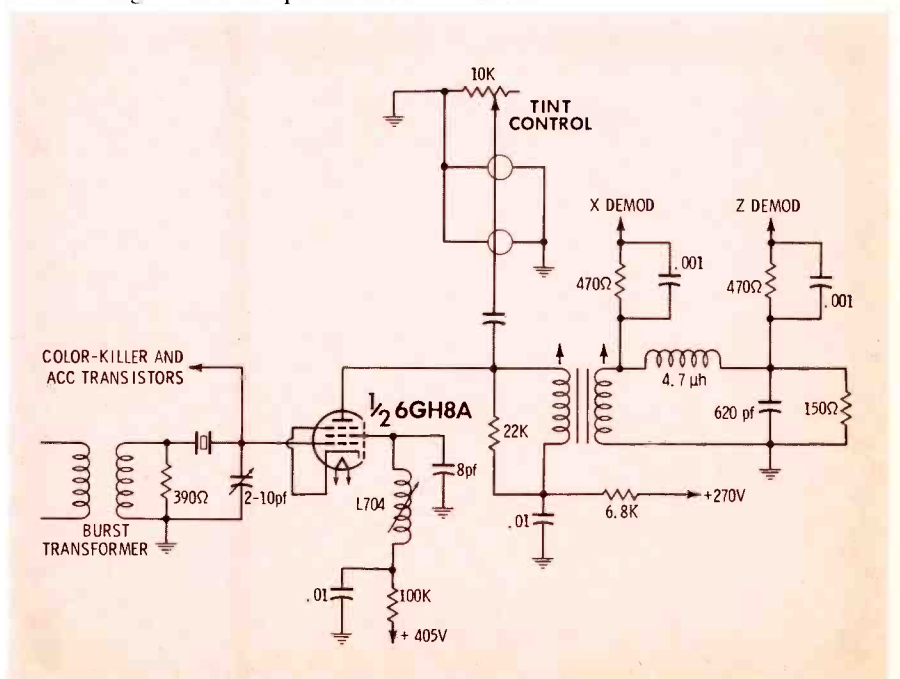


Fig. 4. Simplified reference oscillator circuit of the RCA CTC31 chassis.



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### Admiral Burst Amplifiers and Reference Oscillators

Fig. 5 shows the burst amplifier and reference oscillator circuit of the Admiral 1G1155 and other chassis. The more recent chassis, 3H10, 4H10, 5H10, and 4H12, use essentially the same burst amp and oscillator circuitry except for the tube type. The chroma signal from the plate of the first chroma band-pass amplifier and a positive enabling pulse from the horizontal output transformer are both fed to the burst-amplifier grid. The enabling pulse, having an amplitude of 50 volts, brings the tube out of cutoff and the color burst is amplified to a peak-to-peak amplitude of about 170 volts. The large value of cathode resistance, 39K ohms, prevents saturation. During the time that V5 is conducting, the drop across R166

charges C120. Between pulses, current flows upwards through R166 to discharge C120, maintaining an average cathode bias of about +45 volts. This prevents the chrominance signal from appearing in the plate circuit of the burst amplifier.

The reference oscillator is an injection type, electron-coupled oscillator and its operation is similar to that of the RCA circuit discussed above. The self-bias under free-running conditions (no color) is  $-0.3$  volt. When a burst signal is injected, this bias swings negative and the negative excursion is used to operate the color killer and the ACC circuit. The output of the reference oscillator is coupled through the plate transformer, L35, to the phase shifting circuits, L36, C129, and L37, which establish the correct phase of the reference sig-

nal for R-Y and B-Y demodulation. C128 and R6, the tint control, are used to shift the phase of the reference signal without disturbing the phase displacement between the R-Y and B-Y axes.

### Admiral ACC and ASC Circuits

As shown in Fig. 5, the ACC circuit used in the chassis series 1G1155-1, 2G1156-2, 2G1157-1, 3G1155-2, and 3G1155-3 has two variations. In the solid-line drawing, the ACC control voltage is taken from the grid of the reference oscillator and, after filtering, is used as bias voltage for the first chroma amplifier. Since the oscillator grid swings more negative as the color burst increases in amplitude, the chroma-amplifier gain is reduced as the level of the composite chrominance signal (chroma and color

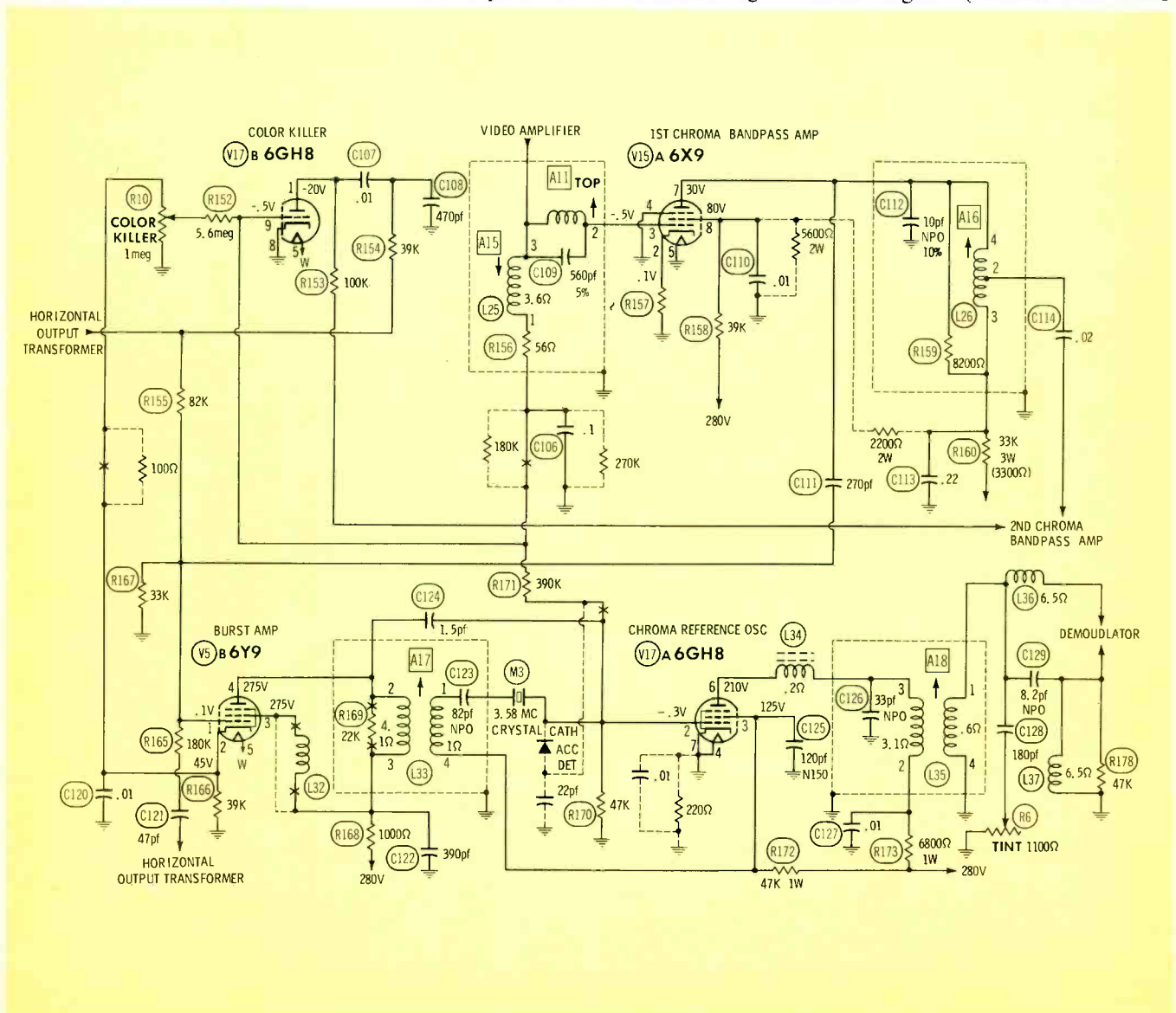


Fig. 5. Reference-signal circuits of the Admiral 1G1155 chassis.

burst) increases. The operation of the dashed-line circuit is much the same, although a diode detector has been added. Since this addition increases the amount of the control voltage, a divider network, 180K ohms and 270K ohms, is also added to the circuit.

The ASC (Automatic Saturation Control) circuit used in the 3H10NC57-1 chassis is shown in Fig. 6. This circuit, as well as the one described above, is a closed-loop system. A portion of the output from the first chroma amplifier is rectified by X11 and the negative voltage which is produced is used, after filtering, to control the gain of the first chroma amplifier. Thus, as the chrominance level increases, the bias increases to reduce the amplifier gain and vice versa. If this were the only control voltage, the dynamic range of saturation would be seriously limited (the degree of color saturation of the picture would remain constant regardless of the degree of saturation of the scene being televised). To prevent this, a second voltage is combined with the bias derived from X11. The negative voltage at the grid of the reference oscillator, which is proportional to the color-burst amplitude, is also fed to the grid of

the first chroma amplifier. Thus, sufficient bias is always available to maintain the desired dynamic range of saturation.

### Admiral Color Killer

The color-killer circuit shown in Fig. 6 is typical of many of the circuits used in late-model Admirals. The positive cathode bias of the burst amplifier is divided across the threshold control, R9, and negative voltage is obtained from the grid of the reference oscillator. In the absence of a color burst, this negative voltage is slight and the color-killer tube will conduct if plate voltage is supplied. The source of plate voltage is the positive pulse from the horizontal-output transformer which is fed to the left side of C128. Current flows through V15A, charging the right side of C128 to a negative potential. Between pulses, C128 partially discharges through R170 and the negative voltage which is developed holds the second chroma amplifier below cutoff. When a color burst is received, the negative voltage at the grid of the reference oscillator increases and cuts off the color-killer tube. This allows C128 to completely discharge and the cut-off bias is removed from the second chroma amplifier.

Notice that the setting of R9 affects the bias of the first chroma amplifier and, if R9 is misadjusted, the operation of the ASC circuit will be impaired. To properly set R9, adjust all front-panel controls for proper operation and set the color control at mid-range. Turn to an unused channel, set the color-killer control fully clockwise, and then adjust it until the color in the snow almost disappears.

### Zenith Burst Amplifier and Reference Oscillator Circuit

The chroma-reference circuits of Zenith's 20X1C36 and 20X1C38 are shown in Fig. 7. In many respects, they are similar to the circuits of the RCA CTC25 chassis discussed under the heading "Circuit Analysis of Reference Oscillator Circuits" in Part 4. The composite chrominance signal from the plate of the first chroma amplifier and a positive enabling pulse from the horizontal-output transformer are fed to the grid of the burst amplifier. Since the color burst is coincident with the enabling pulse, the burst is separated from the remainder of the chrominance signal and amplified. The positive cathode bias of about 45 volts is developed by conduction through R176 while the

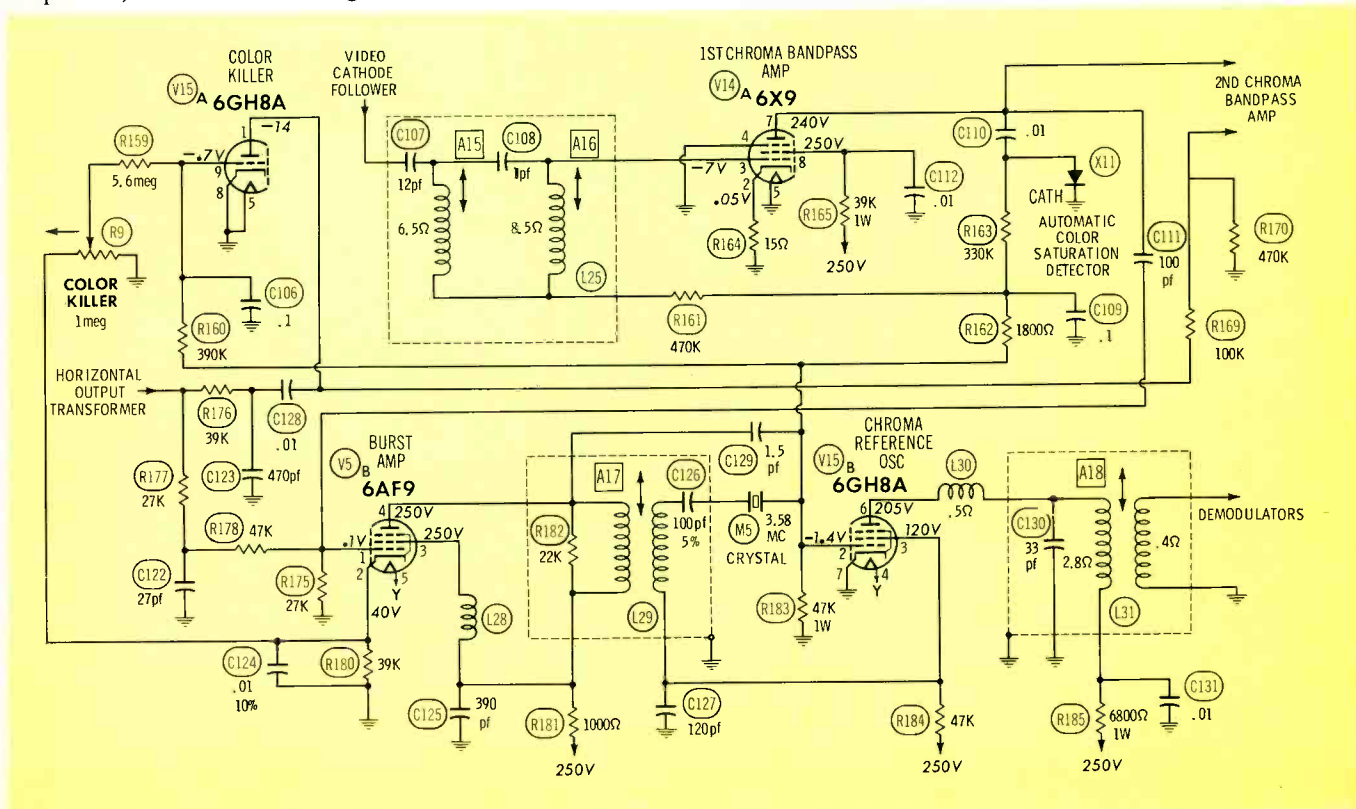


Fig. 6. Reference-signal circuits of the Admiral 3H10NC57-1 chassis.

tube is gated on, and this voltage is sustained between pulses by the charge stored in C127.

The output of the burst amplifier is fed to the chroma-sync phase detector and to the ACC and color-killer detector. The hue control, R3, in conjunction with C131 allows the viewer to vary the phase of the amplified color burst.

The chroma-sync phase detector compares the relative phases of the reference oscillator signal from L30 and the color burst from the burst amplifier. Any phase error is converted to a voltage error which is used to change the conductance of the chroma reference-oscillator control tube. The operation of this type of circuit was explained in Part 3 of this series.

The reference oscillator is typical of the type of oscillator used in conjunction with an AFC tube. Since the system of chroma demodulation used by Zenith requires four reference signals in quadrature, a special output transformer is used instead of the usual RLC phase-splitter network.

### Zenith Color-Killer and ACC Circuits

The color-killer and ACC circuit of the Zenith 20X1C36 chassis is also shown in Fig. 7. The color-killer and ACC detector is a conventional phase detector, but, since the phase relationship of two inputs is constant, the amplitude of the

output becomes a function of the amplitude of the color burst. When no burst is present, the output is  $-0.7$  volt, but, during normal color reception, this potential increases to approximately  $-6$  volts. If the amplitude of the color burst decreases from its normal value for any reason, the detector output also decreases.

The output of the detector is filtered by C64 and used as bias for the grid of the first chroma amplifier, V4B. Under no-color conditions, V4B is near saturation and the screen potential is about 75 volts. This voltage is at one end of a series network consisting of R165, R17, and R164. The opposite end of R164 is connected to the grid of the horizontal discharge tube which is 65-volts negative. When R17 is properly adjusted, the voltage at its junction with R164 is about  $-28$  volts. This voltage is used to bias the second chroma amplifier below cutoff. C118 is a bias filter which integrates the horizontal pulses from the horizontal discharge tube.

During color reception, the grid bias of V4B increases to  $-6$  volts and the screen and plate voltages rise to 225 volts. This would cause the voltage at the grid of the second chroma amplifier to rise to a positive potential if it were not for the clamper diode connected across C118. The actual bias of the second chroma amplifier is 0 volt.

As stated before, the output of the color-killer and ACC detector

is  $-6$  volts under conditions of normal color reception. If the chrominance level varies from its normal value, the detector output will also change. Thus, a decrease in chroma level reduces the negative bias on V4B, increasing its gain. Conversely, an increase in the chroma level increases the bias on V4B to reduce its gain. Notice that small variations in bias on V4B do not affect the bias of the second chroma amplifier because of the action of the clamper diode. This, too, is a closed-loop system.

### General Electric Reference Circuits

Fig. 8 shows the burst gate and subcarrier amplifier circuits of the General Electric HC chassis. The output of the chroma-bandpass amplifier is fed to the cathode of the burst gate tube, V5B, and the 100-volt enabling pulse from the horizontal-output transformer is fed to the grid. This allows the color burst to be separated from the composite chroma signal and amplified. The positive enabling pulse causes the grid of V5B to draw grid current, charging C72 and C73. Between pulses, these capacitors discharge through R87, developing about 85 volts of bias. This bias, of course, holds the tube below cutoff between pulses.

The output from the burst-gate tube is coupled through L20 and excites the 3.58-MHz crystal, caus-

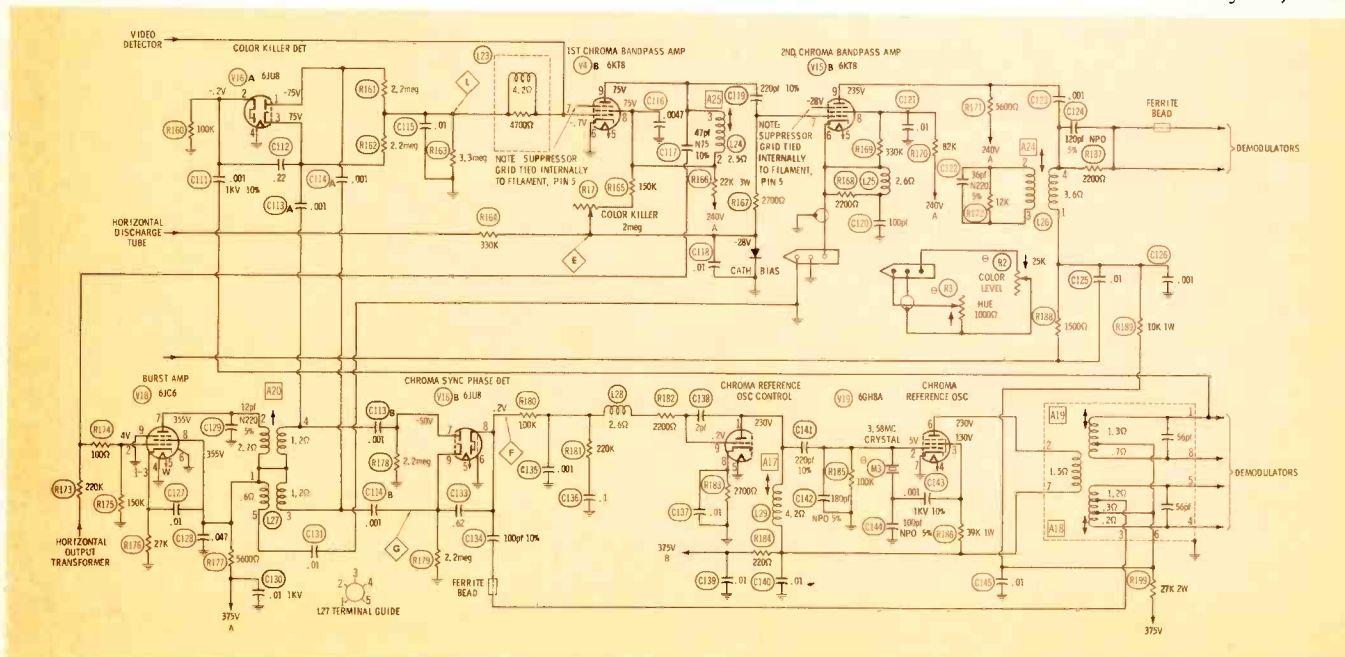


Fig. 7. Reference-signal circuits of the Zenith 20X1C36 chassis.

ing it to ring. Because of the high Q of the crystal, this ringing continues throughout the interval between color bursts. Each successive color burst rephases the crystal if there has been any drift. The amplitude of the ringing signal at the grid of V5C is large enough to overdrive the tube, and thus the output remains constant throughout the interval between bursts.

