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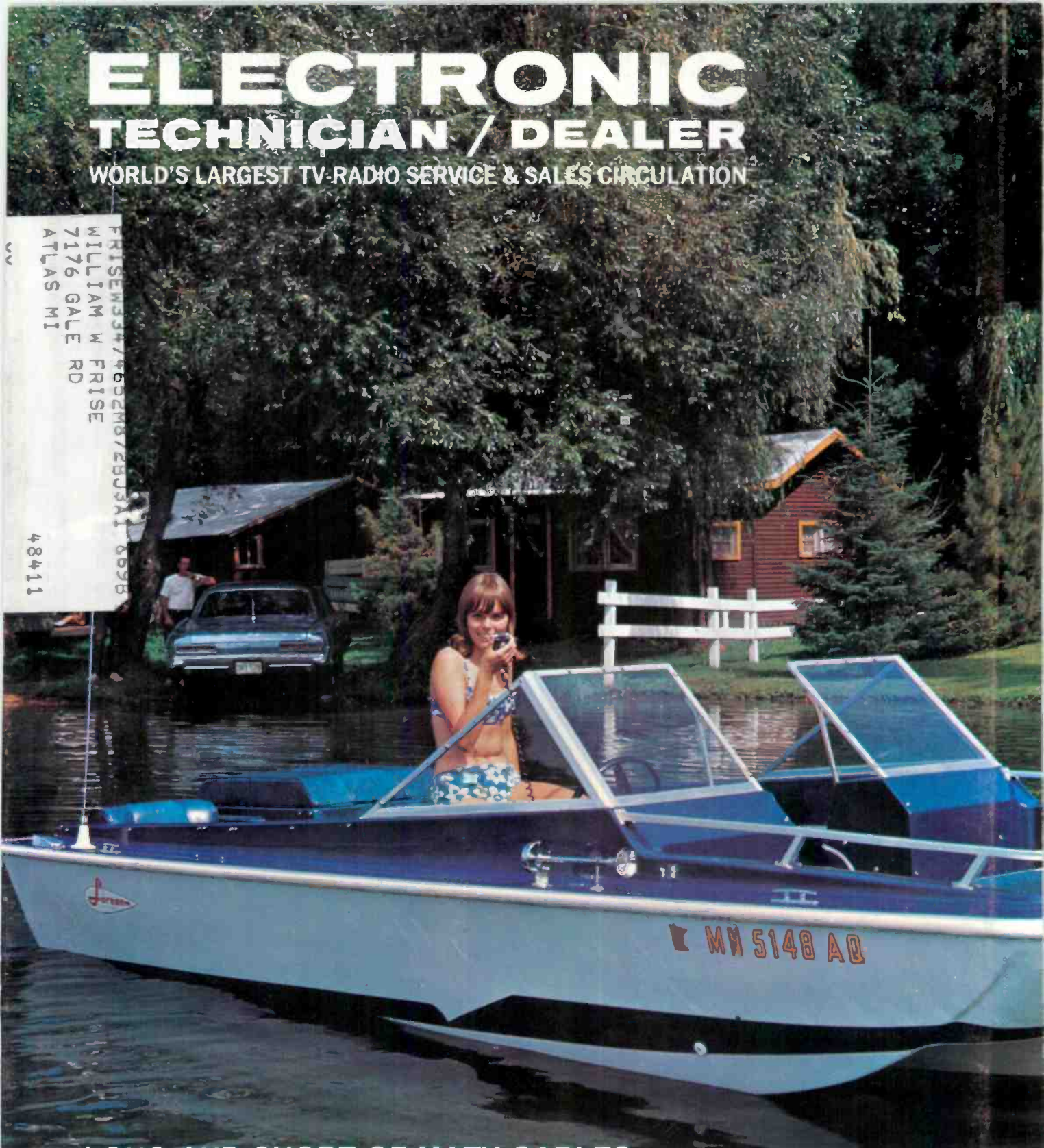

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MAY 1970 A HARCOURT, BRACE & WORLD PUBLICATION

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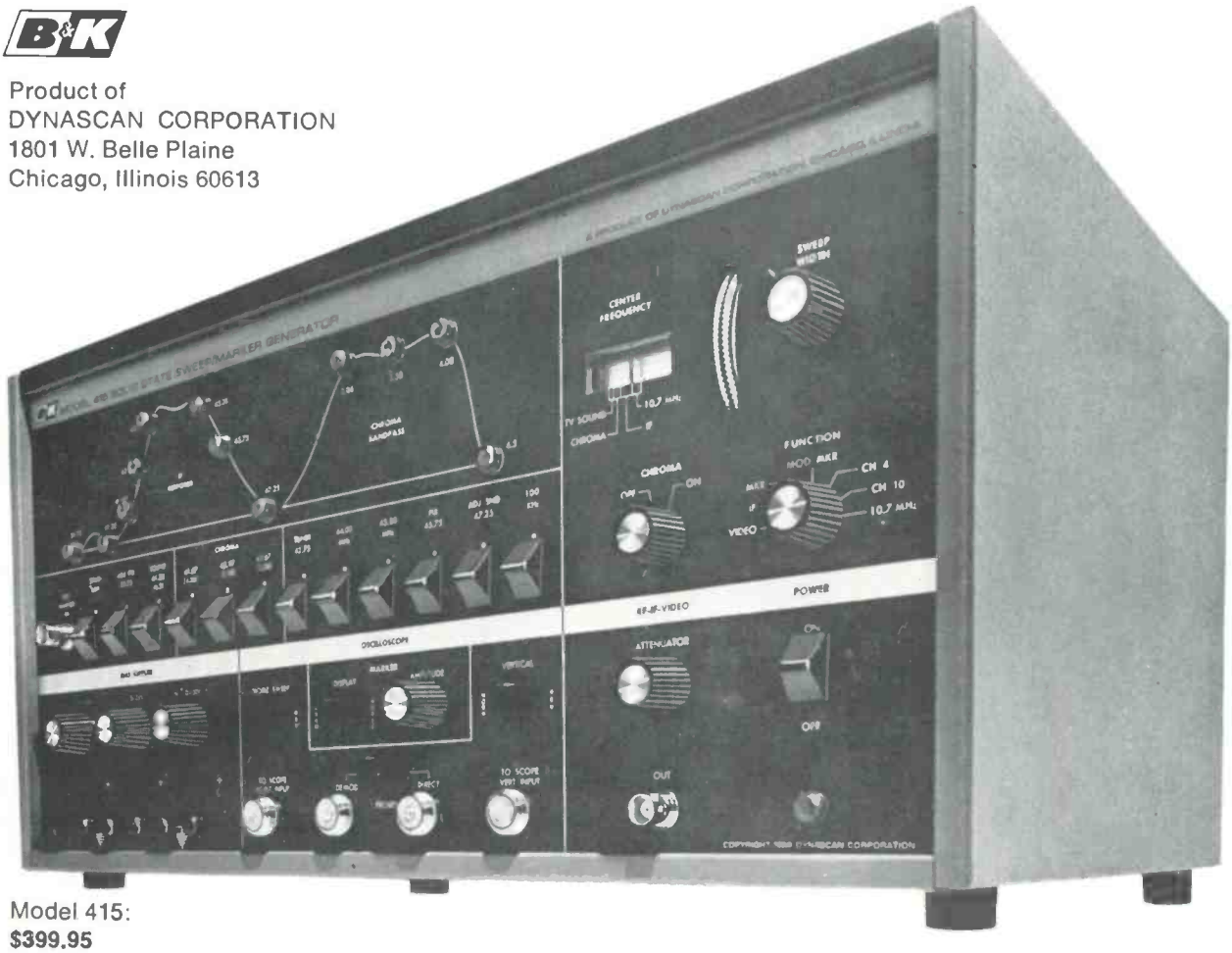

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TEKFAX

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

GROUP 213

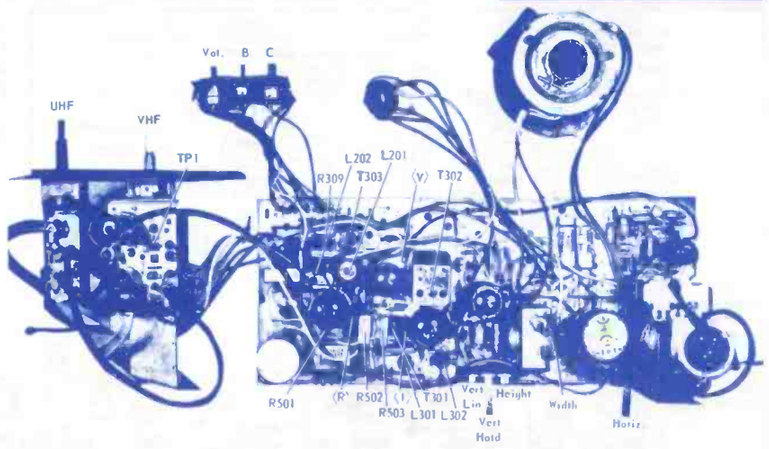
MAY • 1970

1294

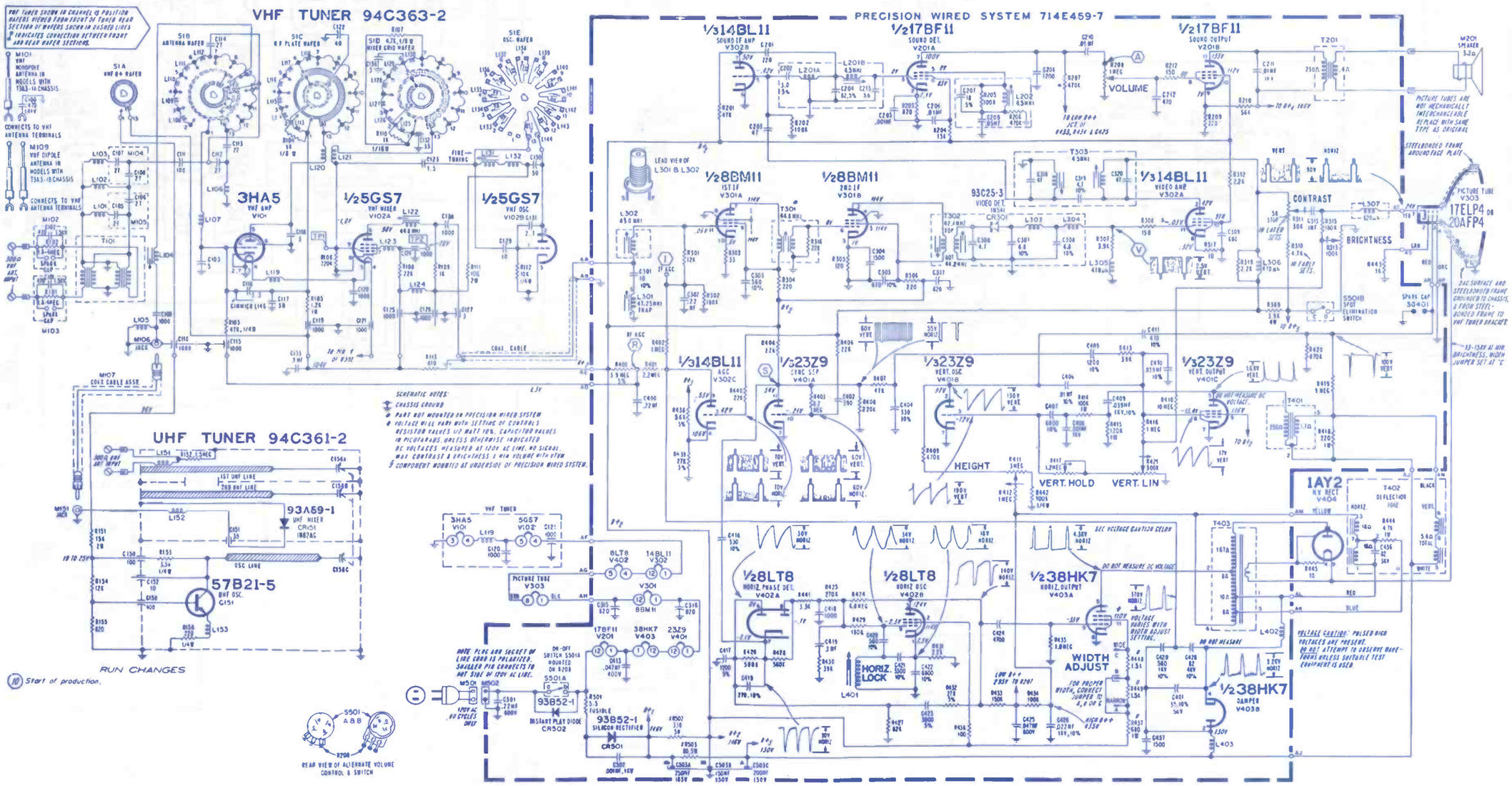
ADMIRAL

TV Chassis T3K3-1A, T3K3-1B

SYMBOL	DESCRIPTION	ADMIRAL PART NO.
R151	15K, 2w	60B20-153
R208	1M, vol control w/sw	75C1-176
R311	30K contrast control	75C112-13
R313	100K, bright control	75C113-13
R411	5M height triple control	75C129-3
R417	1.2M, vert hold triple control	75C129-3
R421	500K, vert lin triple control	75C129-3
R501	5.5Ω, fusible resistor	61C48-1
R502	330Ω 5w	61C20-66
R503	80Ω 5w	61C20-101
C203	47pf 500v NPO cer disc	65D10-198
C204	82pf 5% 500v NPO cer disc	65D10-98
C301	10pf 10% 500v NPO cer disc	65D10-87
C307,308	6.8pf 10% 500v NPO cer disc	65D10-102
C428	82pf 10% 4kv N1500 cer disc	65D10-425
C503A	250μf 165v elect	67C30-11
C503B	150μf 150v elect	67C30-11
C503C	200μf 150v elect	67C30-11
L201A,B	sound IF & phase shift coil	72C301-4
L202	ratio det	72C132-82
L303	5.6 UL RF choke	73C53-243
L304	RF choke	73C31-3
L307	video peaking	73D55-26
L401	horiz lock coil	94D17-19
L402	RF choke	73C31-11
T201	audio output xformer	79C124-3
T301	1st IF xformer	72C308-2
T303	sound take off coil	72C185-7
T401	vert output xformer	79C139-2
T402	def yoke ass'y	700C1089-6
T403	horiz output	79D138-4
	UHF tuner	94D361-2
	VHF tuner	94D363-2



TOP VIEW OF CHASSIS SHOWING ALIGNMENT & SERVICE ADJUSTMENT LOCATIONS



1295

AIRLINE

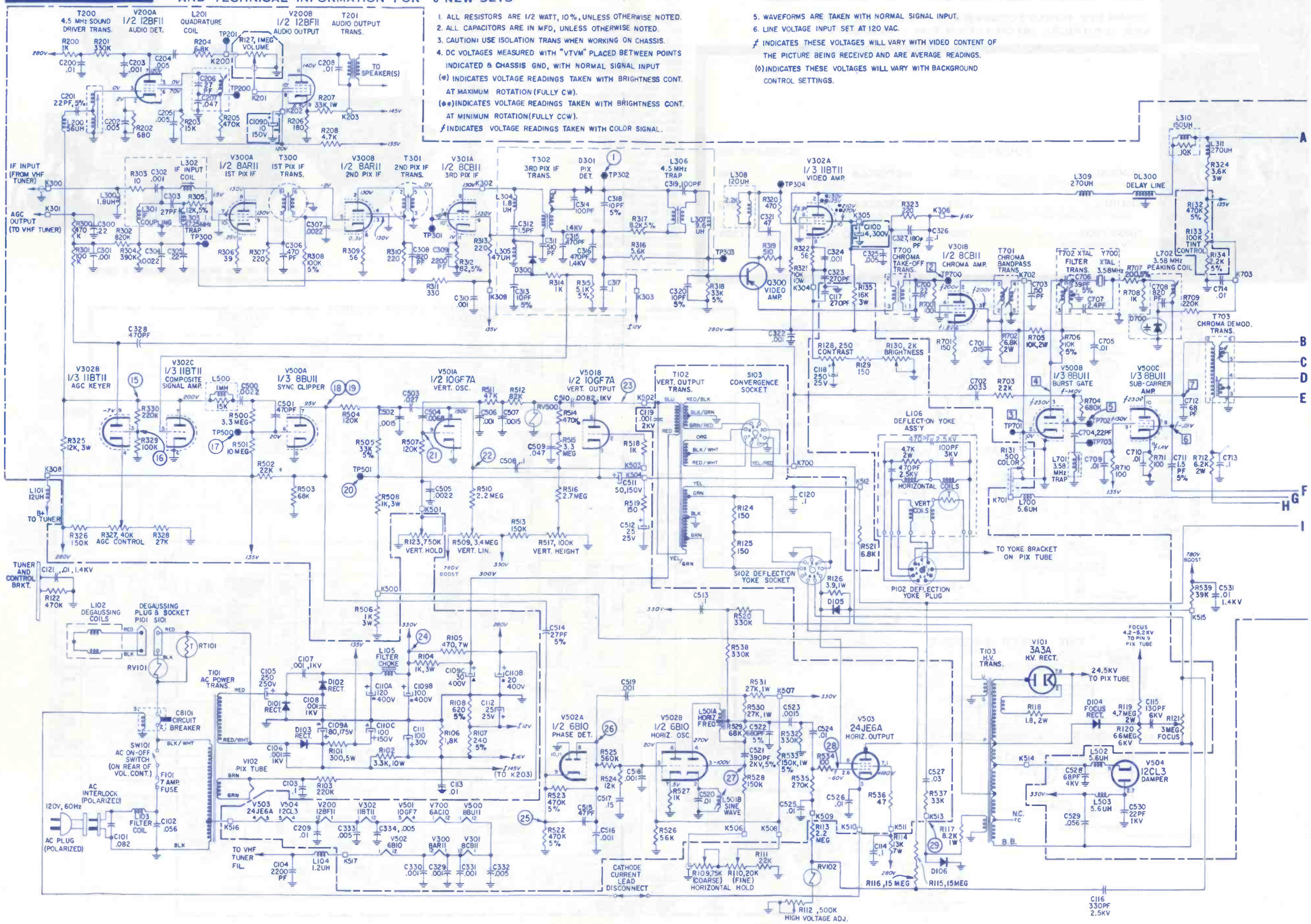
Color TV Models
GC1-12420A,B

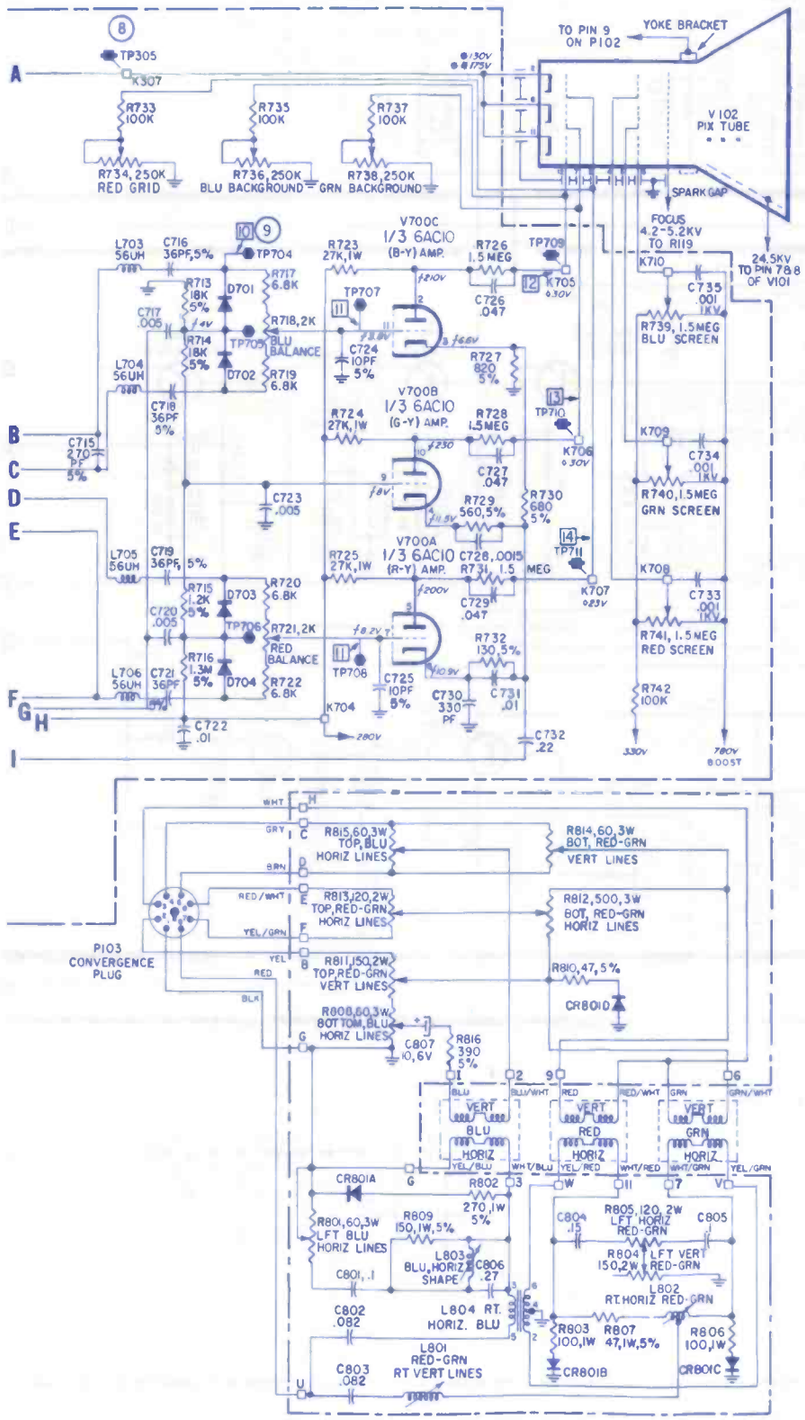
ELECTRONIC TECHNICIAN / DEALER **TEKFAX**

MAY • 1970

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

1. ALL RESISTORS ARE 1/2 WATT, 10%, UNLESS OTHERWISE NOTED.
2. ALL CAPACITORS ARE IN MFD, UNLESS OTHERWISE NOTED.
3. CAUTION: USE ISOLATION TRANS WHEN WORKING ON CHASSIS.
4. DC VOLTAGES MEASURED WITH "VTVM" PLACED BETWEEN POINTS INDICATED & CHASSIS GND, WITH NORMAL SIGNAL INPUT
(*) INDICATES VOLTAGE READINGS TAKEN WITH BRIGHTNESS CONT. AT MAXIMUM ROTATION (FULLY CW).
(**) INDICATES VOLTAGE READINGS TAKEN WITH BRIGHTNESS CONT. AT MINIMUM ROTATION (FULLY CCW).
ƒ INDICATES VOLTAGE READINGS TAKEN WITH COLOR SIGNAL.
5. WAVEFORMS ARE TAKEN WITH NORMAL SIGNAL INPUT.
6. LINE VOLTAGE INPUT SET AT 120 VAC.
ƒ INDICATES THESE VOLTAGES WILL VARY WITH VIDEO CONTENT OF THE PICTURE BEING RECEIVED AND ARE AVERAGE READINGS.
(◊) INDICATES THESE VOLTAGES WILL VARY WITH BACKGROUND CONTROL SETTINGS.

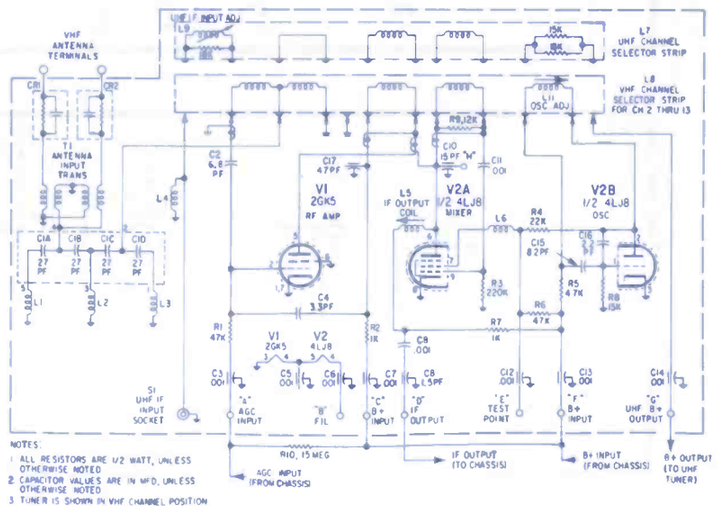




1 — 3V P-P, 60 Hz
2 — 10V P-P, 15,750 Hz
3 — 18V P-P, 15,750 Hz
4 — 40V P-P, 15,750 Hz
5 — 85V P-P, 15,750 Hz
6 — 3.5V P-P, 15,750 Hz
7 — 85V P-P, 15,750 Hz
8 — 105V P-P, 60 Hz
9 — 10V P-P, 15,750 Hz
10 — 10V P-P, 3.58 MHz
11 — 2.5V P-P, 15,750 Hz
12 — 78V P-P, 15,750 Hz
13 — 84V P-P, 15,750 Hz
14 — 96V P-P, 15,750 Hz
15 — 250V P-P, 15,750 Hz
16 — 22V P-P, 15,750 Hz
17 — 50V P-P, 60 Hz
18 — 70V P-P, [illegible] Hz
19 — 70V P-P, 15,750 Hz
20 — 12V P-P, 60 Hz
21 — 100V P-P, 15,750 Hz
22 — 150V P-P, 15,750 Hz
23 — 160V P-P, 60 Hz
24 — 3V P-P, 15,750 Hz
25 — 18V P-P, 15,750 Hz
26 — 28V P-P, 15,750 Hz
27 — 600V P-P, 15,750 Hz
28 — 180V P-P, 15,750 Hz
29 — 420V P-P, 15,750 Hz