C86, connected between the plate of V5C and ground, shifts the phase of the reference signal to provide tint control. Quadrature reference signals are required, so a transformer having two secondaries is used as the plate load of V5C.

No color-killer circuit, as such, is used in this chassis. Since the demodulators have no output unless there is a reference-signal input, and since the 3.58-MHz crystal "rings out" if there is no color burst, the modulators are, in effect, cut off during b-w operation.

### Motorola Reference Circuits

The burst amplifier, chroma sync amplifier, color killer, and demodulator of the Motorola A22TS-918A are depicted in Fig. 9. The chroma cathode follower (not shown) drives both the chroma bandpass amplifier and the burst amplifier. An enabling pulse from the horizontal-output transformer turns on the burst amplifier, V16A, during the horizontal retrace interval, allowing the color burst to be separated from the composite chrominance signal.

The interstage transformer between V16A and V16B is tuned to

the burst frequency. The network consisting of R4, L31, and C149 is a phase-shifting network which allows the phase of the burst to be adjusted for correct hue. V16B further amplifies the color burst and feeds it, via the 3.58-MHz crystal, to the chroma-demodulator tube. Notice that the positive pulse applied to the screen grid of V16B gates this tube on during the horizontal retrace interval only.

The chroma-demodulator tube not only demodulates the chroma signal, but serves as the reference oscillator as well. This combination of both functions in a single tube was not noted in any of the other makes of sets examined. Since this particular portion of the color training series is limited to reference-signal and associated circuits, the method of demodulation will be discussed at a later time. At present, we will consider only the functions of the cathode, control grid, and screen of V15.

Consider V15 as an electron-coupled Hartley oscillator. In the absence of color bursts, oscillations are sustained by virtue of the split-inductance tank typical of a Hartley oscillator. During color reception, the amplified color burst is injected through the crystal to the grid of V15 and rephases the tank circuit to synchronize it with the burst signal. In this respect, the oscillator is similar to the injection-locked oscillator used in a number of other sets.

Since the oscillator is an integral part of the demodulator circuit, there is no way to split the oscillator

phase prior to demodulation. As we shall see later, chroma demodulation may be achieved so long as the phase of either the reference signal or the chroma signal is split. Motorola's decision to split the phase of the latter instead of the former is unique but equally acceptable.

The color-killer circuit is similar to the ones used in many of the sets discussed in the preceding pages. In the absence of color, a pulse from the horizontal-output transformer causes V5B to conduct, charging C131 and producing cutoff bias for the chroma amplifier. During color reception, the cathode current of V15 increases (because of the increased oscillator activity) and this drives the cathode of V5B positive into cutoff. Since C131 cannot charge when V5B is cut off, the bias is removed from the chroma-bandpass amplifier.

### Summary

From an examination of the circuits described in this issue and the latter portion of Part 4 of this series, we observe that there is a great degree of similarity among the several burst amplifiers. The main variation is in the method whereby the composite chroma signal and gating pulse from the horizontal-output transformer are injected into the circuit. The most common circuit configuration combines these two signals at the grid of the burst amplifier, but it is not unusual to have the chroma signal fed to the cathode and the positive enabling pulse fed to the grid.

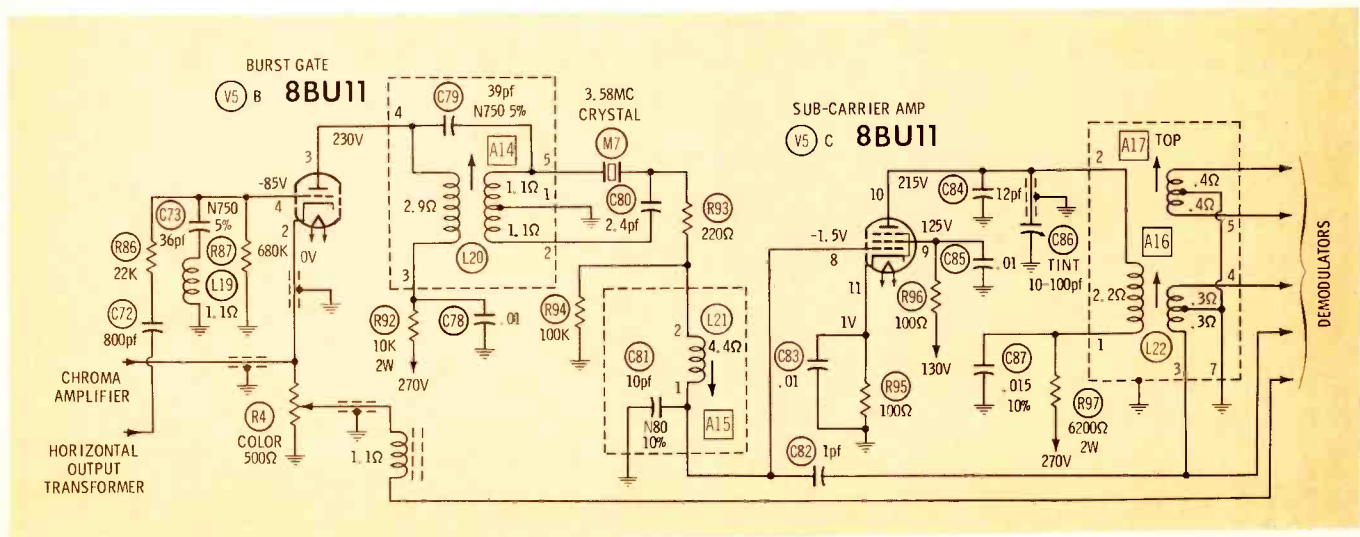


Fig. 8. Burst gate and subcarrier amplifier circuits of the General Electric HC chassis.

Two other variations are technically feasible but are not widely used, if they are used at all. A negative enabling pulse could be fed to the cathode of the burst amplifier while the chroma signal is fed to the grid, or both signals could be fed to the cathode. Notice that when a signal is fed to the cathode, the impedance of the source must be relatively low and a significant load is placed on the source. This is typical of any grounded-grid amplifier configuration.

Three basic methods of phasing the reference signal are in vogue. The system wherein the phase of the output from the oscillator is compared with the phase of the color burst is quite popular. The two signals are compared in a phase detector whose output controls an AFC tube. This circuit is similar to many horizontal-oscillator circuits which employ an AFC circuit. A second popular reference-oscillator circuit,

using injection locking, is also used extensively in horizontal-oscillator circuits. In this type of circuit, the color burst is injected directly into the tank circuit of the oscillator and the phase of the oscillator is controlled by "brute force." A third system uses no reference oscillator at all. Here, the color burst is amplified and fed to a final amplifier which resembles an oscillator but has insufficient feedback to sustain oscillation. The stage simply "rings" throughout the interval between color bursts to provide a continuous reference signal.

Reference oscillators take several forms, but all of them are crystal-controlled or crystal-stabilized. A pentode tube in an electron-coupled configuration is most popular. Nearly any oscillator configuration is possible, but the Hartley and the tuned-plate, tuned-grid types are popular.

Most color-killer circuits are simi-

lar in design, although the means of sensing the color burst varies from one make of set to another. Usually, if the reference oscillator is controlled by an AFC tube, an additional phase detector is used to operate the color killer. If an injection-locked reference oscillator is used, the oscillator-grid bias is normally used to control the color killer. In either event, the color-killer tube is cut off during color reception. The threshold control is set at the point where colored snow in an unused channel just disappears. In sets having an ACC circuit, the setting of the color-killer threshold may be critical. Follow the procedure recommended by the manufacturer or the one contained in the appropriate PHOTOFACT folder for the chassis being repaired.

Part 6 of this series will cover the operation of various chroma amplifiers, demodulators, and color-difference amplifiers. ▲

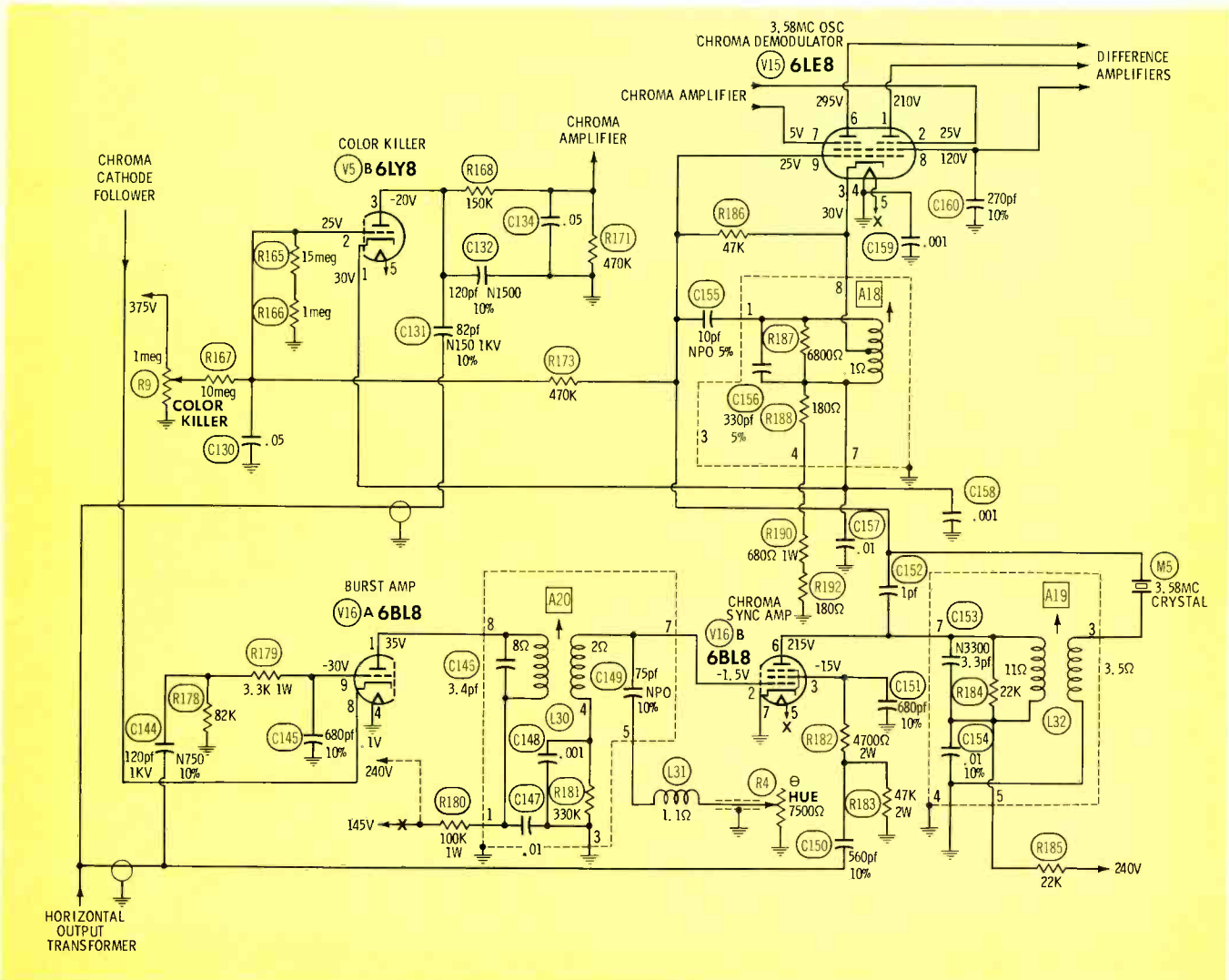


Fig. 9. Reference-signal circuits of the Motorola A22T5-918A chassis.



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NOTE: In addition to the regular 300 ohm models (above), each model is available in a 75 ohm coaxial cable downlead where this type of installation is preferable. These models, designated "XCS", each come complete with a compact behind-the-set 75 ohm to 300 ohm balun-splitter to match the antenna system to the proper set terminals.

## THE FINNEY COMPANY

34 West Interstate Street • Dept. 310 • Bedford, Ohio 44146

Circle 6 on literature card

January, 1968/PF REPORTER 23

# NOTES ON TEST EQUIPMENT

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

by T. T. Jones



Fig. 1. HV probe has built-in meter.

## High Voltage Probe

With the recent rash of publicity about X-rays, we're all aware now that the anode voltage in a color set should be accurately measured each time the set is serviced. This requirement does present a problem, since many servicemen do not like to carry more than a caddy on a house call.

Pomona has an answer to the problem in their Model 2900 High Voltage Test Probe (Fig. 1.) This instrument fits in the caddy, is self-contained, accurate, easy to use, and best of all, it's only \$19.95. Since a good accessory HV probe costs between \$10 and \$20, and you still have to buy the meter, the Model 2900 seems especially attractive.

The instrument is so simple to use its hardly worth mentioning. You just connect the ground lead, touch the probe to the ultor cap, and read the meter. There's no range switch to fumble with, no interpreting or mental arithmetic, and no guess work. The instruction sheet packed with the instrument gives a complete list of safety precautions to be observed while working with high voltage. Perhaps it does not sufficiently stress the fact that the ground lead must be connected before touching the probe to the ultor. Otherwise, you're liable to get a little jolt.

The heart of the tester is the meter in the handle, which is a 50 microamp movement. It's calibrated in 1 kilovolt increments, but the divisions are wide enough so you can interpolate ¼ kilovolt steps. The tester is shipped with a shorting wire across the meter, and it was necessary to disassemble the handle to remove the short before the first use. This gave us a chance to check the construction of the tester. It's constructed of high-impact plastic and appears as though it will stand years of banging around, but we recommend the styrofoam shipping box be used to store the instrument in the caddy.

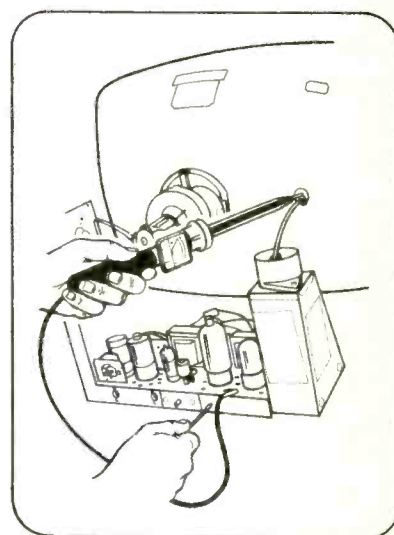


Fig. 2. The Model 2900 in use.

## Pomona Model 2900 Specifications

<b>Range:</b>	0-30 KV DC
<b>Input impedance:</b>	600 Megohms.
<b>Accuracy:</b>	± 3% fullscale.
<b>Power requirements:</b>	None.
<b>Size (LWD):</b>	14¾" × 1¾" × 1½".
<b>Weight:</b>	8 ounces.
<b>Price:</b>	\$19.95.

For further information circle 70 on literature card.



Fig. 3. New transistor tester has no Beta Cal control.

### Transistor Analyzer

The new Seco Model 260 transistor analyzer is the one of the simplest we have used. By simple we mean easy to use, though the circuit is also quite simple.

The in circuit testing procedure consists of: turn on the instrument, switch it to "Dynamic," connect the E, B, and C leads, and read the meter. If the needle moves upscale, the transistor is OK. If the needle doesn't move, reverse the PNP-NPN switch. If it still doesn't move, the transistor should be removed from the circuit for further tests.

The circuit for the dynamic check is shown in Fig. 4. Qx is the transistor under test. The circuit is a regenerative oscillator, operating at about 7kHz. If the transistor is capable of amplification, it will also oscillate, and there will be considerable voltage developed in the tank circuit C1-L1. A portion of this voltage is tapped off through R2, C2, R3, and C3, rectified by the diodes, and read on the meter. The actual voltage doesn't matter, since the presence of any voltage at all indicates the transistor is oscillating and is OK.

• Please turn to page 29

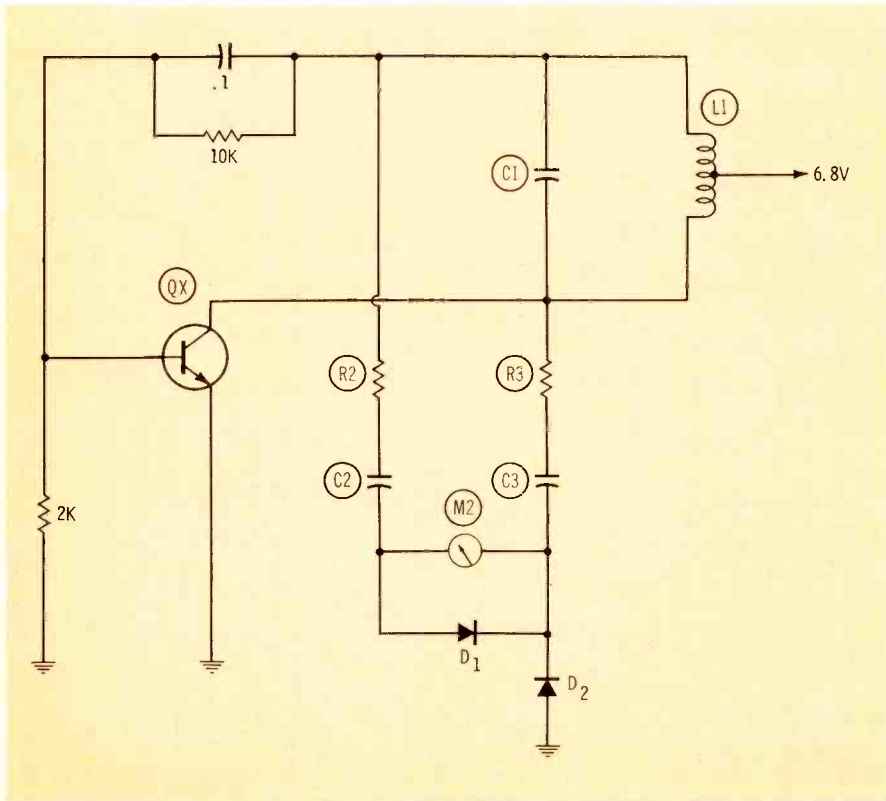


Fig. 4. Dynamic test measures oscillating ability.