SYMBOL	DESCRIPTION	AIRLINE PART NO.
C109A,B,C,D	— 80µf/175v, 100µf/400v, 30µf/400v, 10µf/150v elect	034-030700
C110A,B,C,D	— 120µf/400v, 20µf/400v, 100µf/150v, 4µf/300v, elect	034-030600
R101	— 300Ω, 10%, 5w, fixed film	054-301510
R102	— 3.3K, 10%, 10w, WW	053-332110
R105	— 470Ω, 10%, 7w WW	053-471710
R109	— control, horiz hold 75K (coarse)	055-068500
R110	— control horiz hold 20K (fine)	055-068500
R123	— control, vert hold 750K	055-068500
R112	— control, high voltage adj 500K	055-036500
R121	— control, focus 3M	055-065500
R127	— control, on-off-volume 1M	055-068800
R128	— control, contrast, 250Ω	055-068600
R130	— control, bright 2K	055-068600
R131	— control, color, 500Ω	055-068900
R133	— control, tint, 100K	055-069000
R327	— control AGC, 40K	055-069200
R736	— control, blue background 250K	055-069200
R737	— control, grn background 250K	055-069200
R509	— control, vert lin 3.4M	055-064200
R517	— control, vert height 100K	055-064200
R734	— control, red grid 250K	055-064200
R718	— control, blu balance 2K	055-064500
R721	— control, red balance 2K	055-064500
R739	— control, blu screen, 1.5M	055-064300
R740	— control, grn screen, 1.5M	055-064300
R741	— control, red screen, 1.5M	055-064300
Q300	— trans video amp PNP	002-012800
DL300	— coil, delay line	111-037400
L105	— coil filter choke	032-003000
L106	— def yoke	027-083100
L201	— coil, quad	109-040300
L300-304	— coil, 1.8µh	111-021000
L501A,B	— coil, horiz freq/sine wave	110-031300
L503	— coil, choke 5.6µh	111-036500
L701	— coil, 3.58MHz trap	109-038100
L802	— coil, R/G right horiz lines	111-031700
T101	— xformer, power	033-015400
T102	— xformer, vert output	033-014300
T103	— xformer, high voltage	033-016200
T200	— xformer, 4.5MHz sound driver	109-037800
T201	— xformer, audio output	031-010400
T300	— xformer, 1st pix IF	109-037200
T700	— xformer chroma take-off	109-040500
T701	— xformer, chroma bandpass	109-037000
T702	— xformer, crystal filter	109-037900
T703	— xformer, chroma demodulator	109-037100
CB101	— cir brkr	099-003500
F101	— fuse, 7a	099-003600
	tuner, UHF GC1-12420A	006-023000
	tuner, UHF GC1-12420B	006-023400
	tuner, VHF	006-021000
	yoke, convergence ass'y	027-032700

NOTES:
○ INDICATES "AIR" SIGNAL
□ INDICATES COLOR BAR SIGNAL



VHF Tuner Schematic Diagram

1296
MOTOROLA
Color TV Chassis
TS-934

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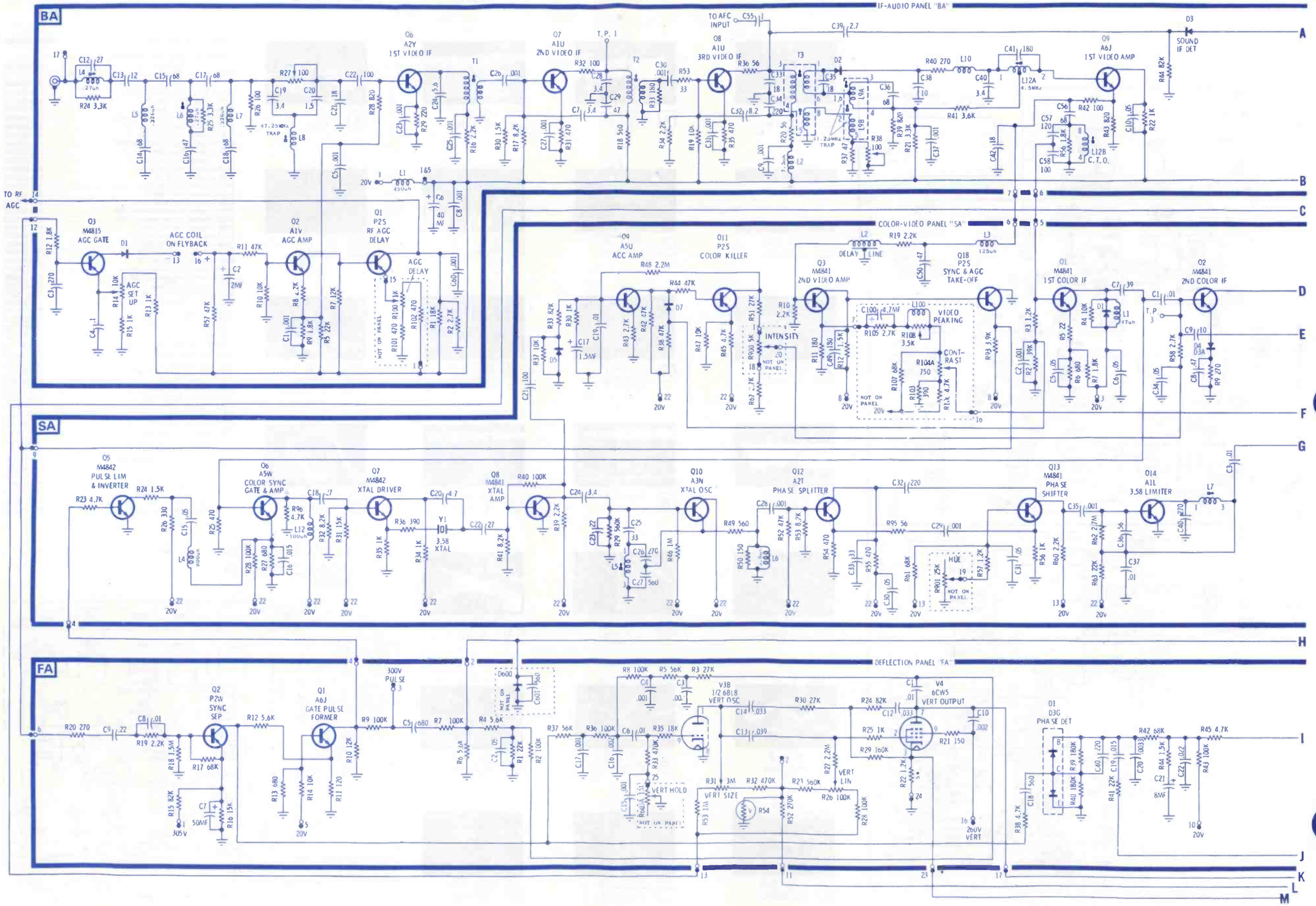
COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR 6 NEW SETS



IMPORTANT NOTES:

PANEL DESCRIPTION & COMPONENT IDENTIFICATION. EACH PANEL IS ASSIGNED A LETTER DESIGNATION (I.E. BA) WHICH IDENTIFIES THE PANEL. SEE CHART BELOW.

PANEL CODING	PANEL FUNCTION
BA	IF - AUDIO
FA	DEFLECTION
HA	CONVERGENCE
KA	AFC (AFT)
SA	COLOR - VIDEO
ZA	D.C. REGULATOR

EACH COMPONENT IS IDENTIFIED WITH A REFERENCE NUMBER AND PREFIX LETTER (I.E. L20) WHICH IS RELATED TO LEGEND ON THE PANELS. ALL "ON" PANEL COMPONENTS ARE IDENTIFIED BY ONE OR TWO DIGIT NUMBERS (1 THRU 99).

ALL "OFF" PANEL COMPONENTS ARE IDENTIFIED BY A 3 DIGIT NUMBER, WHICH VARIES WITH CIRCUIT ASSOCIATION AS INDICATED BELOW

ASSOCIATED CIRCUIT	REFERENCE DESIGNATION
IF & VIDEO	100 - 199
PIX TUBE	200 - 299
AUDIO	300 - 399
AGC - SYNC	400 - 499
HORIZ & HI VOLTAGE	500 - 599
VERTICAL	600 - 699
CONVERGENCE	700 - 799
POWER SUPPLY	800 - 899
COLOR CIRCUIT	900 - 999

IMPORTANT NOTE: ALL COMPONENTS WITHIN THIS DASHED LINE MUST BE REPLACED WITH IDENTICAL VALUES. TOLERANCE AND WORKING VOLTAGE TO MAINTAIN PRODUCT SAFETY AND X-RADIATION PROTECTION. HIGH VOLTAGE MUST NOT EXCEED 27KV AT ZERO BEAM CURRENT AT 122V AC LINE INPUT SEE "SERVICE MANUAL"

1297

MAGNAVOX

TV Chassis T948

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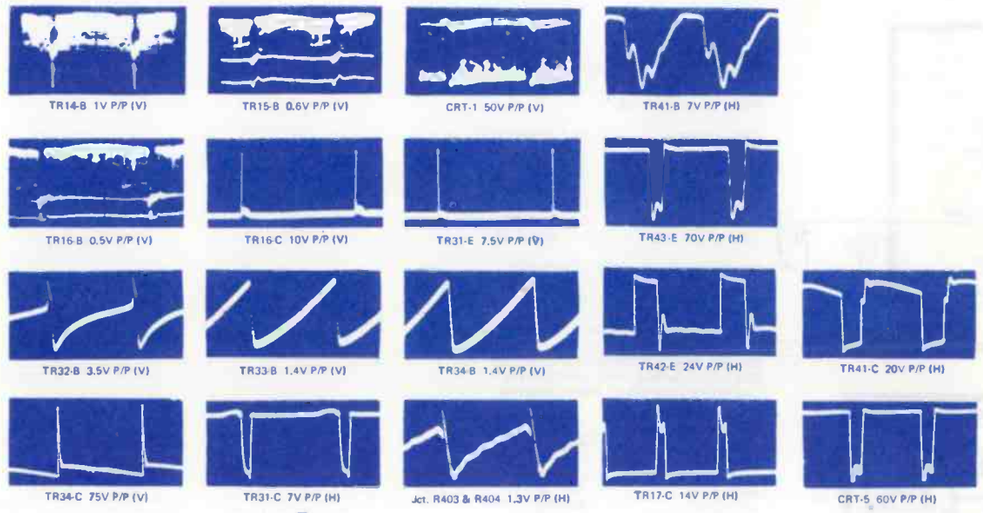
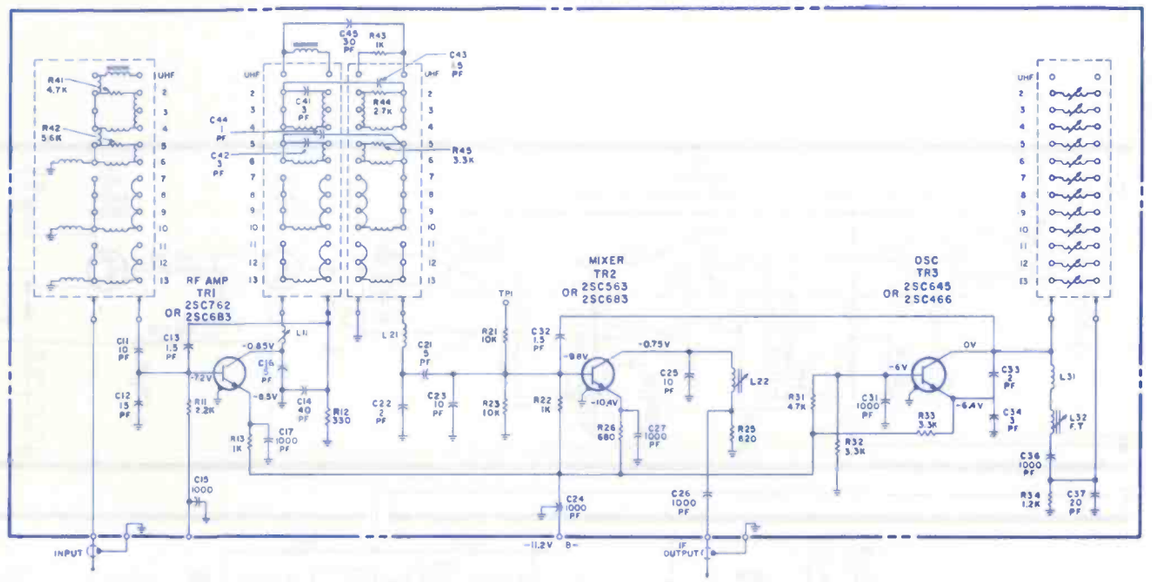
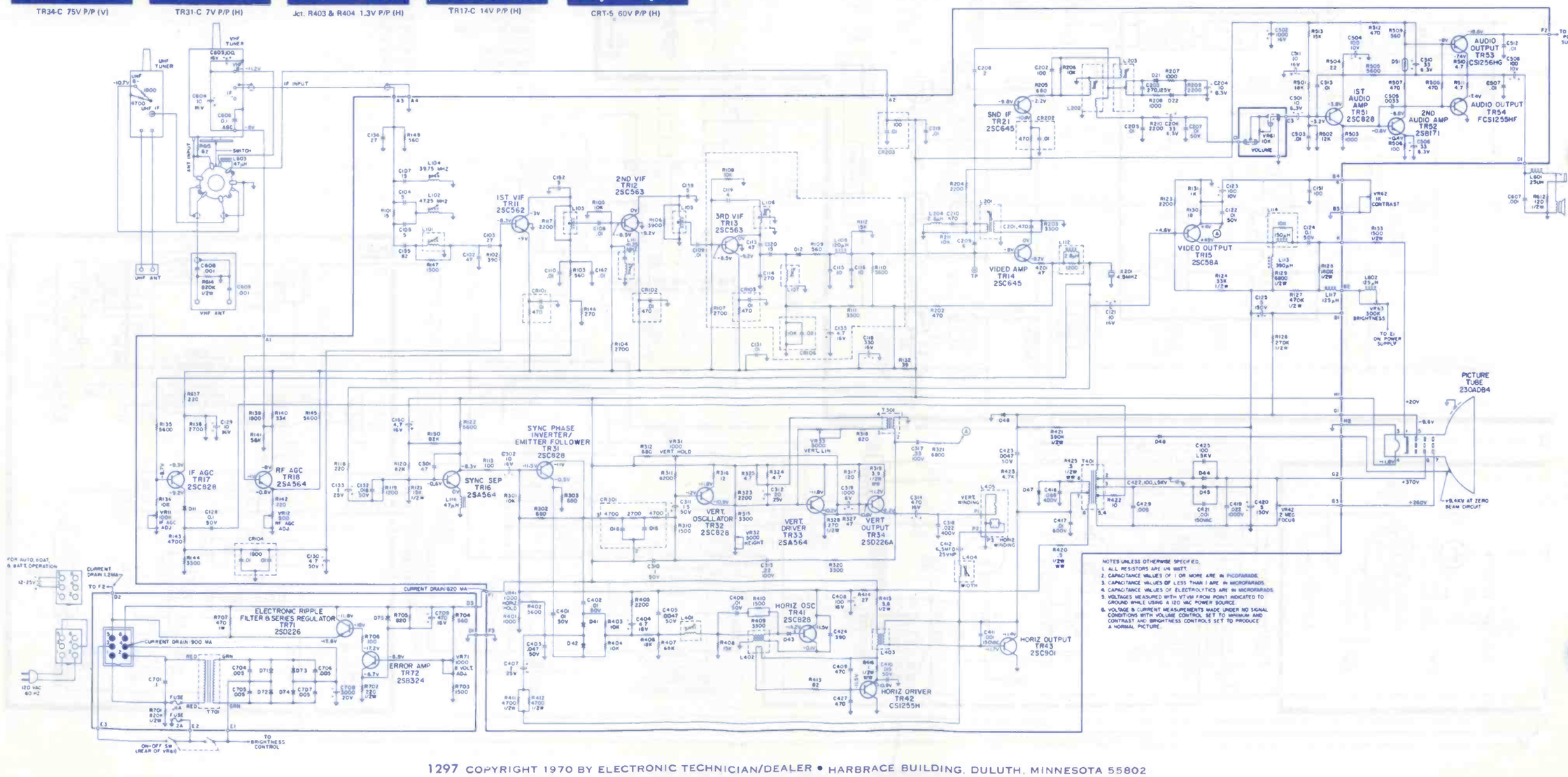