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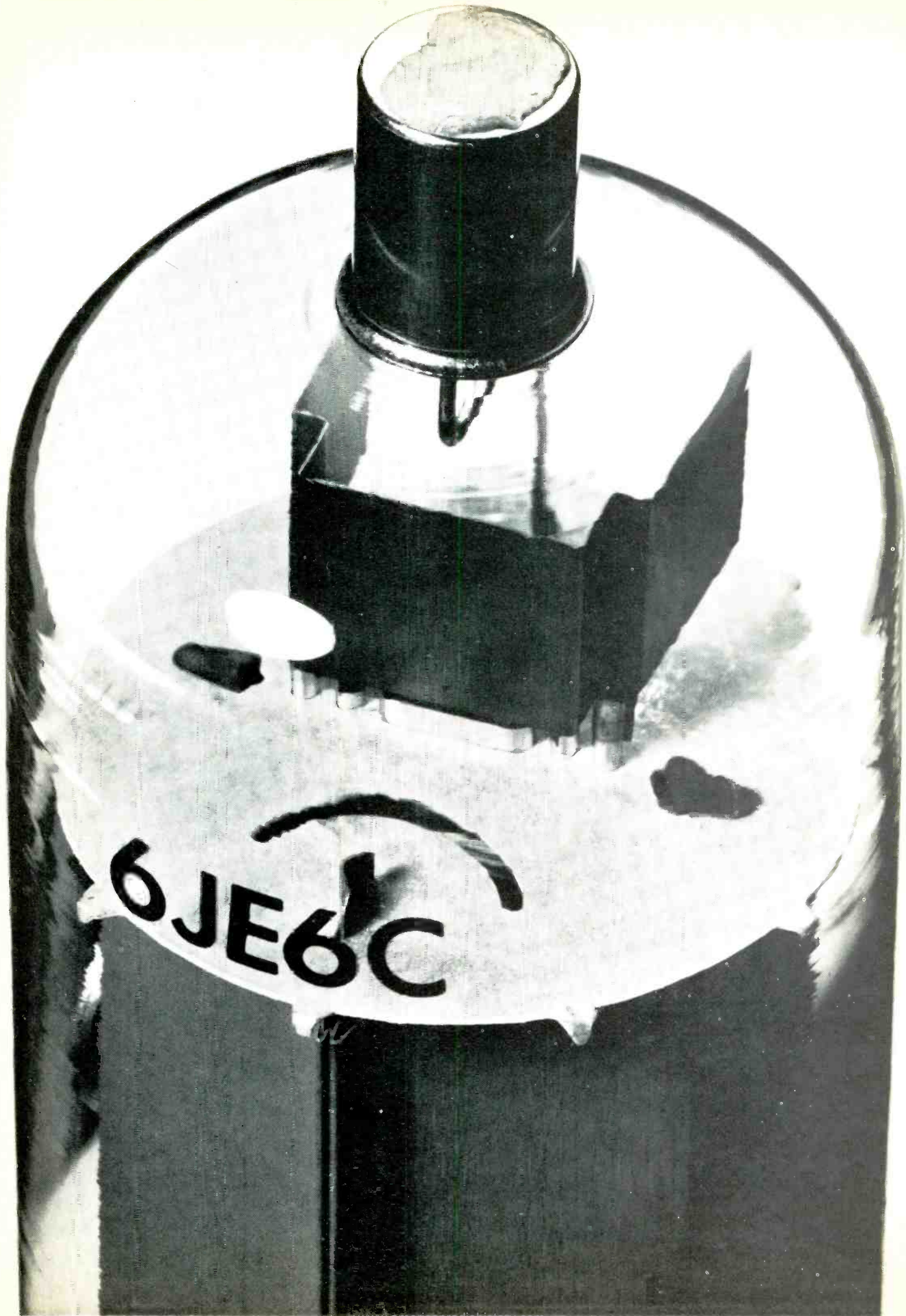
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January, 1968/PF REPORTER 25



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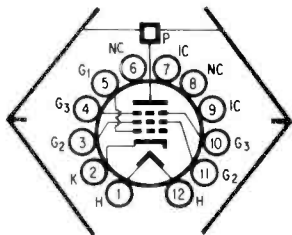
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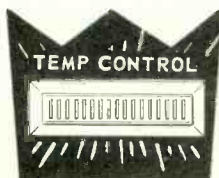
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**NOTES**

(Continued from page 25)

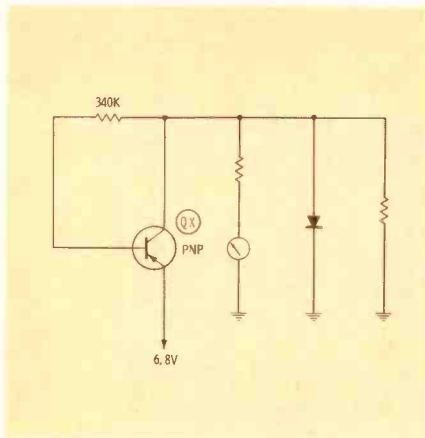


Fig. 5. Schematic of Beta test.

The Model 260 also includes a very simple Beta test. The transistor is inserted in the socket and DC Beta is immediately indicated. The Beta Cal control usually found in transistor testers has been eliminated by the circuit shown in Fig. 5. The 340k resistor is quite large compared to the internal resistance of the transistor, so it effectively regulates the Base current to 20 microamps. With this current fixed, then the meter can be calibrated in Beta, the ratio of base current to collector current. For NPN transistors the meter and voltage connections are transposed.

The Model 260 also measures  $I_{CBO}$  and  $I_{CEO}$  out of circuit. The power supply is a full-wave bridge, zener regulated. The case is leathette-covered wood, and all leads are furnished.

**SECO Model 260 Specifications**

**Tests performed:**

Quality on a relative scale.

Beta; 0-200, 0-1000. Base current 20  $\mu$ A signal, 1 mA power. VCE 6.8v.

$I_{CBO}$ ; 0-2 mA, 0-100 mA power (VCE 6.8v).

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**Size (HWD):**

4 1/4" x 7 3/8" x 8 3/4".

**Weight:**

4 1/4 pounds.

**Power requirements:**

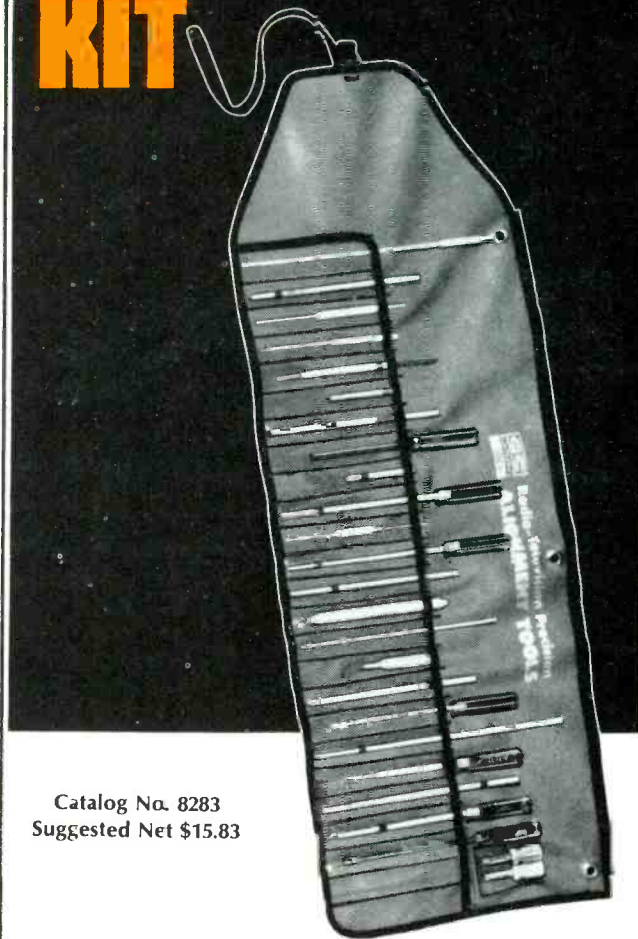
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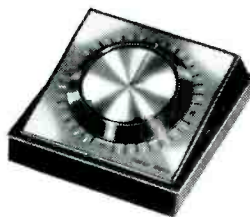
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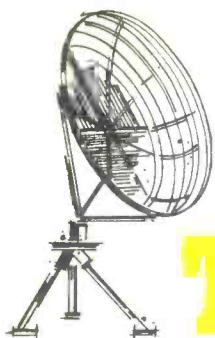
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# THE ELECTRONIC SCANNER

*news of the servicing industry*

### Electronic Sales Up

Despite some slow-downs earlier in the year, the electronics industry in 1967 will show a 10% gain in total factory sales over 1966, according to Robert W. Galvin, president of the **Electronic Industries Association**.

Preliminary estimates of the EIA Marketing Service Department, Mr. Galvin said, indicate that total factory sales in 1967 will reach about \$23 billion for a new record. Continued growth in 1968, he added, will bring an additional rise of more than 5% and combined industry sales of \$24 billion.

Color television set sales rebounded from summer doldrums and 1967 factory sales are expected to total 5.5 million or more compared with 5 million in 1966, the EIA president said. In 1968 the industry believes color receiver sales will exceed 6 million. Rising sales of FM radios and magnetic tape equipment also are helping to push total consumer product sales close to \$5 billion.

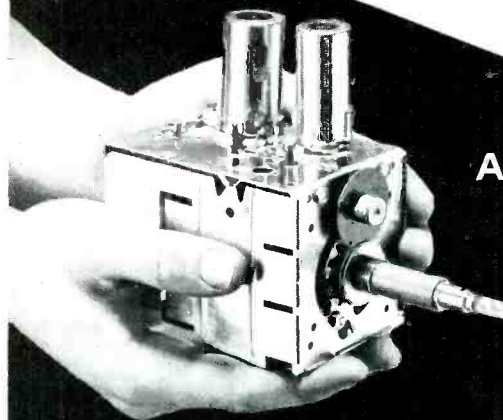
Component sales for the year are estimated at \$5.75 billion, Mr. Galvin said, compared with \$5.64 in 1966, but the increase has been chiefly in newer product areas such as color TV tubes and integrated circuits.

Both imports and exports of electronic products by the United States rose in 1967, Mr. Galvin noted, but exports rose at a faster rate. During the first eight months exports were up 29% and imports 18%.

### CB Industry Moves

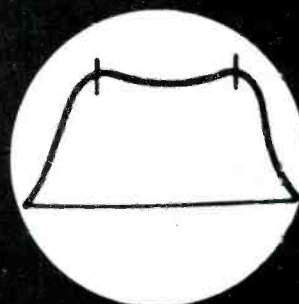
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Tuner Overhauling

# CASTLE

TV TUNER SERVICE, INC.

MAIN PLANT: 5701 N. Western Ave., Chicago 45, Illinois

EAST: 41-90 Vernon Blvd., Long Island City 1, N.Y.

place will spearhead the CB industry's 1968 advertising and publicity program, enthusiastically approved by the Citizens Radio Section of the Electronics Industries Association at its recent quarterly meeting in Los Angeles.

The newly-formed CB manufacturers' group will launch early in the year a market development program to greatly expand public awareness of the value of CB radio through consumer-oriented literature, highway signs, feature articles and store

displays as well as public-service messages in mass media.

#### Wins Service Award

Melvin C. McKenzie, the owner of a radio and TV store in Bay City, Michigan, has just received the third Community Radio Watch Distinguished Service Award to be given in the State of Michigan.

The award—a plaque and two hundred dollars in U.S. Government Savings Bonds—was presented to McKenzie for his quick radio noti-

fication which helped keep a fire from doing considerable damage to downtown Bay City, Michigan.

Mr. McKenzie radioed a report to his wife, who was working his base station, immediately notifying her of the fire and the location. His wife then telephoned the report to the Bay City Fire Department.

Earlier this year, a Detroit area fuel truck driver, Fred R. Howe, received the first Community Radio Watch Distinguished Service Award for notifying the authorities of a woman who had been thrown through her vehicle's windshield as the result of an accident. And later Charlie Jones, a driver for the Detroit Department of Street Railways, received the fifth Distinguished Service Award for saving apartment dwellers from being caught in a conflagration which occurred in the small hours of the morning.

#### Mergers & Expansions

Belden announced that a new plant will be constructed during 1968 at Jena, La., to produce insulated copper wire and cable. Approximately 200 employees will initially staff the new facility upon its completion late next year.

Belden's President Robert W. Hawkinson said a 43-acre site was selected at Jena in central Louisiana, for the Chicago-based company's fifth manufacturing plant. The facility will offer more than 150,000 sq. ft. of space including about 8,000 sq. ft. for offices. It will be designed to permit further expansion to meet future increases in production capacity, Hawkinson said.

Production of color television picture tubes has been started in Monterrey, Mexico by Sylvamex Electronica S.A., a subsidiary of General Telephone & Electronics International. Bernard T. O'Dea, President of Sylvamex, said the operation was begun to meet the anticipated growth of color TV in Mexico. 26,000 square feet has been added to Sylvamex's 60,000-square-foot plant to provide space for production of 10-inch and 25-inch color picture tubes for Mexican TV set manufacturers.

# THE BEST PERFORMING UHF CONVERTER TODAY!



**RMS SOLID-STATE ALL TRANSISTOR UHF CONVERTER HAS BUILT-IN AMPLIFIER... INCREASES GAIN AN ADDITIONAL 10 db!**

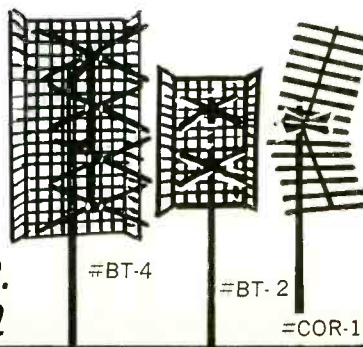
Updates any VHF TV set to receive any of the 83 UHF/VHF Channels. Low noise, drift-free UHF performance. Amplifier increases gain an additional 10 db gain to bring in reception where all other converters fail! Simple hook-up for profitable installation. Easy operation. Attractive Charcoal Gray cabinet.  
 Model CR-550A with Amplifier  
 Model CR-500 without amplifier

List price \$49.95  
 List price \$39.95

## UHF ANTENNAS

Make your next installation profitable with these dependable RMS Antennas. Write for FREE Informative Catalog! . . . Dept. PFC.

**RMS ELECTRONICS, INC.**  
 50 Antin Place, Bronx, N. Y., 10462



Circle 13 on literature card

IRC's Board of Directors approved in principle an agreement of merger with TRW Inc. A preliminary arrangement to combine the firms was announced on October 3rd.

The IRC Board also agreed to reconvene to consider action on the definitive merger agreement, which will be submitted to IRC's stockholders for approval at a special meeting in January. The agreement is also subject to approval by TRW's Board of Directors.

The addition of two new facilities to the training network of **Sams Technical Institute** has been announced by Howard W. Sams, Chairman of the Board, Howard W. Sams & Co., Inc.

A new 15,000 square foot building recently completed in Fort Wayne's Interstate Industrial Park will provide facilities for 400 student enrollments this fall in the northern Indiana area. Initial classes are under way there with additional classes planned for September.

The addition of Bramwell Business College in Evansville adds a complete range of business courses to the STI curriculum. It is the second Evansville STI facility serving southern Indiana. Established in 1919, Bramwell is a resident school offering day and evening programs in seven business subject areas.

The new training facilities in Fort Wayne and Evansville, together with the Indianapolis Center, will bring Indiana STI student enrollment in full-time resident courses to 2,225 by this fall. An additional center in Dayton has 300 students enrolled. Centers are planned for other key cities in the nation, Mr. Sams announced.

**General Instrument** and **Jerrold** announced that their respective Boards of Directors have approved the acquisition of Jerrold by General Instrument on the basis previously announced. The formal merger documents, pursuant to which General Instrument will issue seven-tenths of a share of its Common Stock for each outstanding share of Common Stock of Jerrold, have been signed.

As previously announced, the merger is subject to approvals of stockholders and receipt of a favorable ruling of the Internal Revenue Service.

**Oak Electro/Netics** formally dedicated a new television tuner assembly plant near Seoul, Korea in ceremonies attended by officials of the U.S. and Korean governments.

O/E/N Korea is expected to have an annual production rate of 2 million tuners by 1969. It is the third Far Eastern production facility established in the past five years by O/E/N. The other Far Eastern operations are an 84,000 square foot tuner assembly plant in Hong Kong and a Japanese facility in Hachioji that produces components assemblies for Japanese companies.

#### NARDA Convention

Houston will host the "1978" NARDA Convention next month. The association decided that now is the time for dealers to start planning how to cope with the problems and deal with customers of tomorrow—hence the ten-year theme.

You may register for the convention, to be held in Houston, Texas, February 8th through 10th, by writing to: NARDA, 827 Merchandise Mart, Chicago, Ill., 60654. ▲








*it Pays  
to go  
with  
the Guy  
that  
brought  
You!*



Let's face it! Oxford pioneered this speaker business—to coin a phrase—this "sound" business of speakers you're in. The fact that we were first in the making, and still first in selling, ought to tell you something. We've got the name—the quality—the value that sells.

Take Oxford's new "TEMPO" High-Fidelity speaker line. No one can touch it. Their exclusive "Floating Suspension Surround" extends the low frequency spectrum without "hangover", provides clean, transient response with smooth mid-range and brilliant high frequency response. You don't need to talk this one up... the unsurpassed brilliance and clarity of sound sells itself.

For replacement or new installations, it pays to go with "the guy that brought you", That way, you know you're home safe.

	"TEMPO" Hi-Fi Speakers
	Public Address Speakers
	Paging and Talk Back Speakers
	All Weather Speakers
	Replacement Speakers
	Professional Musical Instrument Speakers
	MEMBER ALMA

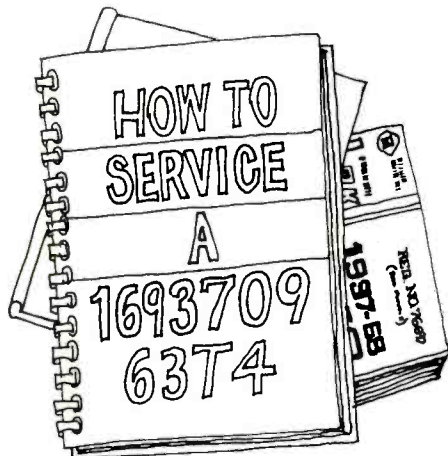
**OXFORD TRANSDUCER COMPANY**

A Division of  
Oxford Electric Corporation

3911 S. Michigan Ave.  
Chicago, Ill. 60653

Circle 14 on literature card

# If none of these things attracts you to the Parts and Service location at our Open House, there's always the free doughnuts.

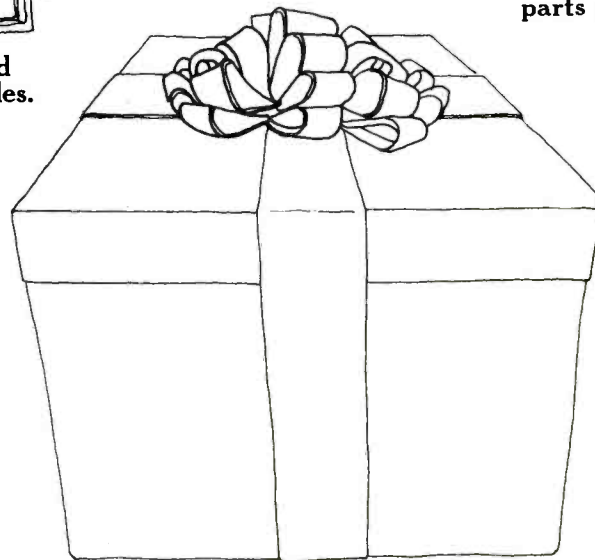
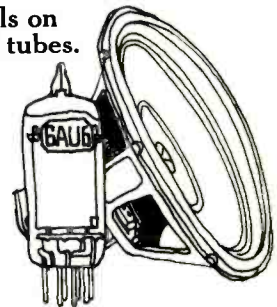


1. Free manuals and trouble-shooting guides.

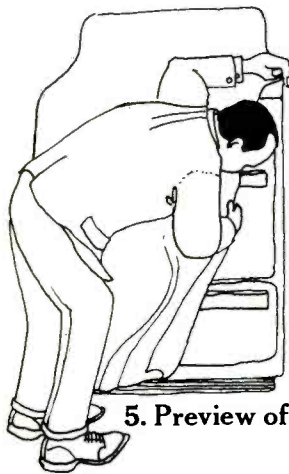


2. Training on new products.

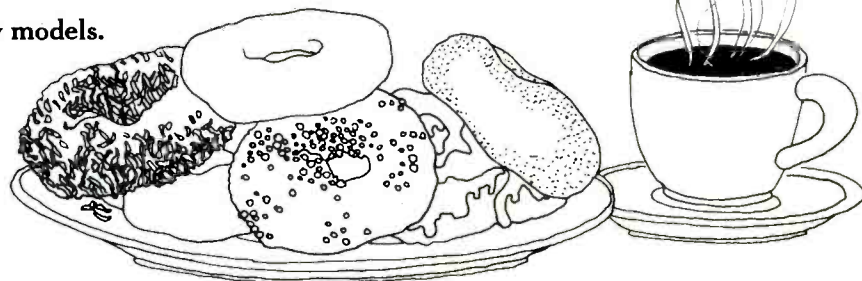
4. Specials on parts and tubes.



3. Free gifts and door prizes.



5. Preview of new models.



If you're feeling a little hungry during January or February, drop into our Open House at your Philco-Ford Distributor's or Parts and Service location.



FAMOUS FOR QUALITY THE WORLD OVER  
Philco-Ford Corporation, Philadelphia, Pa. 19134

# FAST

## COMPLETE OVERHAUL ON ALL MAKES OF TV TUNERS

Maximum Time In Shop 24 Hrs.



(WE SHIP C.O.D.)

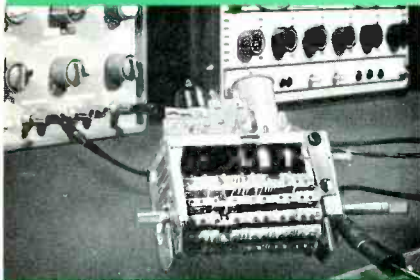
**\$9.50**

Black &  
White  
or Color

VHF or  
UHF

UV Combo's \$15.00

Price includes all labor and parts except Tubes, Diodes & Transistors. If combo tuner needs only one unit repaired, disassemble and ship only defective unit. Otherwise there will be a charge for a combo tuner. Ship tuners to us complete with Tubes, Tube Shields, Tuner Cover and all parts (including) any broken parts. State chassis, model number and complaint.



All tuners are serviced by **FACTORY TRAINED TECHNICIANS** with years of experience in this specialized field. All tuners are **ALIGNED TO MANUFACTURERS SPECIFICATION** on crystal controlled equipment and air checked on monitor before shipping to assure that tuner is operating properly.

## GEM CITY TUNER REPAIR SERVICE

Box 6C Dabel Station  
2631 Mardon Drive  
Dayton, Ohio 45420

Circle 15 on literature card

## LETTERS TO the EDITOR

Dear Editor:

I read Mr. Benzing's letter in the November PF REPORTER with much understanding. We service many Motorola color receivers and the same symptoms had us bugged for a while. While he found the defective component, the defect was of a different nature.

The inner conductor in early production was a tinned wire. During the tinning process some kinks occurred and these kinks caused the conductor to break after repeated heating and cooling cycles. When the set is then cold, the two parts come together and make contact. When the set is in use, the cable warms and expands, thus pulling the inner conductor apart. The capacity between the two parts passes some signal, with the best signal being those on the low band and, of course, the strong stations. Another problem we ran into was that the vertical sync was affected without a loss of picture, again usually on the low band only.

I hope this solution will help a lot of men save their hair.

R. ANDERSON

Palmer, Mich.

Dear Editor:

I have a foreign television set which the owner would like to have converted for American reception. This set is not listed in the PHOTOFACT Index and was last used in Sweden. Before we get too involved, do you think this conversion is practical? What about parts availability on future breakdowns?

H. HANSON

Ashland, Wis.

As a first step, I would advise you to read "Foreign TV Systems" in the July 1964 PF REPORTER. General information is contained in this article. To be specific, Sweden uses the CCIR 625-line system. This would require retuning of the horizontal and vertical scanning oscillators. The vertical circuit would require component changes. Channels E-2 through E-11 and channel E-43 are in use in Sweden with 5.5-MHz picture-sound separation and 7-MHz channel separation. These correspond closely to our channels 2, 3, 7 through 13, and 43. The tuner oscillator coils must be retuned and the RF coils retuned to attain 7-MHz band-pass.

The decision to proceed with the conversion must be made by you and the owner.—Ed. ▲

## impedance mismatch problems?

When most voice coil impedances were either 3.2 ohms or 8 ohms, speaker replacement was relatively simple. Then came transistor sets, and equip-

ment without output transformers, and now voice coil impedances range all over the map.

It's important to remember that a mismatched impedance in a speaker replacement will almost surely create problems... from a loss of volume to a blown transistor.

## Quam... and only Quam... helps you avoid these problems these three ways:

**1. WIDE CHOICE**—As Photofacts/Counterfacts participants, we know in advance what voice coil impedance the new equipment will require, so we generally have the right speaker in our comprehensive line *when you need it*.

**2. VERSATILE SPEAKERS**—Quam *multi-tap speakers* offer a choice of impedances in a single unit. Available in all the sizes you need for automotive replacement, Quam multi-taps handle 10, 20, or 40 ohm applications.

**3. SPECIAL SERVICE**—Just in case you run across an oddball, we offer this convenient exclusive: *any Quam speaker can be supplied with any voice coil impedance, only \$1.00 extra, list price.*



### QUAM

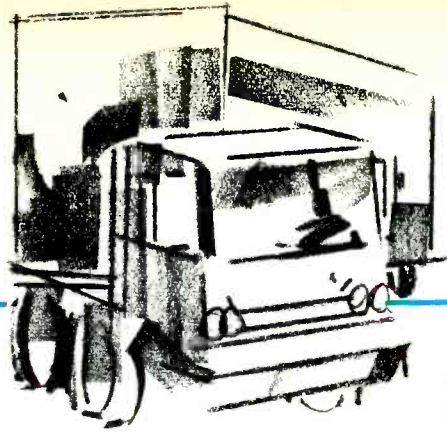
THE QUALITY LINE  
FOR EVERY SPEAKER NEED

## QUAM-NICHOLS COMPANY

234 East Marquette Road • Chicago, Illinois 60637

Circle 16 on literature card

January, 1968/PF REPORTER 35



# TIME TO MOVE ?

■ Nearly every shop owner, at one time or another, ponders the question of if and when to relocate. The correct answer to both questions requires careful consideration of a number of factors, most of which are included in the following check list. ■

*Ernest W. Fair*

Change and movement are marked features of life in the business world today. Each year sees further increase, according to the statistics which study such trends. The change factor is so important today that virtually every multiple-store company has developed its own system for determining the profitable time to move to another location.

Few such firms wait until declining business makes it obvious that a move is required. Instead, they apply their check list each time lease renewal comes up, or any other development makes it wise to do such an analysis.

Survival for the single-outlet electronic service shop owner can be even more important, for his future depends on that one business. It is important to him that he anticipate the need for change of his business location well ahead of its being a necessity for survival.

We've condensed three of the aforementioned systems into the following check-list, and any reader may use it to determine whether or not it is time to move his shop location.

✓ Has the general area of the business operation started to show a decline in buying power of customers therein over at least a six-month period?

If no over-all temporary cause can be isolated, a drop in business is always a prime factor to consider. Residents in another area may possess not only better, but more stable buying power.

✓ Have recent developments resulted in major changes of traffic-

flow into, around or through the area surrounding the shop?

If such a development is making it more difficult or inconvenient for customers to do business with your shop, then the situation is certain to be damaging in the long run. Naturally, any new location being considered must pass the favorable traffic flow test.

✓ Has the problem of customer parking at the present location become acute? Is there no method of handling it or no space available to solve it?

If this is a factor in patronage, the failure to find a solution can result in great loss of business. Change of location may be fully justified under such circumstances.

✓ Are virtually all of the other business establishments in the area being allowed to deteriorate in appearance by their owners?

Sometimes a drive to spruce-up can halt an area decline, but such cooperation is rarely obtained. A deteriorating business area not only fails to attract customers, but it actually repels them.

✓ Has the vacancy percentages of other business buildings in the area been steadily rising?

It is of particular importance to note when worthwhile business buildings continue to remain vacant over a long period of time. Invariably this is an indication that general business confidence in the particular area has disappeared, and usually for very good reasons. It's often more apparent to nonresidents than to the firms struggling to stay alive therein.

✓ Will expensive changes or ex-

pansion in the building be necessary immediately in order to build up the business in the future or even to hold your own for the present?

Where additional space in the immediate area is either too expensive or impossible to obtain for other reasons, or remodeling of an extensive nature will be necessary, it is sometimes wiser to seek another business home elsewhere.

✓ Are costs of doing business in the present location continuing to rise beyond safe margins and are they likely to continue doing so in the future, without a compensating rise in volume of business or net profit?

If increased business volume does not absorb such added costs, then a new location may be the most advisable step for the shop.

✓ Are there opportunities in another area which have such a great potential that the cost of making the move would be inconsequential?

In many cases such a situation will make a move very profitable even though one's shop is not in any unfavorable position at the present location. Utmost care must be exercised in checking, where this is the chief consideration behind a projected change of location.

✓ Will the loss of business closely tied to the present location be of any importance, and is it certain that this will be offset by the volume of new business that will be gained in the proposed location?

Gains of this nature can sometimes be an illusion, for overall increases in business cost on another location may more than offset the added volume. The gains should

# This part speaks for the whole radio.



## This box speaks well of you.

To the listener, the speaker is the most important part of the radio. Reason enough that it be of the highest quality and reliability. And when it says Delco on the box you can be certain you've got it: genuine OEM quality.

Delco Radio Parts are designed by engineers who specialize in automotive radios. Delco Radio speakers, for example, provide greater efficiency and sensitivity per ounce of magnet than any other speakers built. And since nearly half the cars on the road



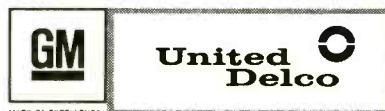
have Delco Radios as original equipment, you are assured of a vast pre-sold market.

Doesn't it make sense to stock the best for your customers?

They know Delco's reputation. So, the next time you reorder, remember your United Delco Supplier. He handles the most widely advertised, merchandised and recognized name in the parts business.

Why not let Delco Radio speakers say something nice about you?

Delco Radio, Division of General Motors, Kokomo, Indiana.



always be assayed against current losses and future costs.  
 ✓ Will it be possible to obtain a lease in the new location which can be handled under a normal volume of business?

When a new location has many advantages over the present one but a costly and restrictive lease goes along with it, then the actual gain made by the move may be small indeed.

✓ Are the attitudes and approaches of the other business men around the present shop location such as to diminish the possibility of any favorable future for the area?

In business districts where general apathy has set in among the owners of the firms therein, the over-all effect will weigh heavily upon one's own business possibilities no matter how much aggressive effort is put into the shop in its present location.

✓ Are the new business ventures being made in the community all bypassing the general area of the shop's present location even though space therein is available for them?

When this occurs one can be certain that very thorough studies are being made, and the results are proving anything but favorable to one's present location. If this has occurred, you should start doing some close checking on your own.

✓ Has depreciation caught up with fixtures and equipment at the present location to the point where very large sums will need to be spent immediately?

If other indications have pointed to the possible need for a change in business location, this can be a big factor for scrap or salvage of present equipment and installing new equipment in a new location. This will eliminate a costly moving bill, which is always a very important factor.

✓ Is the time at hand when remodeling cannot be put off any longer? Wouldn't it be better to move into a new and modern business home than to bear this expense in a present location?

Even after the renovating has been done, it may be of questionable value and do little to better the present location.

✓ Are changes forthcoming in the type of other business firms in the area which could make it less desirable from the viewpoint of a large segment of present customers?

Usually, one step in such a direction leads to many others and the business area seldom returns to the personality which formerly existed.

✓ Have there been changes in the size of families, steadily mounting average-age figures for most residents, and similar factors covering the present location area?

This generally results in a slow but steady decline of average purchases by customers. Whenever such factors become evident, it is always a good time to seriously consider a change of location.

✓ Finally, during the last two or three years has there been a continuous movement of population from the present area of business to some other in the community? Do all indications point to this as being of permanent nature? If they do, seeking a new location now can not only be a wise step but one necessary to survival of one's business. ▲



# PHOTOFACT<sup>TM</sup> BULLETIN



PHOTOFACT BULLETIN lists new PHOTOFACT coverage issued during the last month for new TV chassis. This is another way PF REPORTER brings you the very latest facts you need to keep fully informed between regular issues of PHOTOFACT Index Supplements issued in March, June, and September.

**Airline** GEN-11468A (63-11468) .....925-1  
 GHJ-13668A, GHJ-14098A,  
 GHJ-14148A, GHJ-14158A,  
 GHJ-14548A, GHJ-14558A .....928-1

**Coronado** TV2-6610A .....924-1

**Delmonico-Nivico** CT-195, CT-197EA, CT-199 .....928-2  
 PCT-198 .....926-1

**Magnavox**  
 Chassis T925-01-AA .....927-1

**Penncrest** 4877B-48, 4878B-46, 4886A-49,  
 4887A-47 .....924-2

**RCA**  
 Chassis CTC27A/B .....929-1  
 Chassis CTC30A/B/C/D/AA/AB/AC/  
 AD/AE/AF .....926-2  
 Chassis CTC31A/AA/B/P/R .....928-3  
 Chassis CTC35A/AA/AB/B .....925-2  
 Chassis KCS158B/C .....924-3

**Sears** 7100 (Ch. 564.10012) .....929-2  
 8100 (Chassis 562.10300) .....926-3

**Zenith**  
 20Y1C38 .....927-2

## Production Change Bulletins

**Admiral**  
 Chassis 21A4, 21A4D,  
 21B4, 21C4, 21F4, 21UA4  
 21UB4, 21UC4, 21UF4 .....929-3

**Sears** 5120, 5121 (Ch. 456/528.61240  
**Silvertone** thru 249  
 456/528.61414/415  
 456/528.61560 thru 569) .....926-4



# You can earn more money if you get a Government FCC License

...and here's our famous **CIE Warranty** that you **will get your License if you study with us at home**

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

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

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

## Opportunities in Plants

And there are other exciting opportunities in the aerospace industry, electronics manufacturing, telephone companies, and plants operated by electronic automation. Inside indus-



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



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

**Cleveland Institute of Electronics**

## WARRANTY

**OF SUCCESS IN OBTAINING  
A GOVERNMENT FCC LICENSE**

A Cleveland Institute of Electronics FCC License course will quickly prepare you for a Government FCC License. If you don't pass the FCC exam after completing your course, CIE will refund all your tuition. You get an FCC License...or your money back!

*[Signature]*

trial plants like these, it's the licensed technician who is always considered first for promotion and in-plant training programs. The reason is simple. Passing the Federal Government's FCC exam and getting your License is widely accepted proof that you know the fundamentals of Electronics.

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

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

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

CIE courses are so effective that better than 9 out of every 10 CIE gradu-

ates who take the exam pass it. That's why we can afford to back our courses with the iron-clad Warranty shown above: you get your FCC License or your money back.

## Mail Coupon for Two Free Books

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

## ENROLL UNDER NEW G.I. BILL

All CIE courses are available under the new G.I. Bill. If you served on active duty since January 31, 1955, or are in service now, check box in coupon for G.I. Bill information.

**CIE** Cleveland Institute of Electronics  
1776 East 17th Street, Cleveland, Ohio 44114

Cleveland Institute of Electronics  
1776 E. 17th St., Cleveland, Ohio 44114

Please send me without cost or obligation:

1. Your 40-page book "How To Succeed In Electronics" describing the job opportunities in Electronics today and how your courses can prepare me for them.
2. Your book "How To Get A Commercial FCC License."

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(Please Print)

Address \_\_\_\_\_

City \_\_\_\_\_

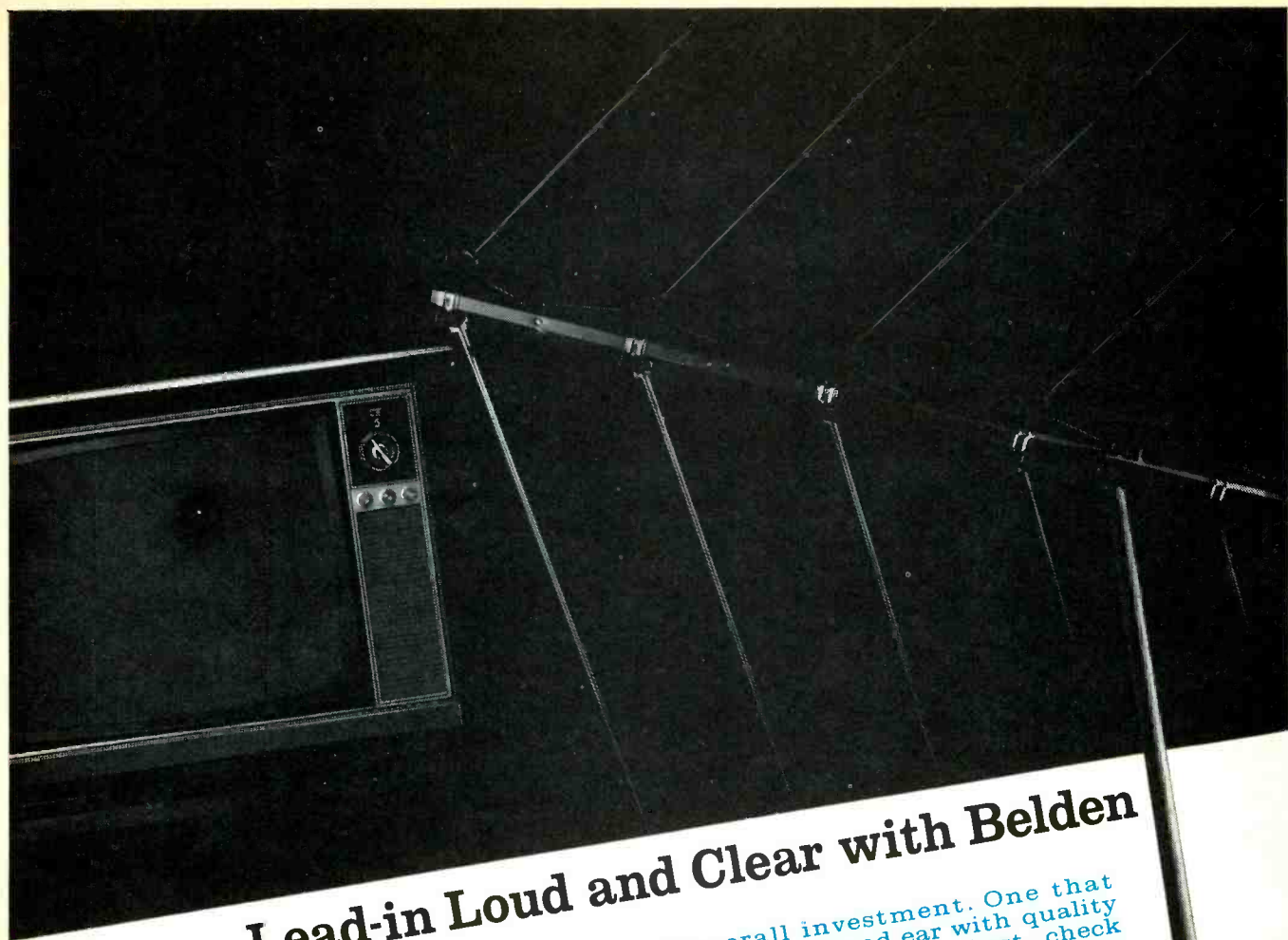
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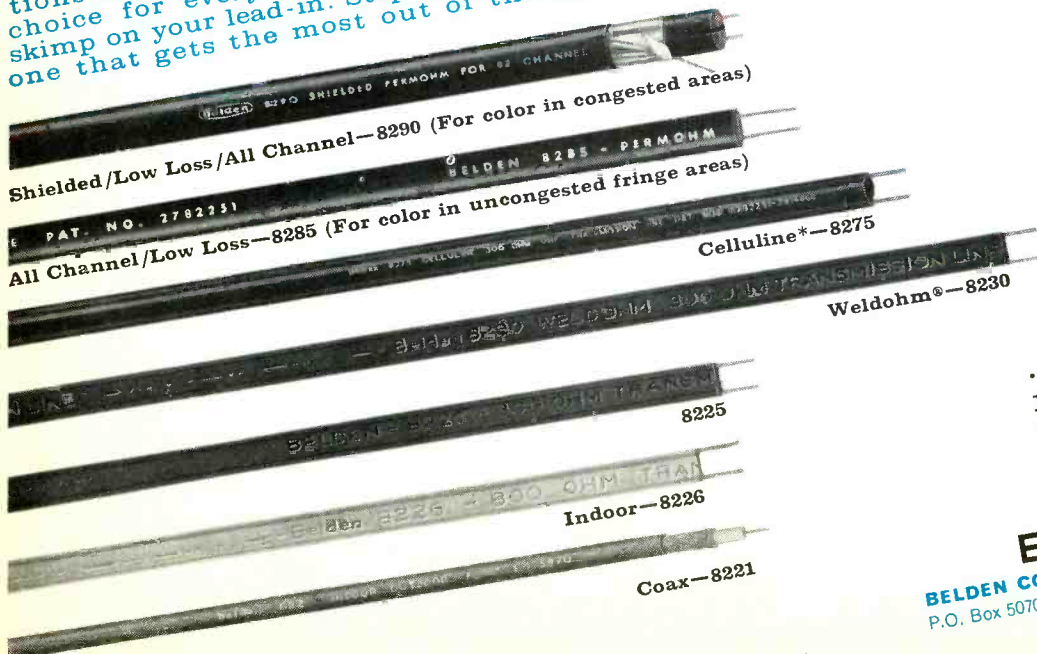
## Step up...Lead-in Loud and Clear with Belden

TV lead-in. Belden makes all kinds. Indoor, outdoor, for color and black and white reception. All have one thing in common: for price and performance you won't find better lead-in anywhere. They provide a picture-perfect link between antenna and set. Since no two installations are alike, Belden gives the right choice for every situation. But don't skimp on your lead-in. Step up... choose one that gets the most out of the cus-

tomers overall investment. One that will delight the eye and ear with quality reception. For the absolute best, check out 8285 and 8290: the Color Twins. You won't find anything comparable for all-channel black and white as well as living color. Your Belden Distributor has all the facts. Talk to him today. Belden Corporation, P.O. Box 5070-A, Chicago, Illinois 60680.