VHF TUNER SCHEMATIC DIAGRAM





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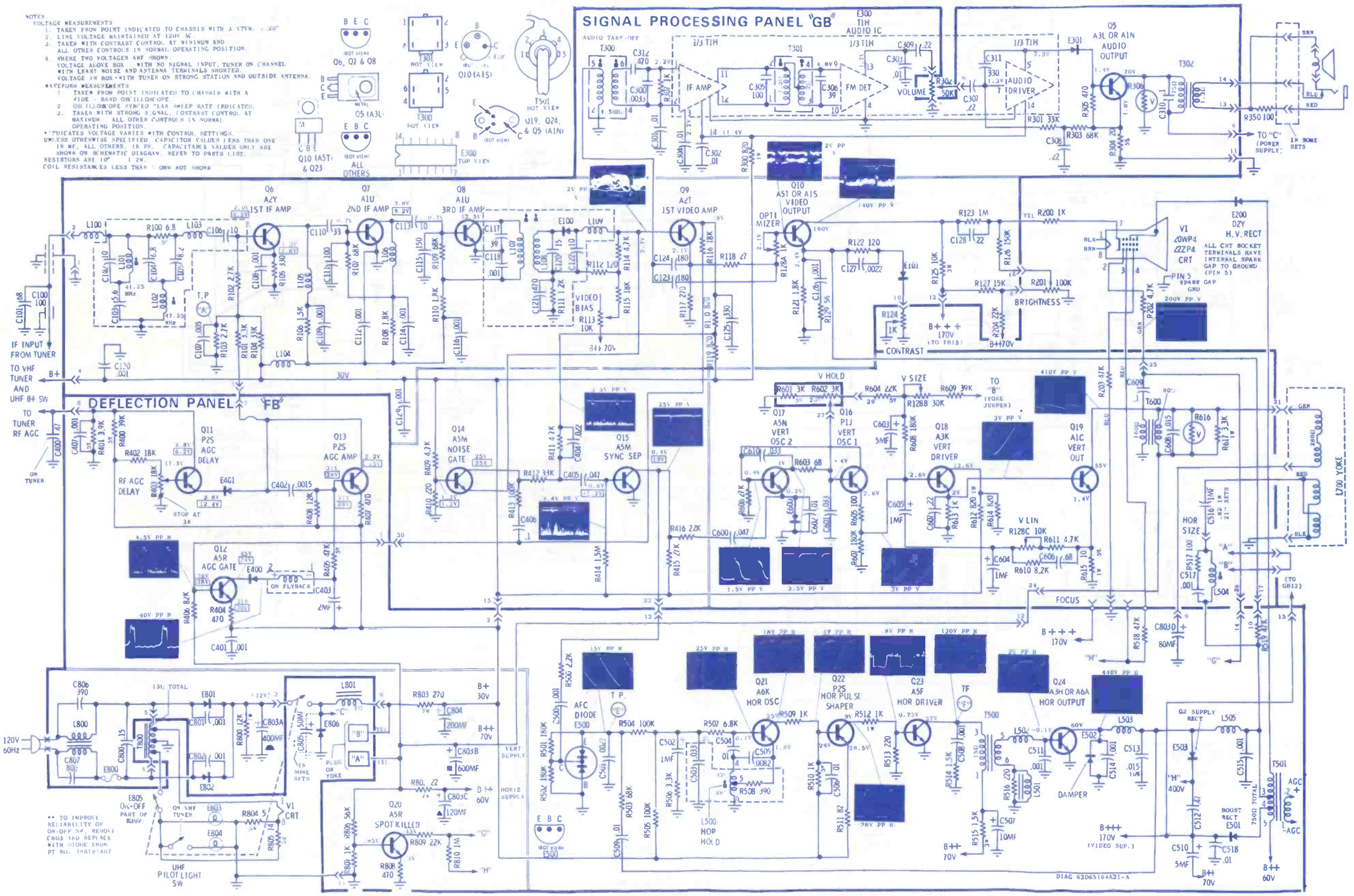
1298

MOTOROLA
TV Chassis TS-599

MAY • 1970

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

SYMBOL	DESCRIPTION	MOTOROLA PART NO.
E300	integrated circuit: T1H rec silicon	
L104	choke, RF	24D65947A94
R113	video bias: 10K	18D66401A19
R128	optimizer: 1K/vert size: 30K/vert lin: 10K	18D67678A09
R306	varistor	6C66263A16
R616	varistor	6C66263A16
T300	4.5MHz trap & ATO	24D68822A07
T301	ratio detector	24D68517A16
T302	audio output	25D67552A25
T600	vert output	25D69990A01
C803	400µf/100v$_2$ 600µf/100v/ 120µf/100v; 80µf/100v lytic	23C69772A02
L500	horiz osc; incls core	24D68130A03
L501	choke, horiz speed up	24D69044A04
L503	choke horiz suppressor	24D69707A18
L504	horiz size	24D69163A04
L505	choke, horiz suppressor	24D65947A74
L800	choke, fine; incls C806 & 807	24V68638A15
R403	RF AGC; 18K	18D66401A20
T500	horiz driver	25D67440A03
T501	HV xformer: complete	24D69826B02
L700	yoke, deflection: 114°	24D68523A05
L801	choke, filter	25D67554A15
R124	contrast: rotary; 1K C21, D21TS-599	18D67502A14
R201	bright; slide; 100K C19TS-599	18D68443A14
	bright: rotary; 100K C21, D21TS-599	18D67637A63
R602	vert: slide; 3K C19TS-599	18D68443A13
	vert: rotary; 3K C21, D21TS-599	18D67637A64
T800	power	25D68499D04
	VHF tuner, CPTT, OPTT-413	
	UHF tuner, KTT-626	



1299

PHILCO-FORD

TV Chassis 20P22

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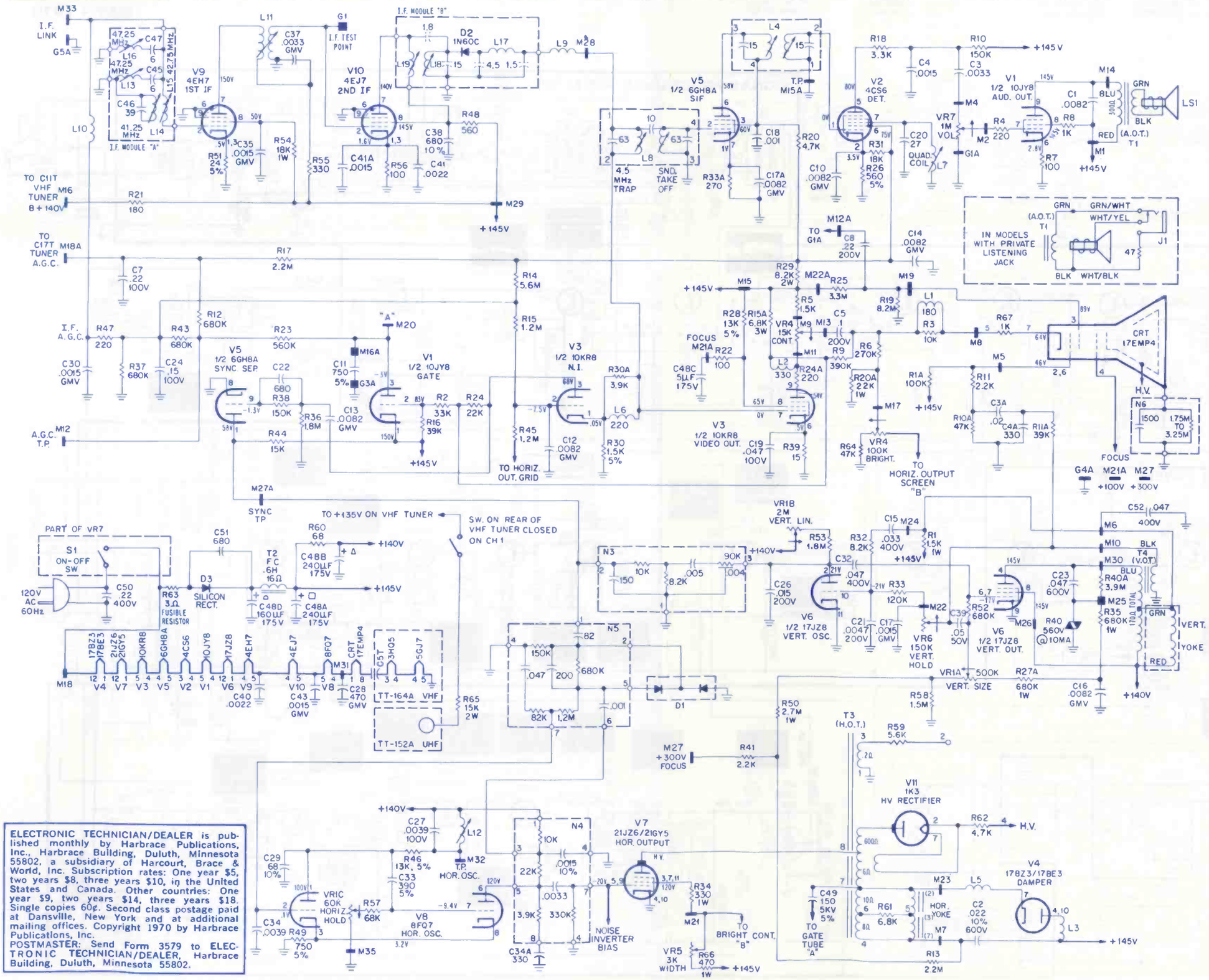
COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR 6 NEW SETS

SYMBOL	DESCRIPTION	PHILCO-FORD PART NO.
C48A-D	160/240/240/5 @ 175v B+ filters	30-2601-33
L7	quad, snd det	32-4876-1
L8	MHz trap & snd take-off	32-4688-13
L12	horiz stabilizer	32-4754-3
L13	47.25MHz trap	32-4652-78
L14	41.25MHz trap	32-4652-80
L17	40MHz det choke	32-4837-1
N3	vert integrator	30-6030-12
N5	phase comp	30-6035-2
N6	CRT isolation	30-6058-2
R15A	6.8K 3w video plate	33-1363-46
R40	varistor vert yoke	33-1373-6
R63	3Ω fusible resistor	33-1381-5
T1	audio output	32-10013-2
T2	filter choke	32-10118-4
T3	horiz output	32-10008-7
T4	vert output	32-10012-6
VR1A-C	500K V size 2M lin. 60K H. hold	33-5595-8
VR4A-B	100K bright 15K contrast	33-5618-17
VR5	3K width	335620-1
VR6	150K vert hold	33-5619-9
VR7	1M vol-on-off, w/cb	33-5634-5
	VIF det assy w/comp (module "B")	38-10302
	Tuner, UHF TT152	76-13827-1
	Tuner, VHF TT164A	76-13579-7