\*Belden Trademark, and Belden U.S. Pat. 2,814,666

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



...the missing link  
in perfect  
picture reception

**BELDEN**  
Belden Corporation  
P.O. Box 5070-A • Chicago, Ill. 60680

Circle 18 on literature card

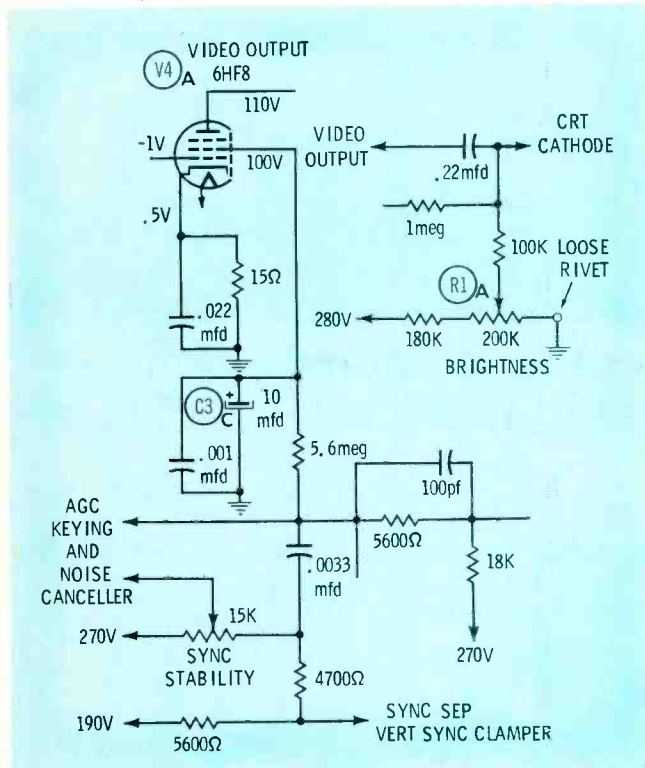
# THE TROUBLE-SHOOTER

## High Voltage Missing

A Zenith Chassis 14M23 (PHOTOFACT Folder 739-4) has no high voltage. Initial troubleshooting revealed an 850-ohm reading between terminal 7 of the flyback and the plate of the high-voltage rectifier. After replacing the flyback with one of the replacements listed in the PHOTOFACT, the set produces only 15kv (as opposed to the normal high voltage of 19.5 to 20.5kv) and the raster width is reduced. Boost voltage is approximately 450 volts (normally 740 volts). The amplitude of the waveform at the grid of the horizontal output tube is 100 volts p-p (normally 180 volts p-p), while the waveform at the grid of the horizontal oscillator is normal. The voltage at the cathode of low-voltage rectifier X2 measures 255 volts (normally 290 volts). However, when the horizontal output tube is pulled, the voltage at X2 increases to 285 volts.

CHARLES CATTERMOLE

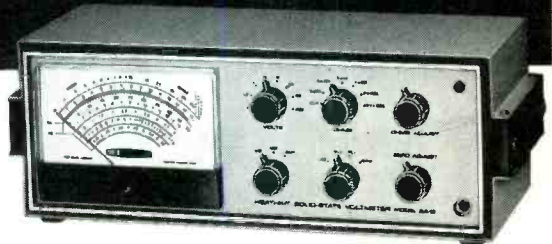
Pleasantville, N.J.



Your description of the trouble symptoms indicates reduced drive to the horizontal output tube, causing it to draw excessive current. However, there are other factors to be weighed before a definite diagnosis can be made. First, is the reduced low voltage a direct result of the increased load caused by excessive current in the horizontal output circuit? To answer this, measure the horizontal output cathode current. If it is more than 160 ma, the excess current could be pulling the high voltage down. If

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the horizontal output cathode current is near normal or below normal (doubtful), the trouble is probably related to a defect within the low-voltage supply, or a defect within another circuit that is pulling the low voltage down. With reduced low voltage, the output of the horizontal oscillator will not be sufficient to drive the horizontal output stage. Or, the original diagnosis of low horizontal output drive may be related to a defect within the plate circuit of the horizontal oscillator—a leaky or partially open C57B could be the culprit.

Before attempting to prove the preceding diagnosis, recheck all connections to the replacement horizontal output transformer, making sure that you have not overlooked a dummy terminal or connected the wrong wire to the wrong terminal, etc. Then, proceed to uncover the reason for the low drive voltage.

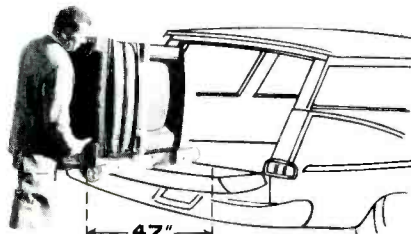
### Sync and Brightness Troubles

We have recently experienced a couple of unusual troubles that might be of interest to other service technicians. One involved vertical rolling in an RCA KCS136YA chassis (PHOTOFACT Folder 704-2). The rolling occurred only on Channel 2—Channels 5 and 11 locked in normally. Troubleshooting the sync circuits did not uncover any defects. The trouble was finally traced to a bad electrolytic (C3C) in the screen circuit of the video output stage.

Another unusual defect involved an RCA KCS142 chassis (PHOTOFACT Folder 768-4) that displayed a dark picture. At first, we thought the trouble was caused by low emission in the CRT, but a check of the picture tube revealed no defects. All circuit voltages checked normal. Finally, while probing around, we discovered that the rivet on the ground end of the brightness control was loose.

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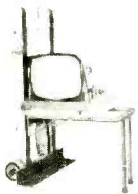
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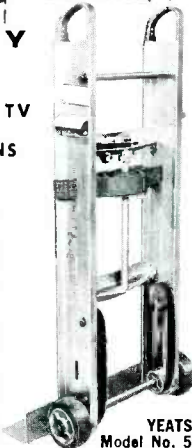
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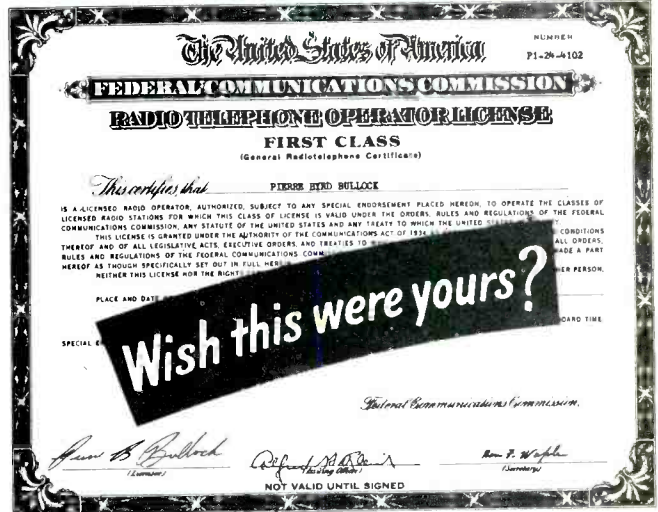
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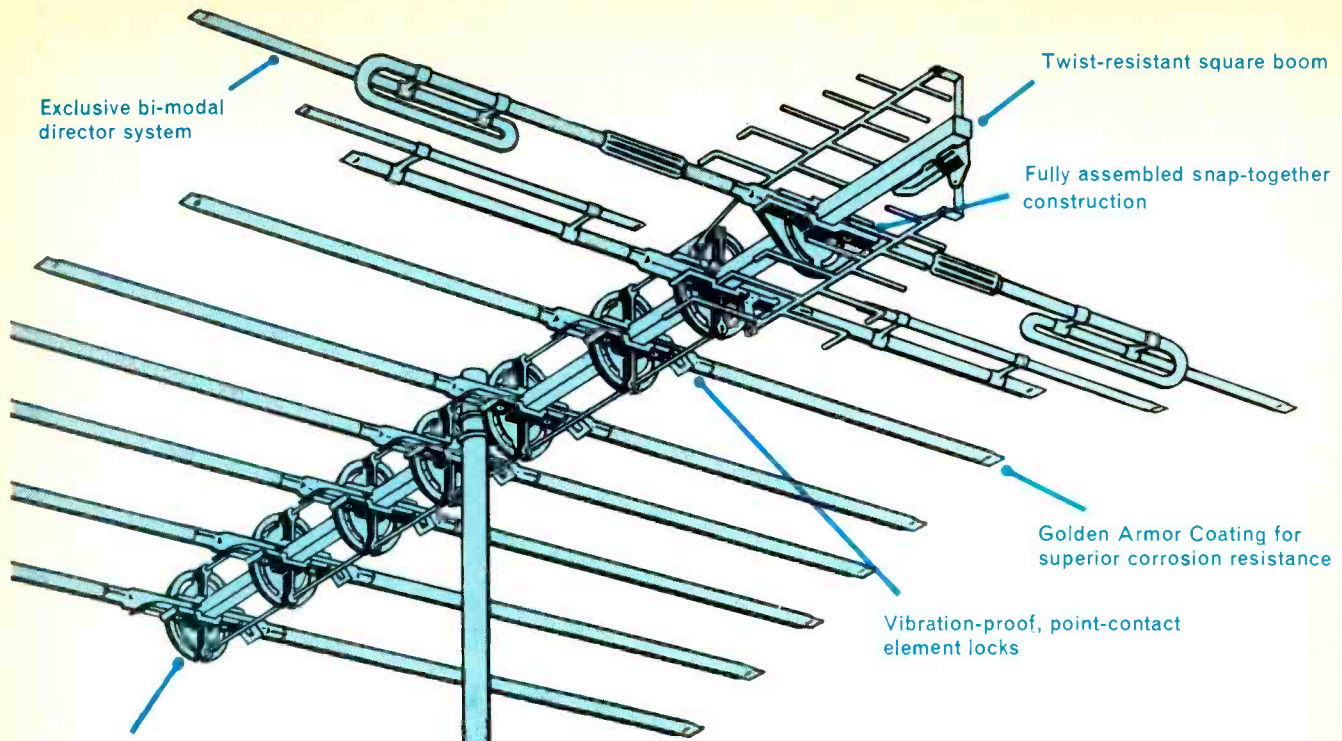
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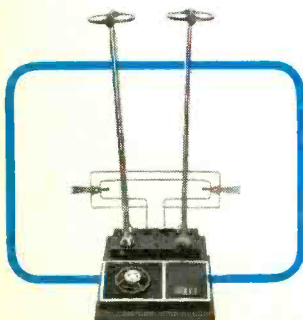
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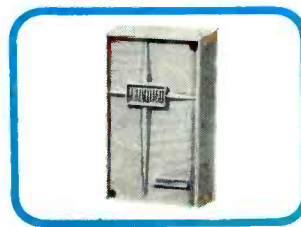
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283 Here are the PHOTOFACT sets with Color TV coverage from the beginning in 1954 through 1967:

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2	32	62	92	122	152	182	212	242	272	302	332	362	392	422	452	482	512	542	572	602	632	662	692	722	752	782	812	842	872	902
3	33	63	93	123	153	183	213	243	273	303	333	363	393	423	453	483	513	543	573	603	633	663	693	723	753	783	813	843	873	903
4	34	64	94	124	154	184	214	244	274	304	334	364	394	424	454	484	514	544	574	604	634	664	694	724	754	784	814	844	874	904
5	35	65	95	125	155	185	215	245	275	305	335	365	395	425	455	485	515	545	575	605	635	665	695	725	755	785	815	845	875	905
6	36	66	96	126	156	186	216	246	276	306	336	366	396	426	456	486	516	546	576	606	636	666	696	726	756	786	816	846	876	906 Sept
7	37	67	97	127	157	187	217	247	277	307	337	367	397	427	457	487	517	547	577	607	637	667	697	727	757	787	817	847	877	907 Sept
8	38	68	98	128	158	188	218	248	278	308	338	368	398	428	458	488	518	548	578	608	638	668	698	728	758	788	818	848	878	908 Sept
9	39	69	99	129	159	189	219	249	279	309	339	369	399	429	459	489	519	549	579	609	639	669	699	729	759	789	819	849	879	909 Sept
10	40	70	100	130	160	190	220	250	280	310	340	370	400	430	460	490	520	550	580	610	640	670	700	730	760	790	820	850	880	910 Sept
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12	42	72	102	132	162	192	222	252	282	312	342	372	402	432	462	492	522	552	582	612	642	672	702	732	762	792	822	852	882	912 Oct
13	43	73	103	133	163	193	223	253	283	313	343	373	403	433	463	493	523	553	583	613	643	673	703	733	763	793	823	853	883	913 Oct
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21	51	81	111	141	171	201	231	261	291	321	351	381	411	441	471	501	531	561	591	621	651	681	711	741	771	801	831	861	891	921 Nov
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24	54	84	114	144	174	204	234	264	294	324	354	384	414	444	474	504	534	564	594	624	654	684	714	744	774	804	834	864	894	924 Dec
25	55	85	115	145	175	205	235	265	295	325	355	385	415	445	475	505	535	565	595	625	655	685	715	745	775	805	835	865	895	925 Dec
26	56	86	116	146	176	206	236	266	296	326	356	386	416	446	476	506	536	566	596	626	656	686	716	746	776	806	836	866	896	926 Dec
27	57	87	117	147	177	207	237	267	297	327	357	387	417	447	477	507	537	567	597	627	657	687	717	747	777	807	837	867	897	927 Dec
28	58	88	118	148	178	208	238	268	298	328	358	388	418	448	478	508	538	568	598	628	658	688	718	748	778	808	838	868	898	928 Dec
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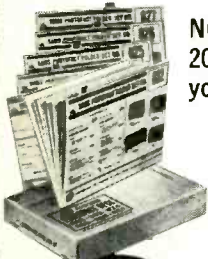
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January, 1968/PF REPORTER 45

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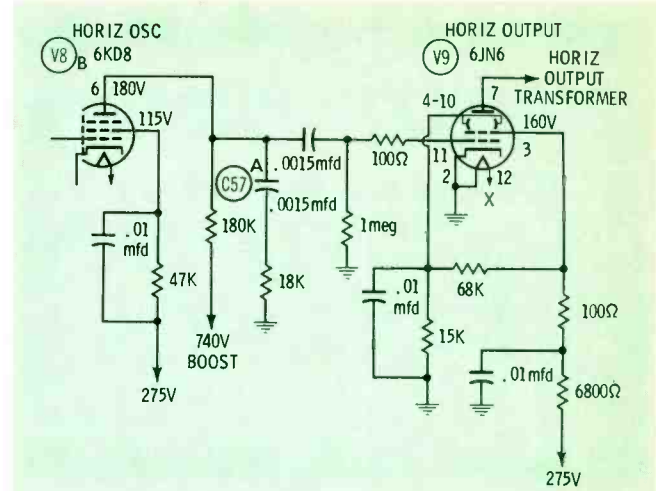
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Resoldering the rivet completed the ground path and the CRT returned to normal brightness.

C. E. COMBS

Atlanta, Ga.



Obviously, in your location, the signal from Channel 2 is not as strong as that from Channels 5 and 11. With C3C leaking, the amplitude of the sync pulses was further reduced, so that a combination of the two factors resulted in insufficient input to the sync separator and clamper. The loose rivet on the ground end of the brightness control opened the circuit, placing the full 280 volts on the CRT cathode—producing the obvious result.

**Tips on Zenith Chassis**

In the Troubleshooting column in the October '67 issue, Mr. C. H. Alexander described a vertical sync

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problem he encountered in a Zenith chassis. I've experienced the same symptom in Zenith chassis, and the cause of the trouble was an open screen bypass capacitor in the video output stage.

In the same column and issue, another technician (Mr. N. Wise) described the high-voltage problem he was experiencing with another Zenith chassis. I've had many such problems with Zenith chassis and have worked out a system of diagnosis that seems to work quite well. I've divided high-voltage troubles into "squeal" and no-squeal" symptoms. The presence of squeal with a high-voltage problem can indicate a dead horizontal oscillator, shorted capacitor (180 pf) between the plate and cathode of the damper tube, an open filter section, or perhaps a shorted IK3 high-voltage rectifier.

A "no high voltage" symptom without squeal can be caused by an open dropping resistor in the plate of the horizontal oscillator. After checking this resistor, try drawing an arc from the plate of the high-voltage rectifier. If no arc can be drawn, or if the arc is weak, disconnect the yoke from the horizontal output transformer. If high voltage returns, or increases, replace the yoke with a new one. If the high voltage does not return, or if the arc is still weak, replace the horizontal output transformer. This procedure has worked with approximately 90% of the high-voltage problems I have encountered in Zenith Chassis.

MAX GOODSTEIN

Flushing, N.Y.

*Thank you for sharing your tricks-of-the-trade with us. Your technique concerning the "squeal" and "no squeal" categorizing of high-voltage problems in Zenith chassis is unique. Obviously, the Zenith chassis you referred to with regard to the vertical sync problem was not a Zenith 14M-21/X chassis. This particular chassis does not have a screen bypass capacitor in the video output stage — the screen is connected directly to the 125-volt B+ line.*

### Ion Spot and Halation

I have a Zenith 17B20 (PHOTOFACT Folder 429-2) that displays an ion spot and halation after the set is turned off. The picture has good definition and contrast at low brightness. How can I get rid of the ion spot and halation?

G. KEIL

Freeport, Ill.

*The ion spot and halation you are experiencing is a result of the fact that*

*the high voltage does not decay as rapidly as the sweep voltage when the set is turned off. The high voltage may remain for as long as two or three minutes unless the set is operating at high brightness, which quickly discharges the high-voltage filter capacitor or aquadog coating of the CRT.*

*Several types of spot-killer circuits have been designed into many chassis to provide quick removal of the ion spot after the set has been turned off. One such circuit uses an extra switch ganged to the on-off switch to decrease*

*the CRT bias when the set is turned off. The same effect can be realized by merely turning up the brightness control before turning the set off. Other types of spot killers include a switch that removes the B+ from the brightness control when the set is turned off, resulting in increased CRT conduction and quicker current drain. Another type applies a positive voltage to the CRT grid to accomplish the same quick current drain. An automatic spot killer using an NE2 neon bulb has also been used. ▲*

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Circle 27 on literature card

January, 1968/PF REPORTER 47

# successful service shop beats rising costs with B&K television analyst



*"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.*



**B & K MANUFACTURING CO.**  
DIVISION OF **DYNASCAN CORPORATION**  
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Export: Empire Exporters, 123 Grand St., New York 13, U.S.A.

SEE PHOTOFACT Set 796, Folder 3

Mfr: Magnavox

Chassis No: T/U 904

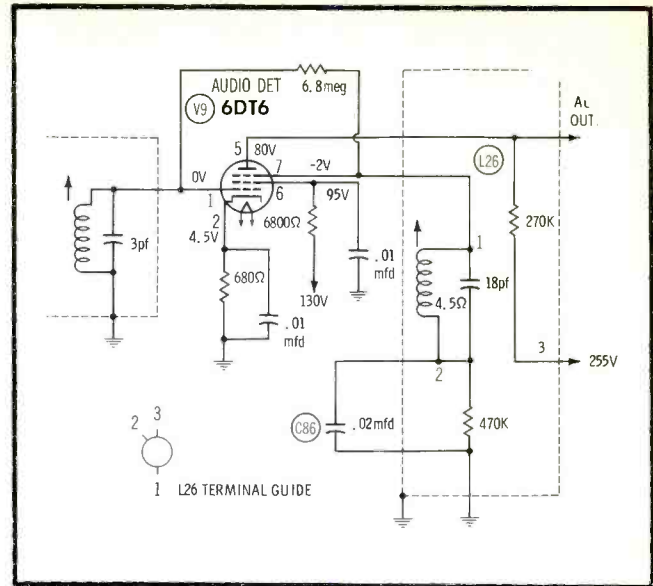
Card No: MA T/U 904-1

Section Affected: Sound.

Symptoms: Buzz in sound.

Cause: Open capacitor in quadrature circuit of audio detector.

What To Do: Replace C86 (.02 mfd).



Mfr: Magnavox

Chassis No: T/U 904

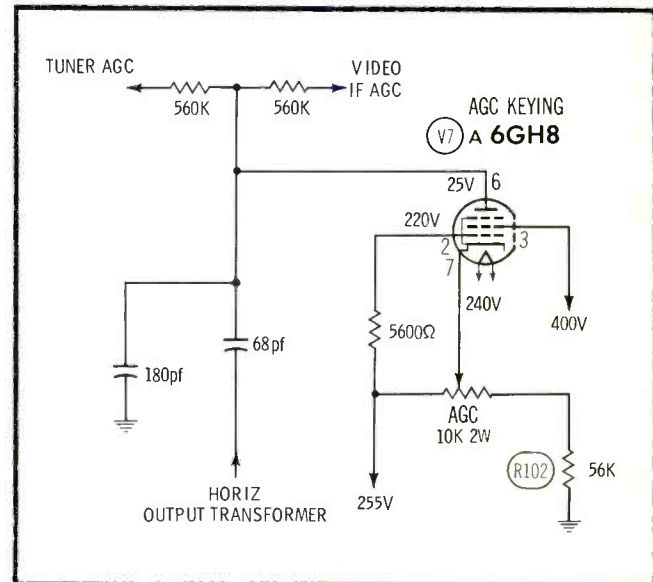
Card No: MA T/U 904-2

Section Affected: Color pix.

Symptoms: Video overload on strong station signal.

Cause: AGC keying circuit cathode resistor overloads and opens.

What To Do: Replace R102 (56K); also V7 (6GH8).



Mfr: Magnavox

Chassis No: T/U 904

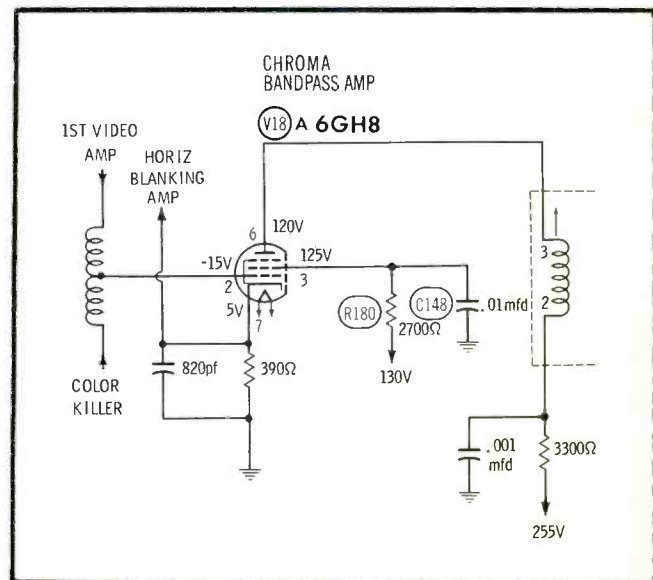
Card No: MA T/U 904-3

Section Affected: Color Pix.

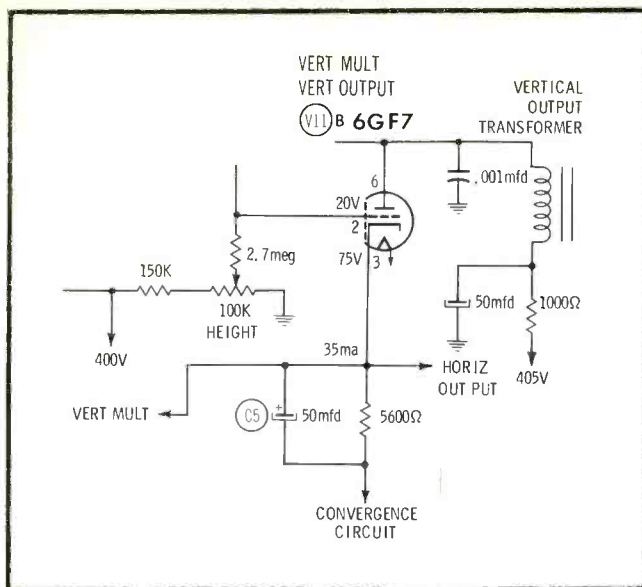
Symptoms: No color pix; black-and-white normal. Low voltage on screen grid (pin 3) of chroma bandpass amplifier.

Cause: Leaky screen grid bypass capacitor in chroma bandpass amplifier circuit.

What To Do: Replace C148 (.01 mfd) and R180 (2700 ohms).



SEE PHOTOFACT Set 796, Folder 3



SEE PHOTOFACT Set 796, Folder 3

Mfr: Magnavox

Chassis No: T/U 904

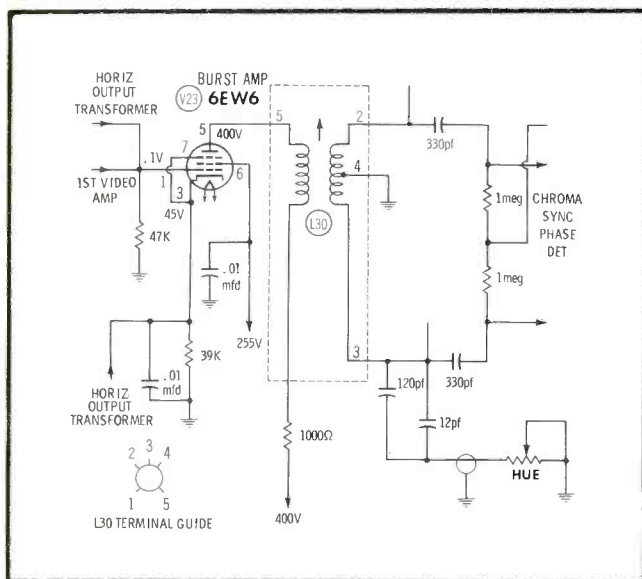
Card No: MA T/U 904-4

Section Affected: Raster.

Symptoms: Vertical jitter.

Cause: Defective cathode bypass capacitor in vertical output circuit.

What To Do: Replace C5 (50 mfd).



Mfr: Magnavox

Chassis No: T/U 904

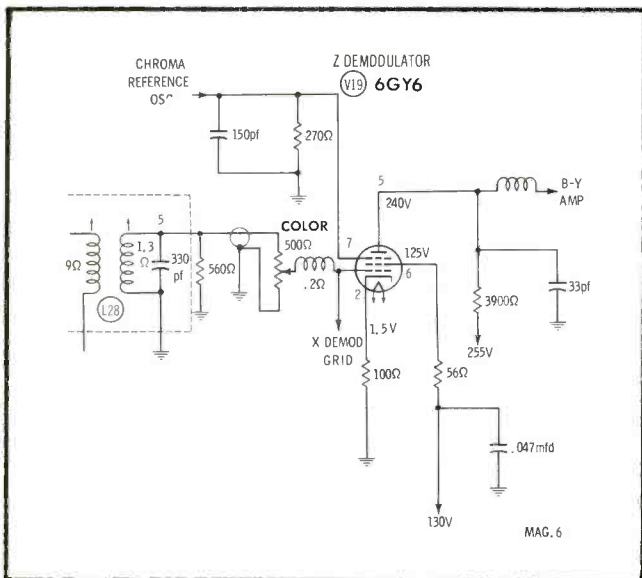
Card No: MA T/U 904-5

Section Affected: Color sync.

Symptoms: Color pix floats in and out of sync; black-and-white pix normal.

Cause: Bad ground connection to burst amplifier transformer.

What To Do: Resolder ground connection at terminal 4 of L30, burst amplifier transformer.



Mfr: Magnavox

Chassis No: T/U 904

Card No: MA T/U 904-6

Section Affected: Color pix.

Symptoms: No color pix; black-and-white pix normal.

Cause: Defective color control cable.

What To Do: Replace color control cable.

SEE PHOTOFACT Set 834, Folder 4

Mfr: Zenith

Chassis No: 25NC37

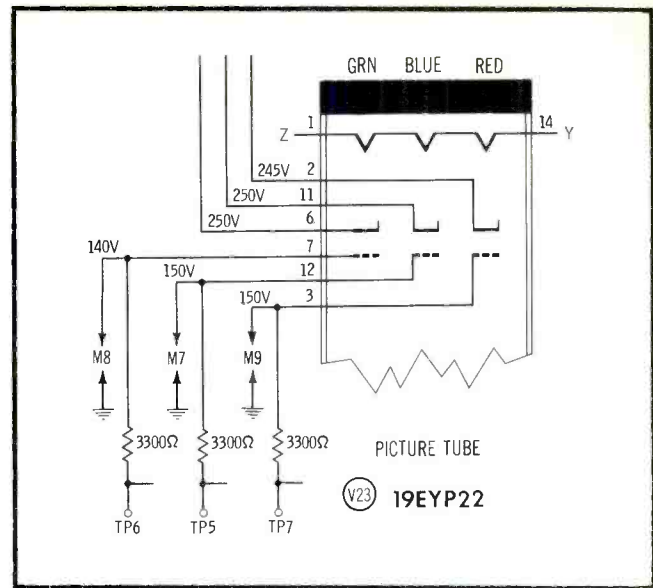
Card No: ZE25NC37-1

Section Affected: Raster; b-w setup.

Symptoms: Red-green and/or blue fields not obtainable.

Cause: Shorted spark gap at one of three screens of CRT.

What To Do: Replace defective spark gap, M7, M8, or M9.



Mfr: Zenith

Chassis No: 25NC37

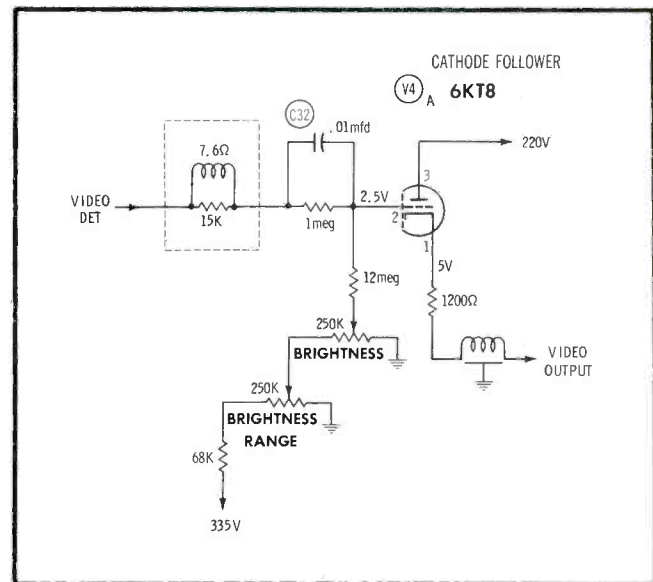
Card No: ZE25NC37-2

Section Affected: Raster.

Symptoms: Very dim raster.

Cause: Shorted coupling capacitor in cathode-follower stage of video amplifier.

What To Do: Replace C32 (.01 mfd).



Mfr: Zenith

Chassis No: 25NC37

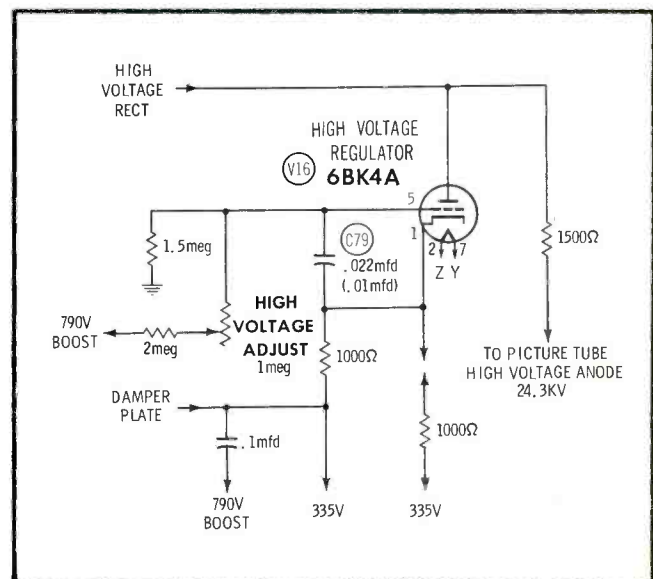
Card No: ZE25NC37-3

Section Affected: Raster.

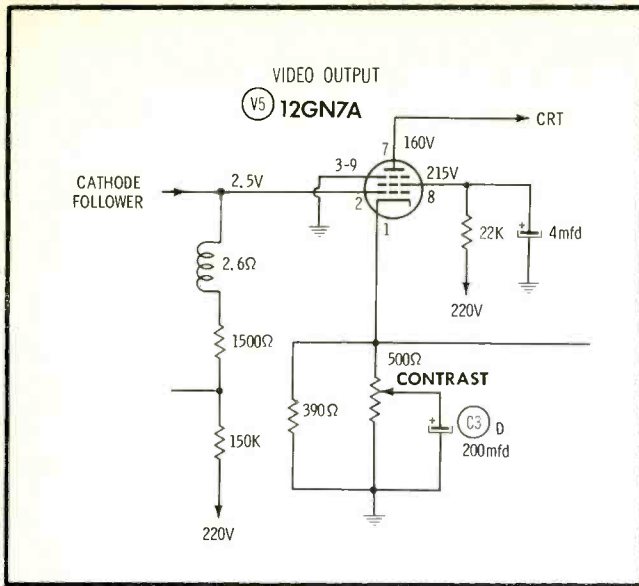
Symptoms: No focus.

Cause: Shorted grid-cathode capacitor in high-voltage regulator.

What To Do: Replace C79 (.022 or .01 mfd).



SEE PHOTOFACT Set 834, Folder 4



SEE PHOTOFACT Set 834, Folder 4

Mfr: Zenith

Chassis No: 25NC37

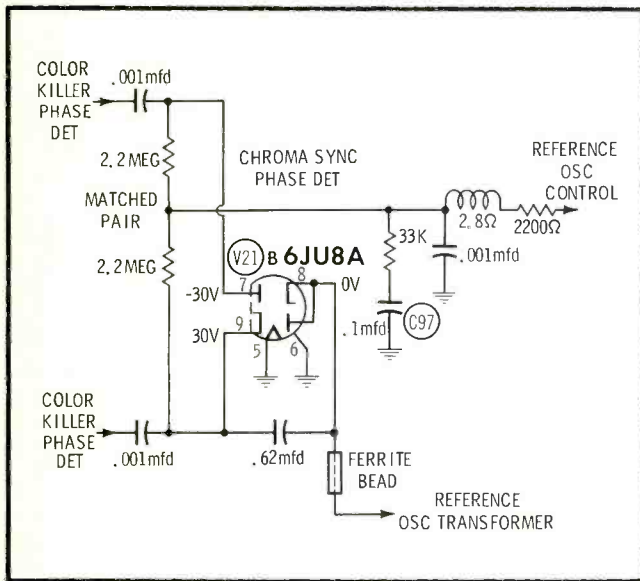
Card No: ZE25NC37-4

Section Affected: Pix.

Symptoms: Poor contrast; no control of contrast.

Cause: Open cathode filter capacitor in video output circuit.

What To Do: Replace C3D (200 mfd).



Mfr: Zenith

Chassis No: 25NC37

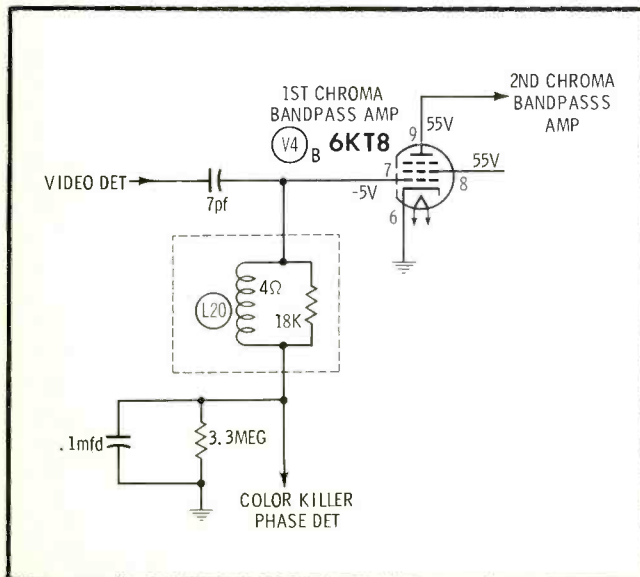
Card No: ZE25NC37-5

Section Affected: Color sync.

Symptoms: Color sync lost when channel is changed.

Cause: Shorted capacitor in chroma sync phase detector output circuit.

What To Do: Replace C97 (.1 mfd).



Mfr: Zenith

Chassis No: 25NC37

Card No: ZE25NC37-6

Section Affected: Color.

Symptoms: Color overshoot; blue shadow occurs on one side of figure; face may be shadowed blue or green.

Cause: Open peaking coil in grid circuit of 1st chroma bandpass amplifier.

What To Do: Replace L20, coil resistor combination.

# COLOR

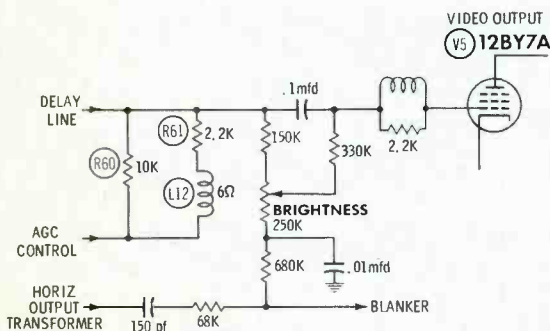
## COUNTERMEASURES

SYMPTOMS AND TIPS FROM ACTUAL SHOP EXPERIENCE

**Chassis:** RCA CTC12, 15

**Symptoms:** Dim picture; no control of brightness.

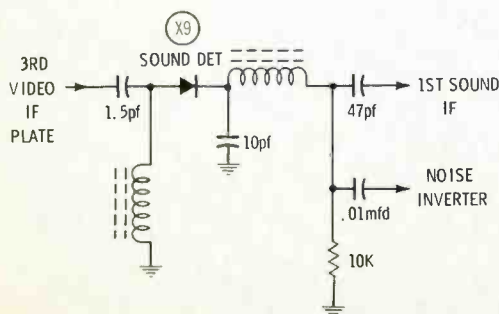
**Tip:** Rotating brightness control produces no change of brightness on screen. Common cause of trouble is open L12 in grid circuit of video output stage. Positive voltage for the brightness control is obtained from the cathode of the AGC keyer and noise inverter via L12 and R61. With L12 open, the only path for this positive voltage is via the 10K-ohm resistance of R60. This added resistance of approximately 7.8-K ohms reduces the positive voltage to a value lower than normally required for proper brightness control action.