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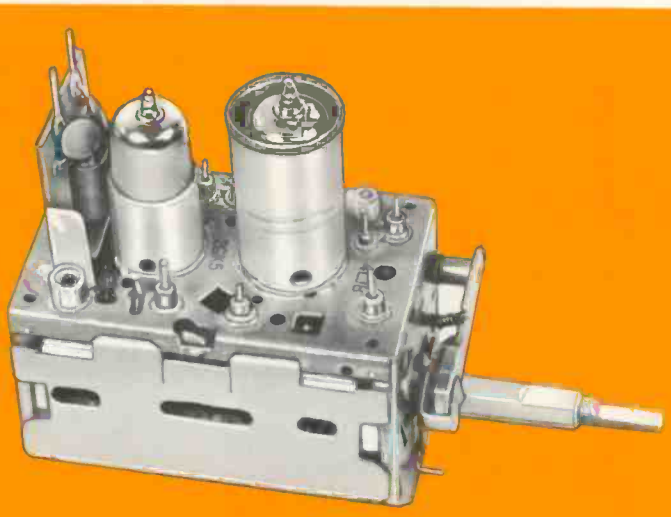

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WORLD'S LARGEST TV-RADIO SERVICE & SALES CIRCULATION

MAY 1970 • VOL. 91 NO. 5

COVER

Our cover this month was taken on one of Northern Minnesota's beautiful lakes and attempts to illustrate the increasing popularity and use of marine electronic equipment as part of the boating enthusiast's basic requirements for safer boating.

TEKFAX • 16 PAGES OF THE LATEST SCHEMATICS • **Group 213**
ADMIRAL: TV Chassis T3K3-1A,T3K3-1B
AIRLINE: Color TV Models GC1-12420A,B
MAGNAVOX: TV Chassis T948
MOTOROLA: Color TV Chassis TS-934
MOTOROLA: TV Chassis TS-599
PHILCO-FORD: TV Chassis 20P22

A HARCOURT, BRACE & WORLD PUBLICATION
Harbrace Publications, Inc.

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ET/D EDITOR'S MEMO

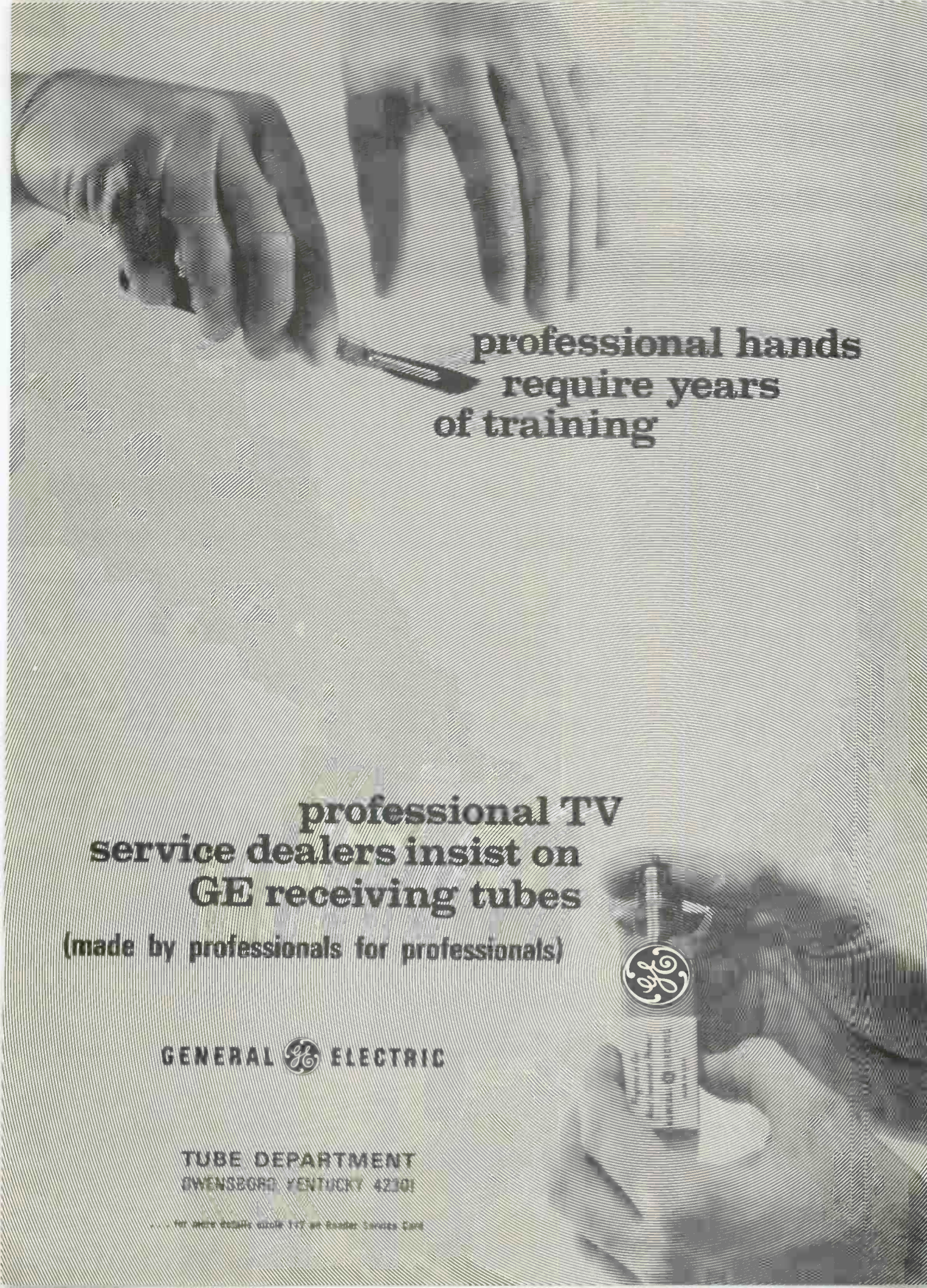
Educational TV

I just returned from the IEEE convention in New York and have to admit that with the airline controllers' sick-in it was something of a long trip. I never spent so much time on one airplane going nowhere in my life.

But if something good were to come of it all, I would say that the IEEE and several of the press conferences were worth it. One of the most interesting meetings I attended was sponsored by CBS for their color EVR (Electronic Video Recording) division. The meeting had as guest speakers Mr. Frank Stanton, CBS president, Mr. E. H. Wavering, President of Motorola, and Mr. Daryl F. Zanuck, Chairman of the Board of 20th Century-Fox Films. The meeting took place in the Grand Ballroom of the Hotel Pierre in N.Y. City in which were set up several Motorola production line monitors, color of course, and several video tape players.

CBS president Frank Stanton and Motorola president Elmer H. Wavering were joined by Daryl F. Zanuck in announcing plans to make 20th Century-Fox theatrical films available for conversion to the new EVR system of showing on home receivers. The color EVR system was developed by CBS, and Motorola obtained the exclusive license to manufacture the players in North America. The players are capable of either black and white or color with only a simple hookup to the regular antenna outlet on rear of the TV set.

Since the premier showing of the EVR system, plans now call for a demonstration tour which will include exhibits at 17 major cities across the nation. Just think, soon you may be selling CCTV and video tape recorders to your color TV customers so they can show their own home color movies from a popular selection of the best of 20th Century films.


professional hands
require years
of training
professional TV
service dealers insist on
GE receiving tubes
(made by professionals for professionals)
GENERAL ELECTRIC
TUBE DEPARTMENT
OWENSBORO, KENTUCKY 42301

ET/D NEW AND NOTEWORTHY

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

COLOR CRT ONE GUN BOOSTER

Boosts only weak gun for proper color balance **700**

Introduced is a solid-state one gun booster for color TV picture tubes. The booster extends color gun life by restoring the brilliance of either the red, blue or green gun.

This unit is not the same as a regular brightener that boosts all three colors equally, but will boost the one weak color as needed for a balanced color picture.

Installation is easy with self-stripping connectors that are included in the package. Workman.

SOLDERING IRON/POWER UNIT

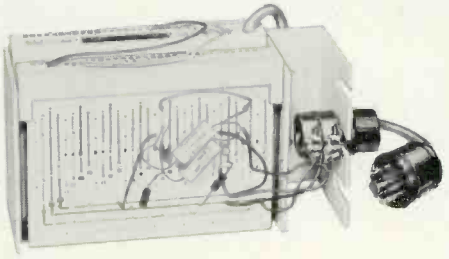
Tips changed without tools **701**

Announced is the Model W-TCP Temperature Controlled, Low Voltage Pencil Iron and Power Unit. The unit represents the most advanced equipment available for production line manual soldering and technical use.

The pencil, weighing 1⅔oz (2½oz including cord) reportedly packs the heating capacity of irons weighing a pound or more. It automatically adjusts to handle jobs in the 15 to 75w conventional iron range and an extended range up to 100w, where production rate is not excessive.

The unit uses interchangeable, premium plated tips, each with its own magnetic temperature sensor for selected tip idle temperature. A wide variety of screwdriver, conical and pyramid tips are available.

The power unit furnishes the soldering pencil with a source of 24v current and is equipped with a handy stand for the pencil. A heavy duty transformer, rated at 60w, 120v, 50/60Hz is housed within the phenolic case, which is also provided with a sponge for tip cleaning. Weller.



PATCH-BOARD 702

More economical than conventional breadboarding

Introduced is the EU-53A "Stack-n-Patch" . . . a technique for circuit design and teaching that is faster, easier and more economical than conventional breadboarding.

The board consists of a small desk-top chassis, a Power Patch Card and a Component Patch Card. Patching up a design is fast and simple . . . pick your choice of power supply and connect it to the Power Patch Card . . . stack the Component and Power Patch Cards in the Chassis . . . and patch components or hook-up wire into the Component Card. The Patch-Board eliminates soldering . . . the special connectors on the cards make a tight, electrically stable connection just by inserting the wire into the connector. The 177 connectors on the board are arranged according to common circuit board practice and closely simulate the circuit density and "stray" interaction of today's printed circuits.

For IC work and other types of design that can't be conveniently built on the component card, a wide variety of factory assembled cards to stack in the chassis is offered. The Model EU-53A is $37.50. Heath.

FOR MORE NEW PRODUCTS SEE PAGES 72 & 84

Now the Chromacolor revolution comes to replacement tubes too!

Now you can install Zenith's patented Chromacolor picture tube that outcolors, outbrightens, outcontrasts and outdetails every other 23″ diag. color picture tube.

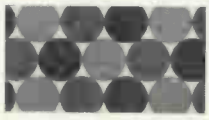
With a full 2-year warranty!

After years of pioneering research and development, Zenith has perfected a color TV picture tube different than any other on the market. So revolutionary that it outcolors, outbrightens, outcontrasts and outdetails every other 23″ diag. color tube. And it's a Zenith exclusive—covered by U.S. Patent No. 3,146,368.

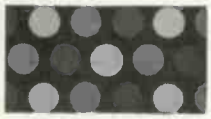
Before Chromacolor, every giant-screen color picture was made up of tiny dots on a gray background.

But Zenith made the dots smaller, surrounded them with jet black and, for the first time, *fully* illuminated every dot. Result: the brightest, sharpest picture tube in giant-screen color TV.

The Zenith Chromacolor tube will readily replace the 23″ diag. tube in almost any TV, whatever brand. And, unlike most replacement tubes, it's warranted for *two* full years.



Magnified drawing of ordinary color TV screen before Chromacolor



Magnified drawing of Zenith Chromacolor TV screen

Simulated TV picture

Order the Zenith Chromacolor picture tube from your Zenith distributor for your next installation. And put your customer in a better light.