**Chassis:** Packard Bell 98C7D, 98C8

**Symptoms:** Video overload when channel changed — clears up in 1 to 4 seconds. In some instances, audio disappears during video overload — depends on strength of station signal.

**Tip:** Possible cause is defective X9, sound detector diode.



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that tests all color tubes  
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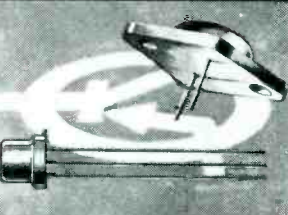

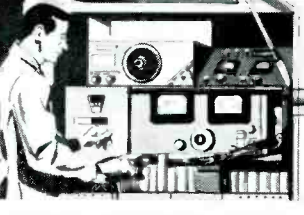
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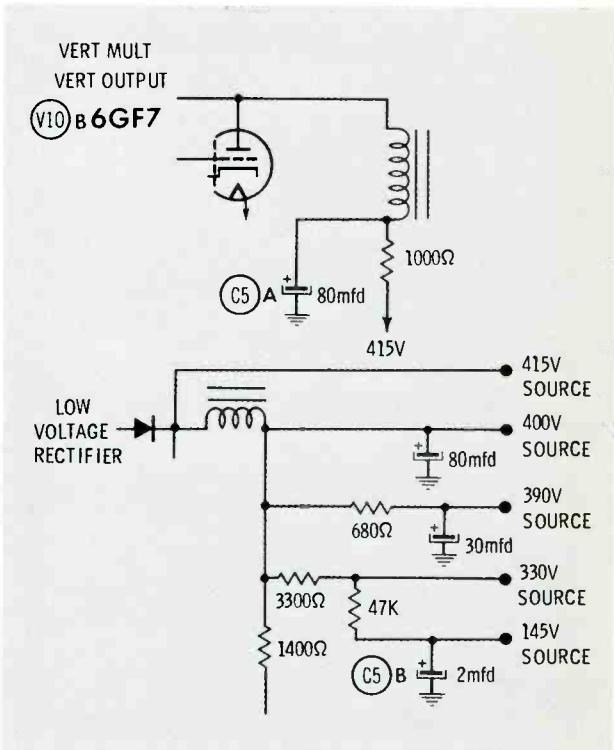
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Chassis: RCA CTC15

**Symptoms:** Picture fades intermittently—screen varies from half black and half white with retrace lines to completely black overall.

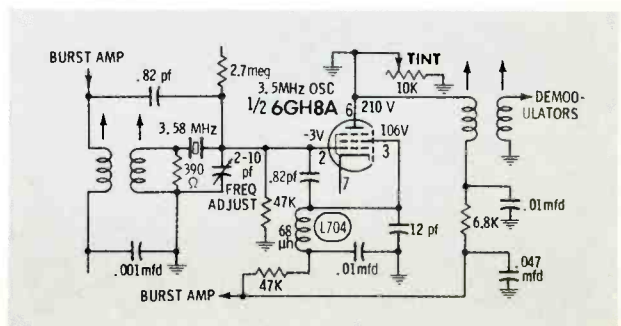
**Tip:** Trouble possibly caused by open filter capacitor C5, sections A and B. Section B of C5 is employed in the 145-volt B+ line that serves the screen grid of the 1st video amplifier—which accounts for blacking out of screen. Section A of C5 is connected to the primary winding of the vertical output transformer—thus the retrace lines. Bridge C5 with a known good capacitor of equal or near equal value—symptom should disappear.



Chassis: RCA CTC19, 20, 24

**Symptoms:** Green or purple horizontal bars appear on screen during b-w reception; however, picture appears normal during color reception.

**Tips:** Possible cause could be shorted L704 in screen grid circuit of 3.58-MHz oscillator. Defect is hard to locate with resistance or screen voltage checks. With L704 shorted, noise is permitted to pass through oscillator to demodulators, causing interference on screen during b-w reception. When color is received, oscillator acts as amplifier for the incoming burst signal and the output is sufficient to demodulate color information.

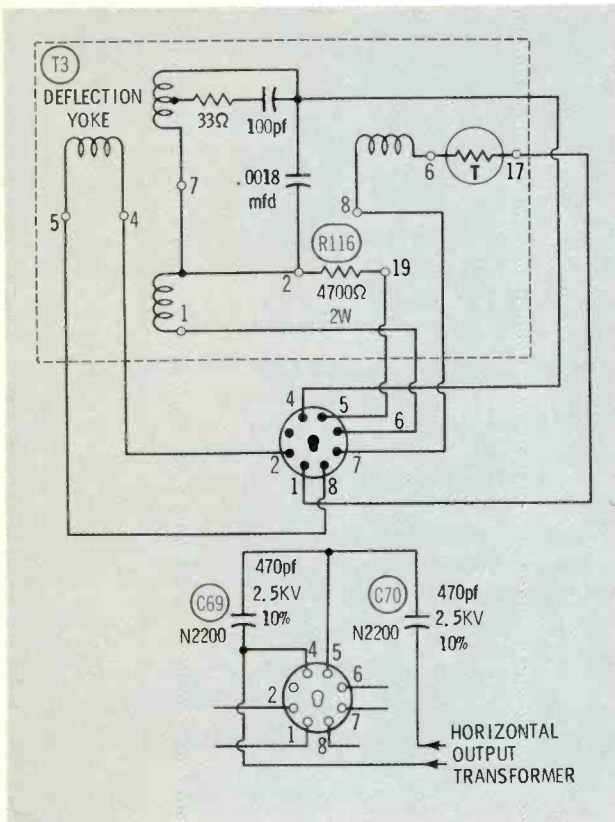




Chassis: RCA CTC24

Symptom: Loss of high voltage; burnt resistor in yoke.

Tip: If R116 is burnt, check C69 and C70 for open or shorted condition. Either defect will unbalance the yoke and cause excessive current to pass through R116.

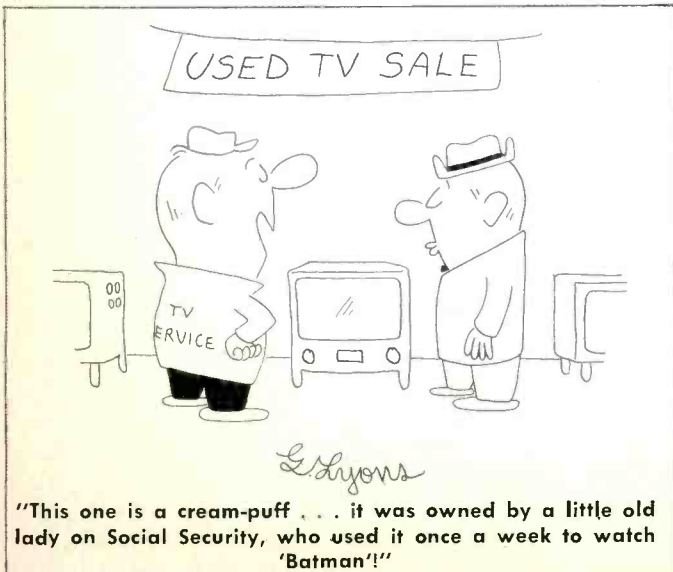


Chassis: RCA CTC12

Symptoms: No sound, no raster.

Tip: Preliminary check of B+ will uncover open R206 in 255-volt line. Failure of R206 in several chassis has been traced to the following causes:

1. Shorted C136 (decoupling capacitor) in plate circuit of Z chroma demodulator.
2. Shorted C115 (decoupling capacitor) in plate circuit of bandpass amplifier—also burns out R155.



"This one is a cream-puff . . . it was owned by a little old lady on Social Security, who used it once a week to watch 'Batman!'"

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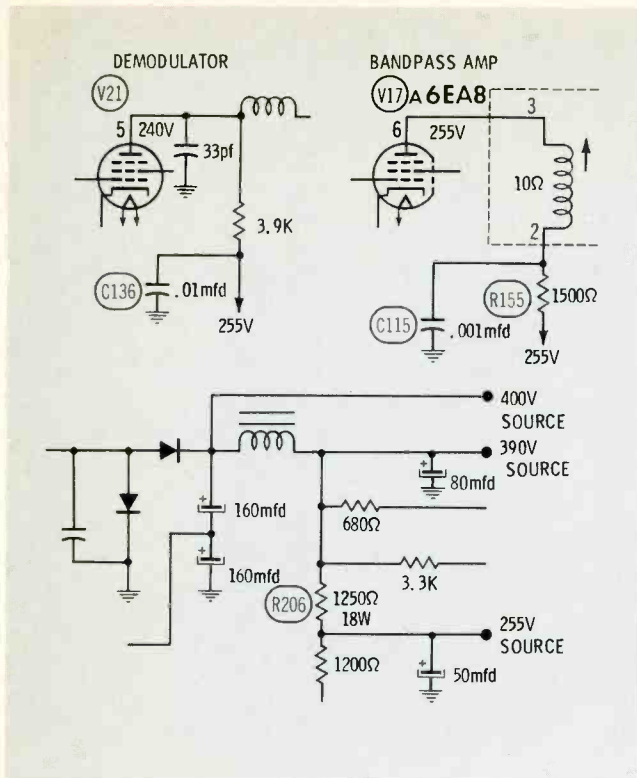
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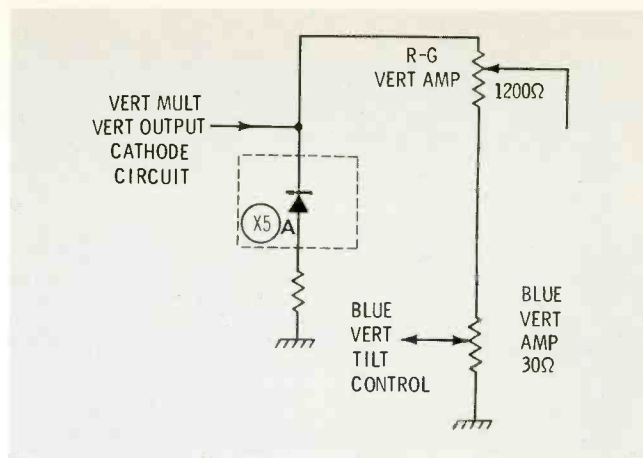
Circle 31 on literature card



**Chassis:** Motorola WTS-907

**Symptoms:** Bottom of raster shrunk.

**Tip:** Possible cause of trouble is defective X5 (silicon rectifier) in vertical convergence circuit.



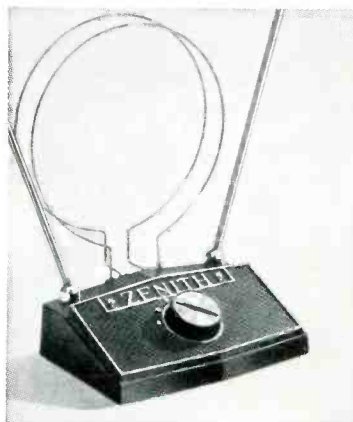
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Share your troubleshooting experiences and techniques with the other readers of PF REPORTER—and get paid for doing it. If you've recently run across an out-of-the-ordinary trouble, briefly describe the symptom(s), cause, and cure. Or, if you have an unusual troubleshooting technique that has proved successful, pass it along. Both typed and hand-written material are acceptable. Submit it to:

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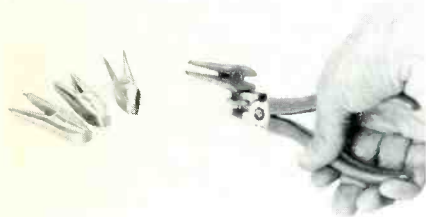
# PRODUCT REPORT

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



**Lamp and Magnifier**  
(60)

The tool shown here is particularly useful for assembling micro components or any other type of work involving the manipulation of small parts or extreme accuracy. Announced by **Swing-O-Lite, Inc.**, the Fluorescent Magnifier-Lamp combines a 5" diameter magnifying glass lens with a 13" focus. The arm has a 45" reach and is counter balanced. A choice of P, C, or W mounts is available, together with a color selection of brown, tan, and grey. Price is \$33.60.

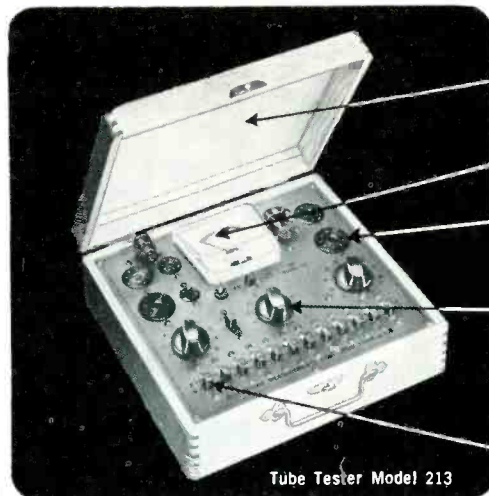


**Swivel-Head Plier Set**  
(61)

A new plier with interchangeable heads that rotate 360° has been announced by **Jensen Tools and Alloys**. Using this tool, the technician can reach into previously inaccessible areas—around corners, into blind spots that cannot even be seen. Eight locking positions are provided at 45° intervals (relative to the plane of the handles). The new Swivel-Head plier thus functions as a standard straight

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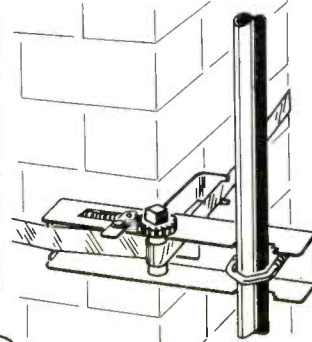
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58 PF REPORTER/January, 1968

plier and as an angled plier with a choice of eight separate angles to match the work.

Furnished in the set are four interchangeable heads of drop-forged tool steel. Included are a long-nose head with serrations on the gripping surfaces, a shorter duck-bill head with serrations, a duck-bill head without serrations, and a retainer-ring head with pins (.06" diameter) at the extreme ends. The pins also have serrations. Overall length of the plier without head is 6". The complete set (plier handle and four heads) is furnished in a compact vinyl case and is priced below \$15.



**Transistor Tester**  
(62)

This factory-wired and calibrated unit is completely portable and requires no external source. It will test low- and high-power transistors and has sockets for both NPN and PNP transistors to allow convenient transistor matching for complementary symmetry applications.

The **RCA** instrument tests transistors in circuit and out of circuit for DC beta from 1 to 1,000, and out-of-circuit transistors for collector-to-base leakage as low as 2 micromperes, and collector-to-emitter leakage from 20 microamperes to 1 ampere. Low-impedance circuitry assures more reliable in-circuit testing.

Collector currents are adjustable from 20 microamperes to 1 ampere in four ranges, permitting most transistors to be tested at their rated current level. A complete "DC forward current transfer ratio curve" can be plotted from the instrument readings. Three color-coded test leads are provided for in-circuit testing and for out-of-circuit testing of those transistors that will not fit into the panel sockets. Price of Model WT-501A is \$66.75.

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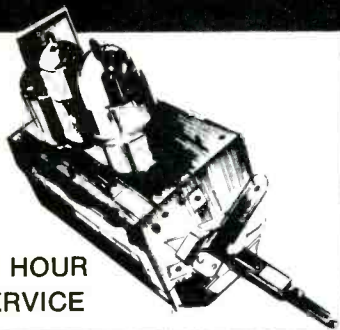
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## Mixer-Preamplifier (63)

A mixer-preamplifier that extends the capability of public address systems or tape recorders has been announced by **Bogen Communications**. Named the Bogen MX6A-T, it is an AC-powered, all-silicon, solid-state unit that can be used singly to add four more microphones or other signals to an existing system. Up to three MX6A-T units can be paralleled to provide 12 individual inputs. The three mixers can be mounted "piggy-back" if desired.

Measuring 9¼" × 6" × 2½" and weighing less than five lbs., installation of the new unit requires only plugging into existing equipment for instant operation. The design of the mixer-preamplifier employs all-silicon semiconductors and printed circuits.

The four inputs can handle either high- or low-impedance microphones or electric guitars, each under continuous control through individual volume controls. In addition, two of the four channels will accept tuner or crystal cartridge signals. The output of the MX6A-T is capable of driving any packaged amplifier through its auxiliary input, and it will also drive power amplifiers with 5-volt or better sensitivity. The unit uses standard phone jacks for high-impedance microphones and guitars; screw terminals for low-impedance microphones; RCA-type phono jacks from the output to the auxiliary input of public address amplifiers or tape recorders. Price is \$74.85.



## Digital Ohmmeter (64)

Direct digital display of resistance measurements is provided by a new Digital Ohmmeter, Model DMS-3200/DP-170, announced by the **Hickok Electrical Instrument Company**.

The new instrument provides direct digital readout of resistance measurements from .001 ohm to 1000 megohms in ten ranges with an accuracy capability of ±0.1% full-scale ±0.1% of reading. Of special interest is the low power applied to the resistor under measurement—maximum 1 mw. Four-terminal input with "guard" terminal permits accurate measurement of both extremely low and high resistances.

All-electronic *Nixie*-type display tubes are used for readout, and decimal point indication is automatically displayed. 100% overrange capability is provided, and display time is variable, with provision for holding a reading indefinitely.

The unit features all-solid-state design, utilizes glass-epoxy printed circuit boards, measures 9" × 7" × 13" and weighs 13 lbs. Price is \$560.

## High Voltage Test Probe (65)

The first CRT high-voltage test probe to be offered with a built-in voltmeter has just been introduced by **Pomona Electronics**. The Model 2900 is small enough and light enough to be carried in a tube caddy, and may be used on any color or black-and-white television set.

With the Pomona test probe, high voltage adjustments can be made in





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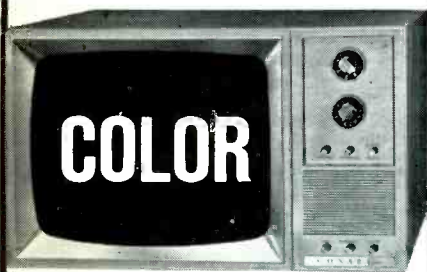
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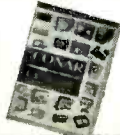
Tops for quality, simplicity of design, ease of building, the new CONAR 600 gives you the latest advances in the art of color TV receiver construction. In addition to 21 tubes, this all-channel receiver incorporates a transistor UHF tuner, transistor noise cancellation circuit and 16 solid-state diodes. Separate gun killer switches and a cross hatch generator are built in. All hardware is engineered for accessibility. Attractive bronze-tone steel cabinet with durable wood-grained vinyl covering.

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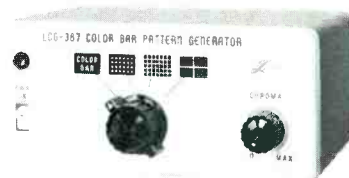


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60 PF REPORTER/January, 1968



the home without the need for extra equipment. All a technician has to do is ground the instrument, contact the high-voltage anode with the probe tip, and read voltage (up to 30 KV) from the self-contained meter. The probe contains no batteries, and needs no warm-up time. Net Price: \$19.95.