At Zenith, the quality goes in before the name goes on.®

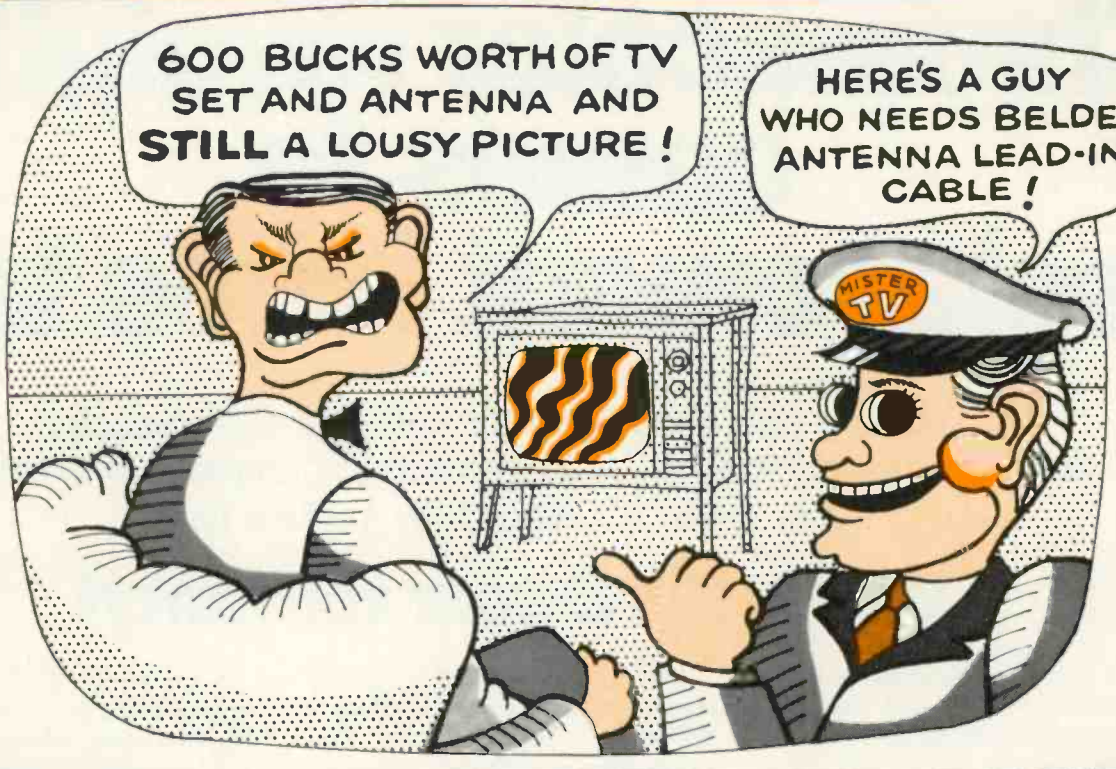
TWO-YEAR WARRANTY

Zenith Radio Corporation warrants the replacement CHROMACOLOR picture tube to be free from defects in material arising from normal usage for two years from date of original consumer purchase. Warranty covers replacement or repair of picture tube, through any authorized Zenith dealer; transportation, labor and service charges are the obligation of the owner.

ZENITH®

CHROMACOLOR™

ONLY ZENITH HAS IT



Color or UHF set perfect? Antenna perfect? Then obviously there's a missing link. Check that antenna lead-in cable. Old, worn-out, weather-beaten cable, or the ordinary flat ribbon kind designed for black and white VHF, causes more fuzzy, distorted pictures than you can count. It's your opportunity to upgrade these customers to a cable matched to their particular signal reception situations. One of Belden's Big Four—the link to perfect reception.

FOR CONGESTED AREAS...

8290 SHIELDED PERMOHM®

In congested, in-city areas, stray electrical interference and noise are at their worst. For perfect, all-82 channel reception—color or B/W—replace old cable with Belden's 8290 Shielded Permohm. Its aluminum Beldfoil® shielding prevents pickup of ghost signals and electrical noise by the lead-in. Weather-proof and water-proof. You can tape it right to the mast. Or install it underground, in conduits—even in rain gutters.

AWG & (Stranding)	Color	Nom. O. D. (Inch)	Nom. Velocity of Propagation	Nom. Capacitance (mmf/ft.)	Nom. Attenuation per 100' mc	db	Standard Package Lengths in ft.
22 (7 x 30)	Brown	.305 x .515	69.8%	7.8	57 85 177 213 473 671 887	1.7 2.1 3.2 3.5 5.4 6.6 7.7	50', 75', 100' coils have terminals attached. Available in counter dispenser. 250', 500' spool.

Copperweld, 2 conductors, orange polyethylene insulation and web between conductors, cellular polyethylene oval insulation, Beldfoil shield, stranded tinned drain wire, polyethylene jacket.

FOR FRINGE AREAS...

8285 PERMOHM®

Antenna cable in uncongested or fringe areas picks up little electrical interference. But does get a lot of weathering, which degrades an already weak signal. These customers need encapsulated cable. Belden 8285 Permohm. Its special polyethylene jacket protects the energy field, regardless of weather conditions. It delivers the strongest signal of any unshielded twin lead under adverse conditions. Requires no matching transformers and connectors. For all 82 channels, color or B/W.

AWG & (Stranding)	Color	Nom. O. D. (inch)	Nom. Velocity of Propagation	Nom. Capacitance (mmf/ft.)	Nom. Attenuation per 100' mc	db	Standard Package Lengths in ft.
22 (7 x 30)	Brown	.255 x .468	73.3%	5.3	100 300 500 700 900	1.4 2.8 3.8 4.8 5.6	50', 75', 100' coils have terminals attached. Available in counter dispenser. 250', 500' coils and 1000' spool.

Copperweld, 2 conductors parallel, orange polyethylene insulation and web between conductors, cellular polyethylene oval jacket.

FOR LOCAL BLACK AND WHITE...

8275 CELLULINE®

Cracked, corroded, weathered cable, full of dirt and moisture, loses signal strength; prevents any TV set from delivering a quality picture. Upgrade B/W VHF and local UHF customers to Belden 8275 Celluline. Performance is improved because all possible moisture between conductors has been eliminated. Abrasion-resistant and weather-resistant for a long, long service life. And, it requires no end sealing.

AWG & (Stranding)	Color	Nom. O. D. (inch)	Nom. Velocity of Propagation	Nom. Capacitance (mmf/ft.)	Nom. Attenuation per 100' mc	db	Standard Package Lengths in ft.
20 (7 x 28)	Brown	.300 x .400	80%	4.6	100 200 300 400 500 700 900	1.05 1.64 2.12 2.5 2.98 3.62 4.3	50', 75', 100' coils in counter dispenser. 250', 500', 1000' spools.

Bare copperweld; 2 conductors parallel, polyethylene jacket with inert gas filled unicellular polyethylene core.

FOR MATV AND CATV...

8228 DUOFOIL® COAX

Got an apartment or townhouse complex in your area? Motels or hotels? Or is CATV coming? Use Belden's new 75 ohm coaxial cable—8228 Duofoil. Shielding is 100%—sweep tested 100%. Spiral wrapped drain wires provide long flex life. Small diameter saves space in conduit installations. Use Duofoil for all coaxial color and B/W VHF, UHF and CATV applications.

AWG & (Stranding)	Color	Nom. O. D. (inch)	Nom. Velocity of Propagation	Nom. Capacitance (mmf/ft.)	Nom. Attenuation per 100' mc	db	Standard Package Lengths in ft.
18 Solid, Bare	Black	.242	78%	17.3	50 100 200 300 400 500 600 700 800 900	1.5 2.1 3.1 3.8 4.5 5.0 5.5 6.0 6.5 6.9	100', 500', 1000' spools.

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

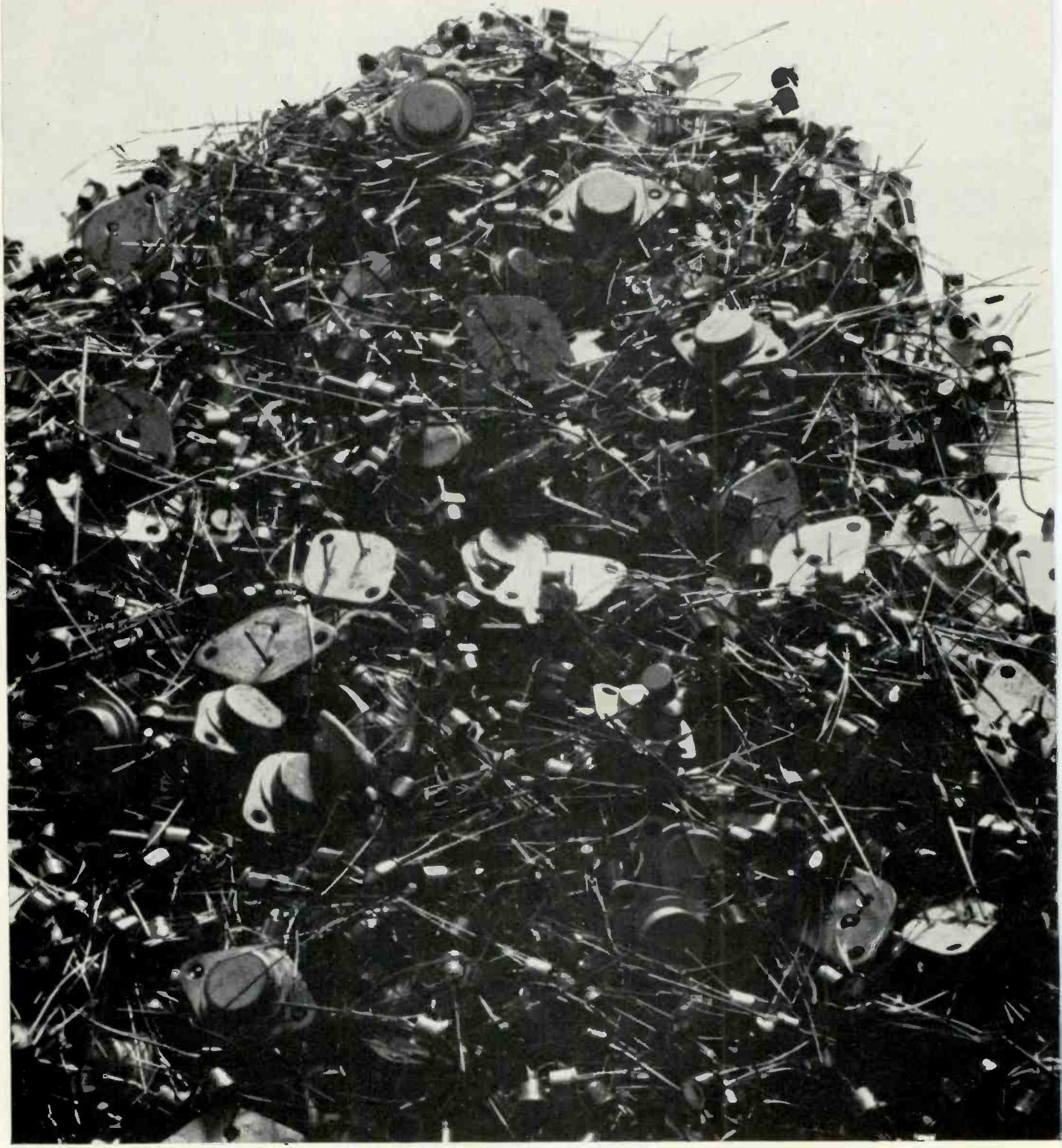
See your local Belden distributor for full details or to order. For a free copy of the recent reprint article, "Electronic Cable," write: Belden Corporation, P.O. Box 5070-A, Chicago, Illinois 60680.

BELDEN

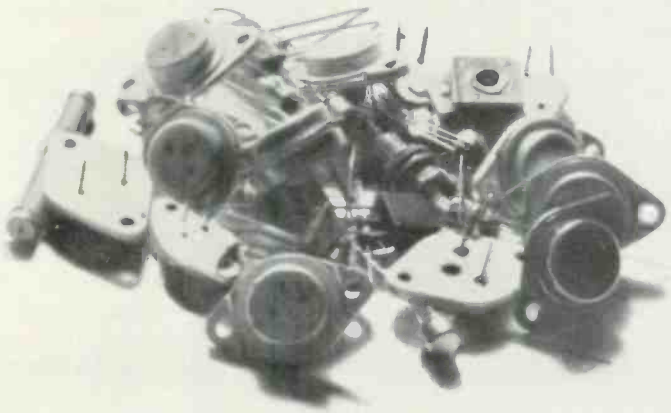
8-6-8A

... for more details circle 106 on Reader Service Card

This is 30,000 solid state replacement parts.



So is this.



It used to be if you wanted to satisfy everyone, you had to stock over 30,000 different solid state replacement parts.

Well, everyone realized that was ridiculous. So some enterprising people came up with a bunch of universal replacements.

Then you only had to stock about eleven or twelve hundred.

That was a lot better, but we still thought it was a little ridiculous.

So two years ago (when we went into this business), we figured out how to replace all 30,000 with only 60.

Now all you have to do is stock 60 of our diodes, transistors, integrated circuits, etc., and you can replace any of the 30,000 parts now in use. Including all JEDEC types, manufacturers' part numbers, and foreign designs.

That means you invest less money.

You don't tie up valuable space.

You do away with complicated inventory control.