**Pattern Generator**  
(66)

Leader Electronics announces development of a new ultra compact completely solid-state Color Bar Pattern Generator designated the LCG-387. The instrument is designed for convergence and synchronizing adjustments in color and monochrome

TV receivers. It is used extensively in production testing and field servicing, and the only connections are made to the TV receiver antenna input.

Crystal controlled oscillators of 189 KHz and 3.563795 MHz are incorporated in the device for the sync and color burst signals respectively. Flipflop and logic circuitry are incorporated to generate stable and reliable sync and signal pulses. Only transistors of the silicon epitaxial planar type are employed to insure high performance and reliability. Price is \$140.00.



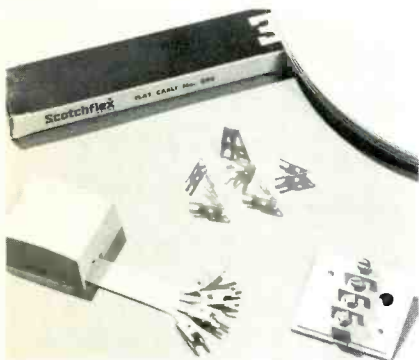
**Field Effect Meter**  
(67)

A new completely portable solid-state field-effect volt-ohm-milliammeter, said to provide all the advantages of a VTVM with none of the disadvantages, has been announced by SENCORE.

Designated the FE14, the compact instrument represents a new approach to circuit testing. With 15-megohm input resistance on DC, and 10-megohm input impedance on AC, the FE14 accurately measures voltages with a minimum of circuit loading. Unlike a VOM, which changes loading with

each range, the FE14 is constant on all ranges.

A mirrored scale to prevent parallax error is included as a standard feature. Both meter and internal circuitry are said to be fully protected against AC overload. The FE14 is priced at \$59.95 complete with test leads, less batteries. Optional high-voltage probe 39A19, is \$9.95.



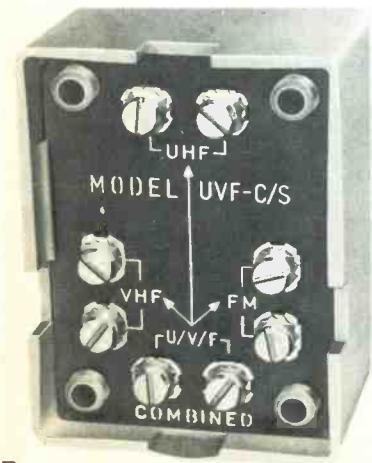
### Low Voltage Connector (68)

A new low-voltage electrical connector designed for use in control systems, sound installations, and other electrical applications of 30 volts or less has been announced by the 3M Company.

It is called "Scotchlok" brand self-stripping connector No. 560. Preinsulated tap splices, inline splices, and pigtail splices can be made with one connector without stripping, twisting or soldering, according to 3M.

The new connector features a self-stripping "U-type" element encased in white polypropylene. Connections are made by driving the "U-type" element down over the conductors with pliers. The spring compression reserve in the "U-type" element supplies holding power and electrical contact with strong, permanent pressure. A hinged cover attached to the connector's case then is snapped into place for additional protection.

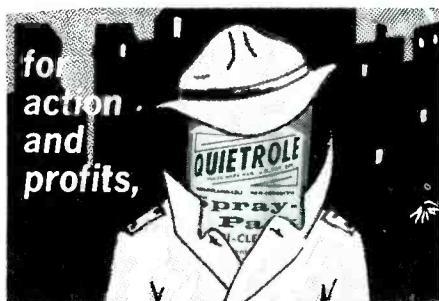
Designed for use on No. 14-18 gauge solid or stranded copper wire, the connector is available in 4-unit blister packs priced at 49¢.



### Combiner/Splitters (69)

A series of accessories called combiner/splitters that provide single-downlead installation in systems using separate antennas has been announced by **Blonder-Tongue Laboratories, Inc.** The units are designated Models UVF-1 and UVF-c/s for UHF/VHF/FM installation and Model UV-c/s for UHF/VHF.

Model UV-c/s provides separate outputs for an all-channel TV set or converter. This unit mounts indoors either on the back of the set or on the baseboard. Models UVF-1 and UVF-c/s are designed for systems delivering reception on TV channels 2 to 83 and on FM. These weather-proof combiner/splitters can be used indoors or outdoors. Both units can take a single 300-ohm down-lead carrying signals for channels 2 to 83 plus FM and split it into three outputs: one for the FM set and two for the TV set (one for channels 2 to 13; one for channels 14 to 83). The UVF-1 is the deluxe model recommended for all reception areas. It offers high isolation between UHF, VHF, and FM sections. The UVF-c/s is recommended for general applications. Prices for the three units are: Model UVF-1, \$14.95; UVF-c/s, \$6.25; and UV-c/s, \$3.75. ▲



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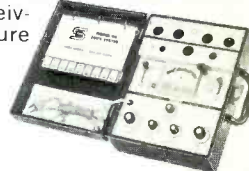
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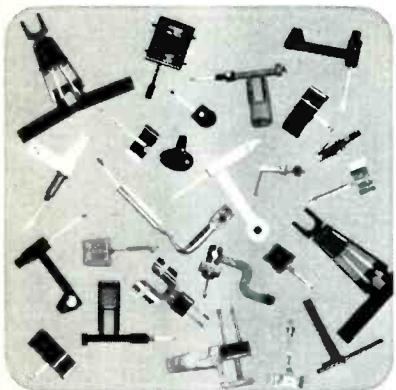
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62 PF REPORTER/January, 1968

# BOOK REVIEW

**Know Your Sweep Generators:** Robert G. Middleton; Howard W. Sams and Co., Indianapolis, Indiana, 1967; 176 pages, 8½" x 5½", soft cover; \$3.25.

An understanding of the design and application of sweep generators is essential for those technicians who service TV and FM receivers. Equally as important is the related subject of sweep alignment.

This text covers both subjects in a manner that electronic students, as well as service technicians, will find comprehensive and thorough. Review questions at the end of each chapter help the reader evaluate his understanding and retention of the subject matter. In addition, an appendix located at the back of the book outlines various experiments that involve the use of the sweep generator, thus providing practical application of the knowledge obtained. Included in the outline of each experiment is a list of the materials and equipment needed, a step-by-step description of the procedure, and a reference to the specific portion of the text that relates to that particular experiment.

The text begins with a discussion of the basic principles of sweep alignment, including resonant circuits, frequency response, bandwidth, characteristics of an FM test signal, and response-curve displays. Methods of FM test-signal generation are dealt with in Chapter 2.

Chapters 3 through 6 cover specific types of sweep generator design including beat-frequency, wide-band audio-frequency, wide-band RF, and UHF types. Chapter 7 is devoted to a section-by-section analysis of the trouble symptoms and troubleshooting and servicing procedures associated with sweep generators.

"Constructing Sweep-Generator Kits" is the title of the final chapter. A detailed description of the various aspects of kit building is presented, along with testing and adjusting techniques. ▲

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by John E. Warren. Explains the mechanical and pneumatic principles governing all pneumatic control instrumentation. Thoroughly analyzes all of the basic components used in control instruments, first individually, and then in the groups in which they are commonly used. Case studies of instruments are presented, each explained by a schematic, a block diagram, and a functional word train. This approach enables anyone to analyze and understand similar complex control equipment. Color is used liberally in illustrations to emphasize force arrows, inputs, outputs, and circuit paths. 160 pages; 8½ x 11"; comb-bound. \$9.95  
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### 101 Questions and Answers About CB Radio Operations

by Leo G. Sands. A handy and practical book answering the most frequently asked questions about CB radio. Each of four special sections deals with one generalized area of CB radio operations, including questions and answers about the four classes of CB radio and their permissible uses, licensing and FCC rules, operating procedures, and advice about the selection of CB equipment. Anyone with an interest in CB will find this an easily understandable and invaluable guide. 96 pages; 5½ x 8½". \$2.95  
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### Experimental Earth Sciences

by Morris Goran. This fascinating book enables you to learn about the earth and its atmosphere through simple experiments, covering such subjects as the essentials of meteorology (the science of weather and the atmosphere); geology (the study of the earth's crust and interior); oceanography (the science of the seas); and astronomy (the science of the stars). Describes 60 experiments in each of the four areas covered, using readily available materials; includes construction-type experiments for building models. \$2.95  
128 pages; 5½ x 8½". Order 20601, only

### Practical Problems in Number Systems, Logic and Boolean Algebra

by Edward Bukstein. This workbook is a 62-lesson introduction to digital computer mathematics. Begins with the various number systems (binary, ternary, octal, decimal converting numbers from one system to another, and some common codes). Then develops the binary and octal arithmetics as a basis for introducing Boolean algebra. The latter, with its relations of AND, OR, and NOT, is elaborated by a variety of tables, diagrams, and maps. Also covers the implementation of Boolean algebra in electronic gating and inverting circuits. The workbook is suitable for either classroom or individual use. No special background in mathematics is required for understanding. \$2.95  
128 pages; 8½ x 11". Order 20609, only

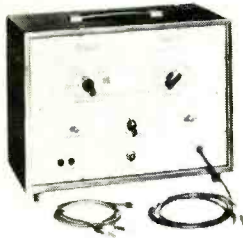
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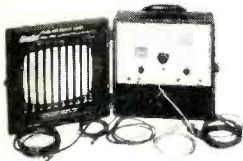


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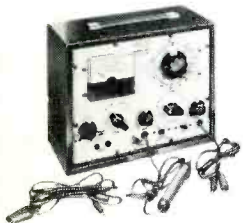
**GC-660 COLOR BAR/DOT GENERATOR** — Generates ten-bar gated rainbow type color signals plus vertical and horizontal bars, crosshatch and dot patterns. 300-dot pattern and small dot size based on 0.1 sec pulse for extra convergence speed and accuracy. All solid state.

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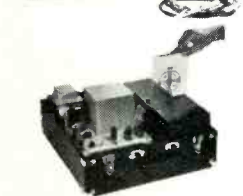
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## INDEX TO ADVERTISERS

January, 1968

B & K Mfg. Co., Div. of	
Dynascan Corp. ....	48
Belden Mfg. Co. ....	40
Bussmann Mfg. ....	14, 15
Castle TV Tuner Service, Inc. ....	31
Channel Master ....	30
Chemtronics, Inc. ....	63
Cleveland Institute of Electronics ....	39
Cornell-Dubilier ....	Cover 2
Delco Radio Division ....	37
Electronic Measurements Corp. ....	57
Electro-Voice, Inc. ....	62
The Finney Co. ....	23
G. C. Electronics ....	29
Gem City Tuner Repair Service ....	35
Heath Co. ....	41
Hickok Electrical Instrument Co. ....	63
Jerrold Electronics Corp. ....	44
Kay-Townes Antenna Co. ....	60
Leader Electronics ....	55
Lectrotech, Inc. ....	53
Littelfuse, Inc. ....	Cover 4
Mallory, P. R. & Co., Inc. ....	9
National Radio Institute ....	25, 43, 60
Olson Electronics, Inc. ....	59
Oxford Transducer Co. ....	33
Philco-Ford ....	34
Quam-Nichols Co. ....	35
Quietrol Co. ....	61
RCA Electronic Components & Devices (Entertainment Tubes) ....	Cover 3
RCA Institutes, Inc. ....	54
RCA Sales Corp. ....	42
RMS Electronics, Inc. ....	32
Sams, Howard W. & Co., Inc. ....	45, 62
Sarkes Tarzian, Inc. ....	17
Seco Electronics Corp. ....	58, 61
SENCORE, INC. ....	28, 47
Simon, H. K. ....	58
Sprague Products Co. ....	11
South River Metal Products Co., Inc. ....	57
Superior Tuner Service ....	59
Swing-O-Lite ....	46
Sylvania Electric Products, Inc. ....	26, 27
Texas Crystals ....	58
Weller Electronics ....	46
Yeats Appliance Dolly Sales Co. ....	43
Zenith Sales Corp. ....	56

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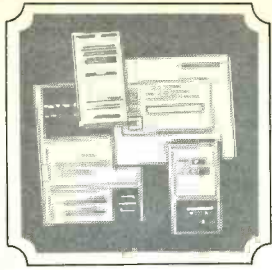
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111. **GIBBS**—Literature for use of reverberation units with audio amplifiers.
112. **OXFORD TRANSDUCER**—Bulletin A-109 features speaker installation in automobiles, hospitals, and recreation rooms.
113. **RACON**—Catalog C66ST on horns, drivers, sound columns, and accessories.
115. **UNIVERSITY SOUND**—New 28-page 1968 commercial sound product catalog.

## COMMUNICATIONS

116. **AMPHENOL**—2-color spec sheets on new Model 650 CB transceivers and Model C-75 hand-held transceiver.\*
117. **CUSH CRAFT**—Full line catalog of base station antennas for CB and Business Band radios.

118. **MARK PRODUCTS**—Flyer sheets CB659 and AM661 on antennas and accessories for CB and Ham radios.
119. **MOSLEY**—Catalogs on antennas for TV/FM, CB, and Ham use.
120. **SQUIRES SANDERS**—Bulletin on the "Commodore" CB rig.

## COMPONENTS

121. **BEIDEN**—Catalog 867, a 56-page catalog of the complete Belden line.\*
122. **BUSSMANN**—12-page booklet listing the complete line of BUSS and FUSETRON small dimension fuses by size and type, also indicates proper fuseholder—also shows list prices. Ask for BUSS Bulletin SFUS.\*
123. **CENTRALAB**—24-page replacement parts catalog No. 33GL.
124. **CORNELL-DUBILIER**—New 4-page Color-lytic list.
125. **GRAYHILL**—52-page catalog of switches.
126. **MALLORY**—Bulletin 4-82 describes radial and axial lead tantalum capacitors.
127. **MILLER**—Catalog 167, a 156-page general catalog with complete cross-reference guide to the J.W. Miller Line.\*
128. **LITTELFUSE**—Pocket-sized TV circuit breaker cross reference gives the following information at a glance. Manufacturer's part number, price, color or b/w designation. A second glance gives trip ratings and acquaints you with a line of caddies. Ask for CBCRP.\*
129. **QUAM-NICHOLS**—New catalog No. 67 has complete detailed information on the entire Quam line.
130. **SPRAGUE**—C617, a complete catalog of the Sprague Line.\*
131. **TEXAS CRYSTALS**—12-page catalog of crystals including engineering data, specifications and prices.
132. **WORKMAN**—46-page catalog #100 on resistors, fuses, circuit breakers, brighteners, adaptors, and test accessories. Cross-reference charts included.\*

## SERVICE AIDS

133. **CASTLE TUNER**—How to get fast overhaul service on all makes and models of television tuners is described in leaflet. Shipping instructions, labels, and tags are also included.\*
134. **GC**—FR-67, the full-line catalog.\*
135. **MM BUSINESS FORMS**—Brochures about and samples of two new professional service contract forms designed to earn extra money.

136. **PERMA-POWER**—New 4-page catalog of TV accessories.

## SPECIAL EQUIPMENT

137. **ATR**—Literature about DC-AC inverters up to 600 watts load.
138. **WINDSOR ELECTRONICS**—Booklet entitled "The Open Door to TV Profits".

## TECHNICAL PUBLICATIONS

139. **CLEVELAND INSTITUTE OF ELECTRONICS**—Free illustrated brochure describing electronics slide rule and four lesson instruction course and grading service.\*
140. **RCA INSTITUTES**—New 1968 career book describes home study programs and course in television (monochrome and color), communications, transistors, industrial, and automation electronics.\*
141. **SAMS, HOWARD W.**—Literature describing popular and informative publications on radio and TV servicing, communications, audio, hi-fi, and industrial electronics, including special new 1967 catalog of technical books on every phase of electronics.\*

## TEST EQUIPMENT

142. **B & K**—New 1968 catalog featuring test equipment for color TV, auto radio, and transistor radio servicing, including tube testers designed for testing latest receiving tube types.\*
143. **EICO**—New spec sheet describes model 100A4 multimeter with DC sensitivity of 100K ohms per volt.\*
144. **HICKOK**—Quick reference catalog No. 67D gives brief descriptions and prices for complete test equipment line.
145. **LECTROTECH**—Two-color catalog sheet on new Model V6-B color bar generator, the latest improved model of the V-6. Gives all specs and is fully illustrated.\*
146. **MERCURY**—All-new 16-page test instrument catalog.
147. **SECO**—Operating manual for the HC8 in-circuit current checker for horizontal output tubes.\*
148. **SENCORE**—New 12-page catalog on all SENCORE products.\*
149. **SIMPSON**—Reprint: "A Guide to the Selection of Multitesters." Explains how to evaluate multitesters before you buy.\*
150. **SINGER**—Brochure about the DM-4 deviation monitor scope.
151. **TRIPLETT**—New panel meter catalog D-68 with complete line of measuring instruments.\*

## TOOLS

152. **ARROW**—Catalog sheet showing 3 staple gun tackers designed for fastening wires and cables up to 1/2" diameter.
153. **CHANNELLOCK**—Updated catalog #66 with price schedule.
154. **ENTERPRISE DEVELOPMENT**—Time-saving techniques in brochure from Endeco demonstrate improved desoldering and resoldering methods for speeding and simplifying operations on PC boards.\*
156. **SWING-O-LITE**—Catalog sheet on Models BBM-9 and BB45 low-priced bench lamps.\*
157. **VACO**—Catalog SD-127 about ratchet box wrenches.
158. **XCELITE**—Bulletin N867 describes hollow-shaft nutdrivers which speed lock-nut/screw adjustments.\*

## TUBE AND TRANSISTORS

159. **RCA**—PIX-300, a 12-page product guide on RCA picture tubes covering both color and black-and-white. Includes characteristics chart, terminal diagrams, industry replacement, and interchangeability.\*

## We can't leave well enough alone...

...so we redesigned the RCA-6BK4A to improve its capability in shunt regulator circuits of high voltage power supplies in color TV receivers. Always the best tube to do the job, the RCA-6BK4B is now even better.

An improved plate provides highly efficient heat radiation and uniform temperature distribution...and permits a 40 W max. plate dissipation rating. This rating is especially important in present-day color receivers. An increased peak

negative heater-cathode voltage capability of 450 V max. results from better heater insulation and tighter processing controls. A redesigned top cap reduces strain on dome of the glass envelope for greater strength and reliability.

Innovations and improvements that make your service operation more reliable, efficient and profitable are our constant aim. So see your local Authorized RCA Tube Distributor for quality RCA receiving tubes.



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



**The Most Trusted Name in Electronics**

# Give yourself a break you can depend on!



actual size  
1 3/4" x 1 3/8" x 1/2"



#094077

#### CIRCUIT BREAKER CADDY

10 ratings, one each 2-1/4, 2-1/2, 2-3/4, 3, 3-1/4, 4, 4-1/2, 5, 6 and 7 amps.

#### SERVICE CADDY

##### Breakers and Fuses

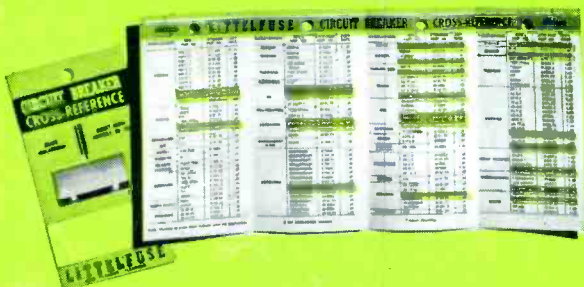
One service call is all —8 breakers—one rating each 2-1/4, 2-3/4, 3, 3-1/4, 4, 4-1/2, 5 and 7 amps and 30 fuses—five each type C3/10, C1/2, C3-1/2, N3/10, N7/10 and N1.



#094076

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

Available individually packaged one breaker per display card; or 5 breakers of same rating per unit pack or as complete, versatile assortments for shop use or replacements in the field.



Included with each assortment:  
Pocket size cross reference on color and black/white TV circuit breaker applications.  
Form No. CBCRP-1266H

# LITTELFUSE

DES PLAINES, ILLINOIS

Circle 48 on literature card