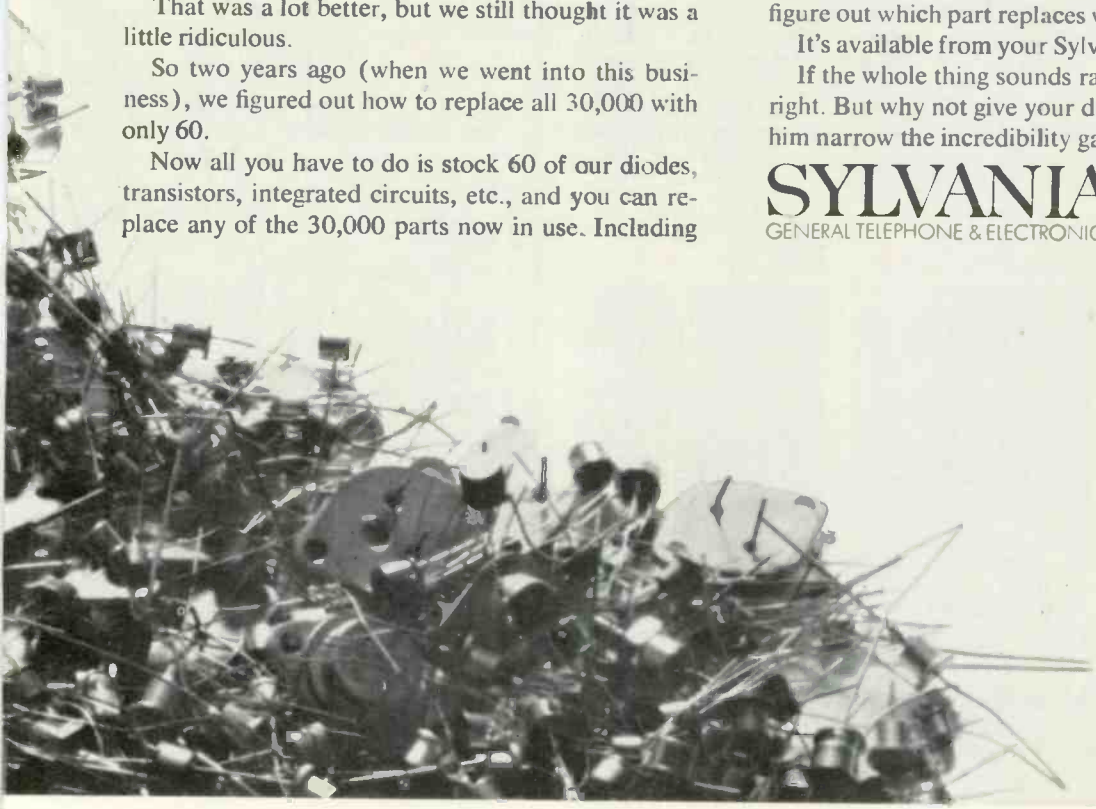
And you operate more efficiently.

To make life even easier, we've got a new book that gives you all the cross references you need to figure out which part replaces which.

It's available from your Sylvania distributor.

If the whole thing sounds rather incredible, you're right. But why not give your distributor a call and let him narrow the incredibility gap.

SYLVANIA
GENERAL TELEPHONE & ELECTRONICS



ET/D LETTERS TO THE EDITOR

Reader's Aid

We need a schematic and instruction manual for a Sonora electronic organ, Model 200 400. This company, Sonora Electronic, Inc., has been out of business for many years. Any help will be much appreciated.

NORMAN L. FITKIN
Norman L. Fitkin Television Sales and Service
207 Circle
Sebring, Fla.

We have a Citizens Band transceiver made by Polytronics, which was located at 900 Burlington Ave., Silver Springs, Md. 20910.

I wrote to them and the mail has been returned, so I presume they are no longer in business. We cannot locate a dealer or distributor that could furnish me with the schematics and instructions for the above mentioned transceiver. It is a Poly-Comm 30 Serial No. 126A21, issue No. 1. If there is any way you can help me, I would gladly pay all costs involved.

Your magazine has been very beneficial and we definitely look forward to its arrival each month.

LOU WEISS
Better Radio & Television Service
957 Morris Park Ave.
Bronx, N.Y.

I am a subscriber of your magazine in need of some information that I am unable to find anywhere. Could you please tell me where I can obtain parts for Webcor models?

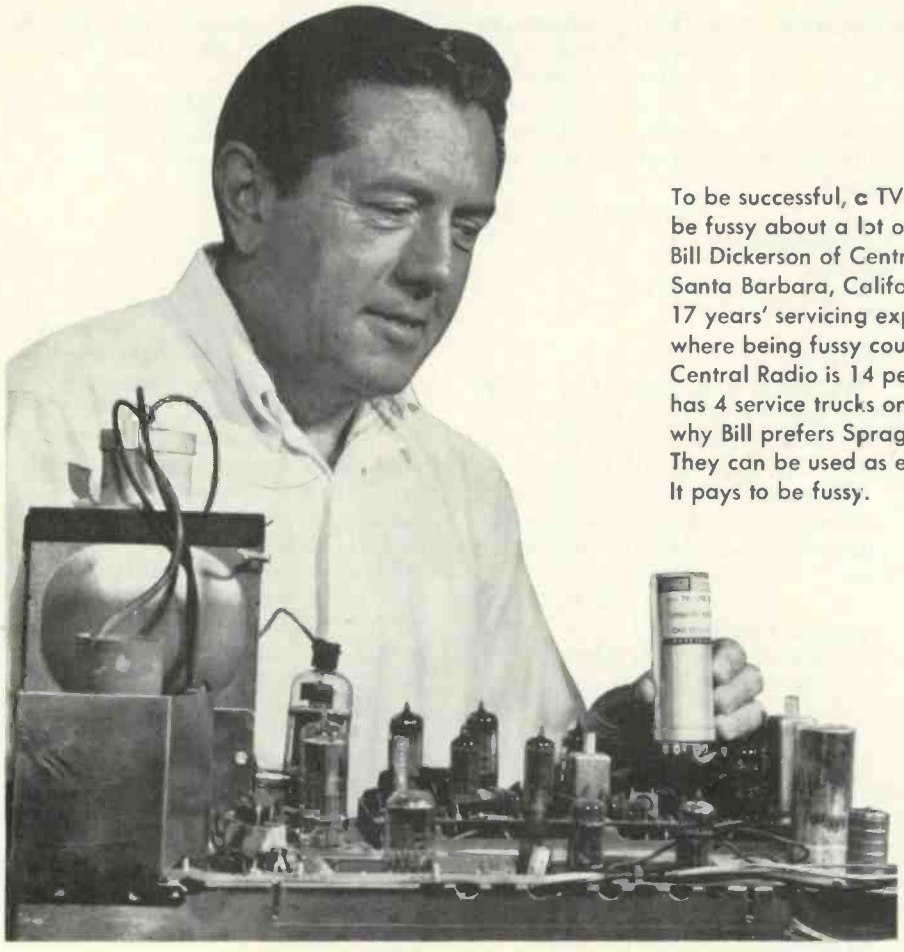
I know that they went out of business, and I am having difficulty trying to find parts for them.

JAMES R. CAHILL
Jim Cahill
Radio, Television & Electronic Servicing
Wilmot Flat, N.H. 03287

As a subscriber of ELECTRONIC TECHNICIAN/DEALER, for I believe 20 years, I have yet to see very much covering the subject of marine radio equipment in the 2 to 4 MHz band, or much if anything on mobile radio equipment in the 150 to 174 MHz band. I presume it is mostly because there is a much greater demand for the entertainment type of electronic gear. However, there must be many other technicians interested in com-

Do you judge capacitors on the same basis Bill Dickerson does?

Then you'll use Sprague Twist-Lok® Capacitors when you need twist-prong electrolytics.



To be successful, a TV service dealer has to be fussy about a lot of things. No one knows it better than Bill Dickerson of Central Radio and Television, Santa Barbara, California. He's building on his 17 years' servicing experience every day in a spot where being fussy counts a lot. Central Radio is 14 people strong and has 4 service trucks on the go. It's easy to see why Bill prefers Sprague Twist-Lok Capacitors. They can be used as exact replacements to avoid call-backs. It pays to be fussy.

Ask your Sprague distributor for a copy of Sprague's Electrolytic Capacitor Replacement Manual K-109 or write to: Sprague Products Company, 65 Marshall St., North Adams, Mass. 01247

P.S. **You can increase your business 7½% by participating in EIA's "What else needs fixing?" program. Ask your distributor or write to us for details.**

SPRAGUE®
THE MARK OF RELIABILITY

63-9116

. . . for more details circle 140 on Reader Service Card

ET/D LETTERS TO THE EDITOR

municications equipment topics also.

My real reason for writing you is that I am looking for a recommended list of test equipment most needed to adequately equip my shop for the installation and servicing of communications equipment, such as the above mentioned. Would you be so kind as to tell me what you and your staff might recommend, and furnish me with a listing of manufacturers that I might contact for their catalogs and price information. Of course, if you can help me in any other way I would certainly appreciate it.

Radio and TV servicing has been my trade for the last 20 years, but I feel that I must slow down a little so I am giving up all the TV and radio business, only keeping my marine radio work. In so doing I am invited to service all the local mobile radio equipment on the Island of Nantucket and to do so will naturally require me to invest in, I presume, considerably more test gear than what I have had heretofore.

FREDERICK W. COOK
Cook's Electronics
Box 831
Nantucket, Mass. 02554

We have a dc voltmeter, Model 20A, manufactured by F. L. Mosley Co. of Pasadena, Calif. This voltmeter was made for the Navy.

We would like to know if any of your readers has any information, diagrams or an address for the Mosley Co.

CHARLES F. MEYER
Electronics Instructor
Twin Falls Senior High School
Twin Falls, Idaho 83301

Please send me the address of Russell Industries. They manufacture shielding. If you do not have this address, then can you tell me where I can get it?

PAUL CAPITOL
Capitol Radio Service
637 West 21 St.
Erie, Pa. 16502

I am in need of information on a Grundig record player and hope you or a reader can help me. A letter to Grundig in New York resulted in the information that they did not import that model. It is a Grundig Model Mandello-b No. 5263 HE.

What I need is a cross reference to one of the tubes, an EAF-801 and a cross reference on the cartridge or needle. The cartridge number is AG 3306 AHDT or AG 3310 AHDT.

Any help would be appreciated.

DONALD C. TREECE
Don's Electronic Service
Route No. 3
Kahoka, Mo. 63445

Selling Business

I have an excellent going business here in South Georgia. The people are friendly and the climate is very good, but the time has come for me to step down, due to age.

It would be an excellent opportunity for one or two younger men to take over a fully equipped and going business of 21 years. If you can pass this along to your readers, I will furnish all particulars.

I have enjoyed your publication for years, in fact we are paid up for the next three. I hope to at least be able to keep up with the trade for some time to come.

WILLIAM H. REYNOLDS, SR.
Emerson Park TV & Electrical
Appliance Service Co.
RFD No. 3, Box 217
Waycross, Georgia

Comments on Articles

I would like to say how much I enjoy reading your magazine. It is probably one of the finest technical publications available.

I am employed as a communications technician with the Ontario Hydro Power Commission. While I do not become involved in TV servicing, we are involved in FM, AM, SSB, microwave and multiplex systems (not to be confused with transmitted radio multiplex).

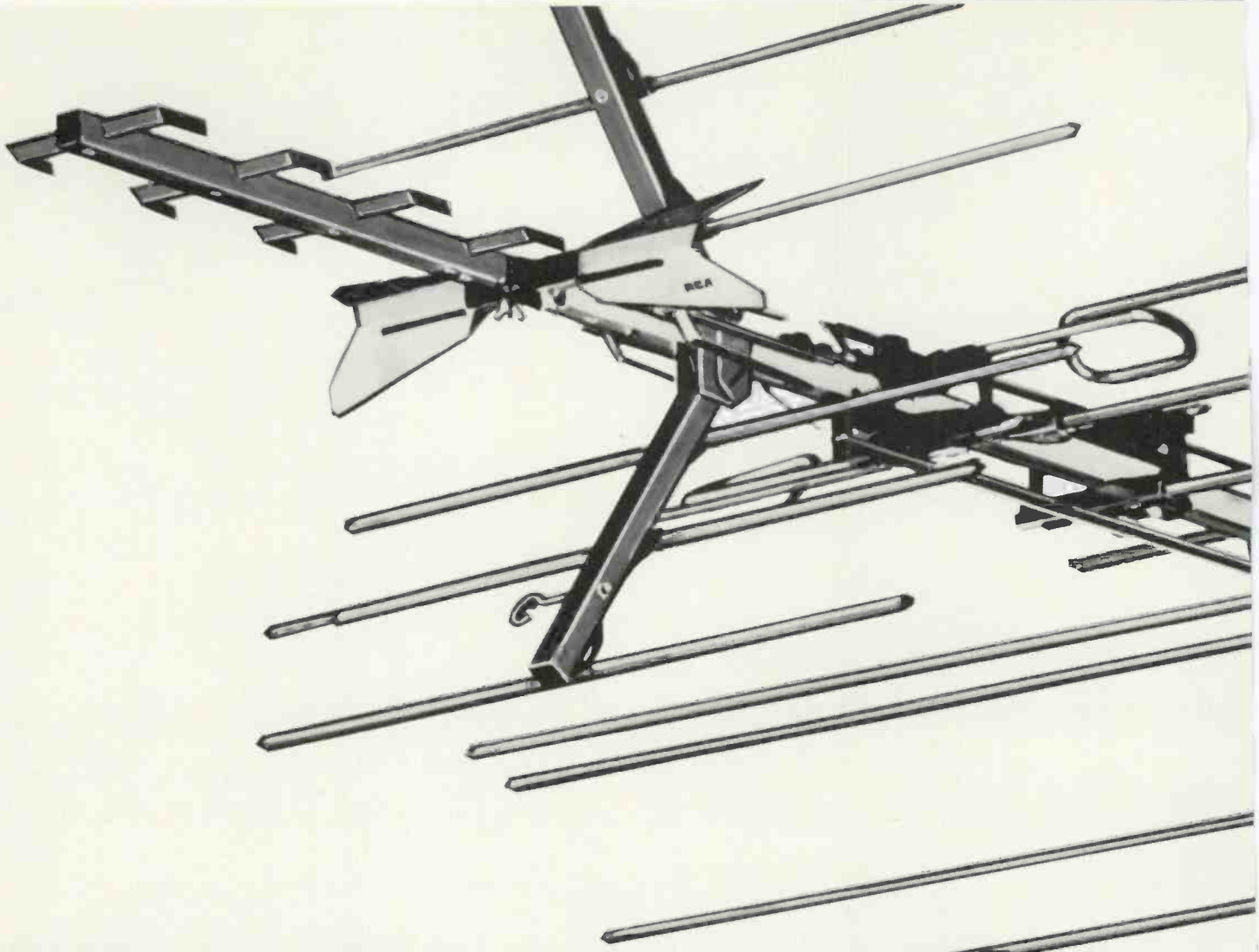
One feature which I think your readers might find enjoyable would be a series of articles on the early history of electronics. I think it would make a fine series.

I am interested in obtaining a complete set of your "Semiconductors From A to Z" series. Would this be available in book or pamphlet form? Unfortunately, I started to get your magazine about halfway through the series.

EDDIE LEHMAN

The "Semiconductors From A to Z" series was printed in book form by Tab Books and the book is now in its second printing. The book has been listed in many of their advertisements in ELECTRONIC TECHNICIAN/DEALER, *as well as being listed in Lafayette Electronic Corp.'s 1970 catalog. Ed.*

When RCA engineers put their minds to antennas, outstanding things happen:



RCA Permacolor

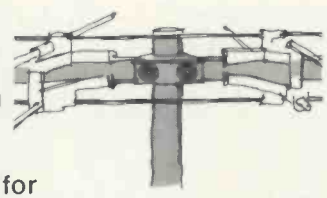
Permacolor is not just an improved antenna, it's a completely new antenna. New in looks. New in design. Very easy to set up and install.

And Permacolor is manufactured exclusively by RCA. Here are a few of its many unique features:

Permanent Connections.
Any antenna is as permanent as its electrical connections. Particularly between the elements and the feed line. If a connection fails, ghosts, streaks, "noise," even total reception failure may occur.

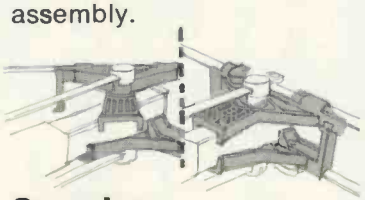
On a Permacolor an aluminum strap solidly connects every active element to the feed line. Connection failure is virtually eliminated.

Tuned Circuits.
Permacolor elements are integral parts of tuned circuits and many perform more than one function. Circuits stay "perma-tuned" because elements are permanently connected. Feed lines are unbroken aluminum strips perfectly balanced for optimum impedance match and minimum ghost pick-up.



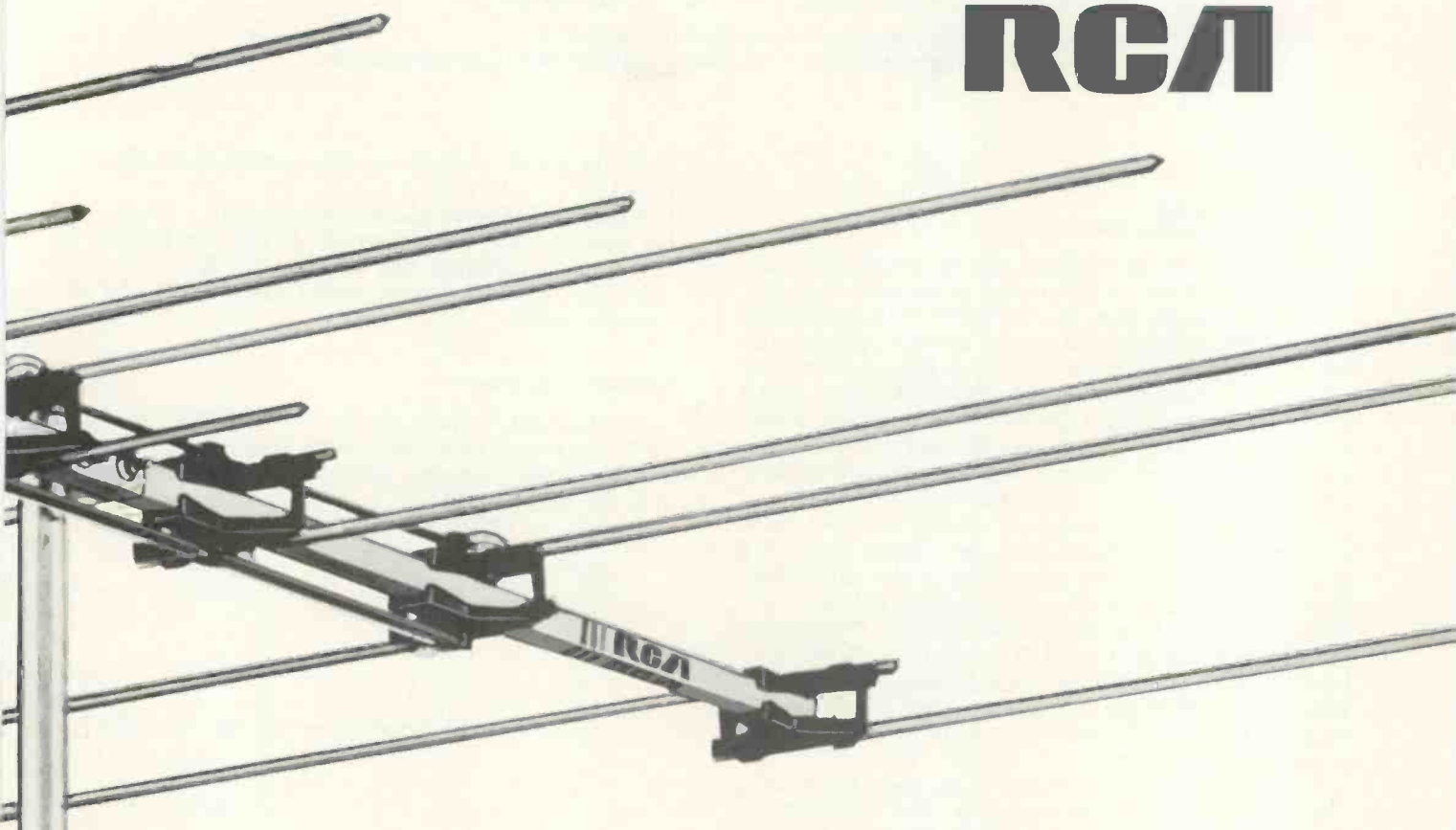
Revolutionary Insulators.
Permacolor insulators are polypropylene, a tough, flexible, water-proof plastic with superior electrical properties. Their unique design includes many ribs and barriers to make leakage paths longer.

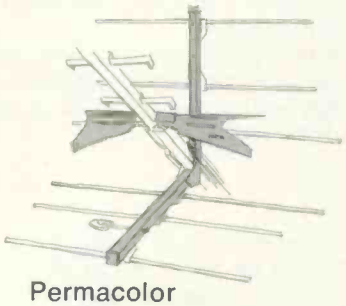
On a Permacolor, elements do not pivot. Instead, the elements are assembled right into the insulators. Each insulator, gripping 5½ inches of element, pivots as a unit. When the Permacolor unfolds, insulators snap in place and permanently lock to form a rigid truss. There's no point of high stress along the entire assembly.



Superior Combinations.
UHF and VHF get bigger boosts on Permacolor combinations. On the corner reflector, the angle is increased to 110° for optimum efficiency. And for the first time, a bow tie is included. This best type of UHF dipole is integrated into a single downlead, made possible by a newly designed three-tuned-circuit coupling/isolating network.

RCA



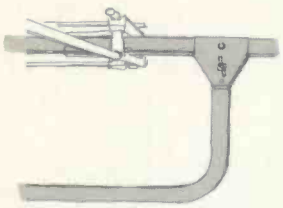


Permacolor combinations are uncompromising all-channel antennas.

Square Boom.
A square boom supports the Permacolor. And it isn't a feed line—it's at ground potential. Detuning effects that often occur when a grounded mast is coupled to a signal carrying boom are eliminated.

The mast clamp is heavy plated steel and locks around the boom without rivets. A double set of serrated teeth take a vise-like bite on the mast to prevent slipping or twisting.

Goes Up Easier.
A Permacolor goes up in one piece. On the roof. Not on the ground. There's no bag of parts. There's nothing to take apart. An installer's job has never been easier or faster.



And installation is just as easy on larger models. A double boom gives added strength, yet takes up only 10 inches on the mast. This allows Permacolor to be placed closer to a rotator, thus minimizing stress on the rotator as well as the mast.

Tough Finish.
Permacolor has a tough blue and gold vinyl finish on all aluminum parts—even the hidden areas. It's similar to the long-lasting coating on aluminum siding for homes.

There's not another antenna like the new, trim, clean RCA Permacolor.

See the complete line of Permacolor antennas today. Your RCA Parts and Accessories Distributor has them now.

Parts and Accessories
Deptford, N.J.

. . . for more details circle 133 on Reader Service Card

ET/D TECHNICAL DIGEST

The material used in this section is selected from information supplied through the cooperation of the respective manufacturers or their agencies.

MAGNAVOX

Record Changers Model W624-W800—Intermediate Gear Alignment

Reports from the field indicate that the intermediate gear (Part No. 76130310), which is part of the immediate gear and striker assembly Part No. 76130389 is being replaced unnecessarily in attempts to correct changer cycling problems. The gear is assumed to be at fault because of the two shaved teeth adjacent to the end of the striker level which are a part of the normal design. Some confusion results from the early design of this gear that had only one tooth shaved. The additional shaved tooth was incorporated later to prevent a condition of continuous cycling.

The general cause of improper cycling has been found to be a mis-aligned intermediate gear center post. Two symptoms can result if the post, which is part of the intermediate gear lever assembly, is incorrectly aligned. If the post is bent away from the turntable gear, the intermediate gear and turntable gear can lose mesh at the shaved intermediate gear teeth. This will cause failure to complete the change cycle and is generally accompanied by a chattering sound as the turntable gear slips against the shaved teeth of the intermediate gear.

The second symptom is caused if the post is bent away from the axis of the main cam gear. This condition can cause the intermediate gear to "climb" the main cam gear and lose mesh with the main cam gear. When the out of cycle condition exist, the intermediate gear is not allowed to retract when the main cam gear reaches the neutral position. Symptoms may include failure to reject and chattering.

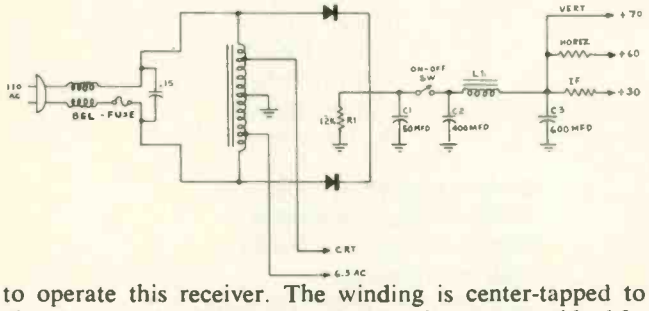
Either of these symptoms may be corrected by removing the intermediate gear and re-forming the intermediate gear center post so it is perpendicular to the changer baseplate. After this adjustment has been made, replace the intermediate gear and run the changer through cycle several times to be certain there is positive mesh between the intermediate and turntable gears, particularly at the point where the teeth are shaved. Also check to be certain the teeth of the intermediate gear have some clearance from the lower lip of the main cam gear. In the neutral position there should also be approximately 1/32in. clearance between the intermediate gear and the turntable gear.

MOTOROLA

TV Chassis TS-599—Circuit Descriptions

Power Supply

A single-winding auto transformer provides the voltages

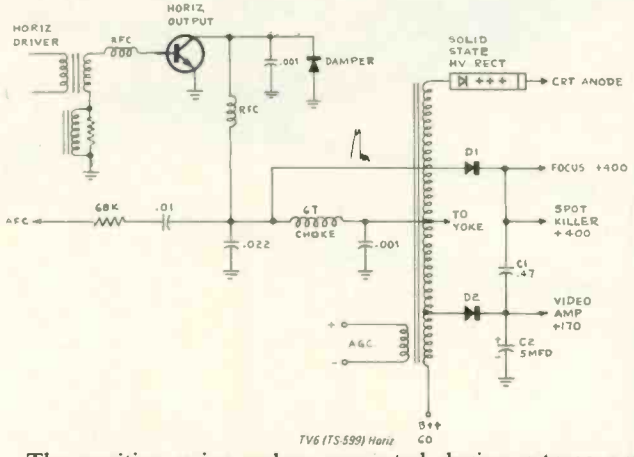


to operate this receiver. The winding is center-tapped to chassis ground and taps on each side of center provide 6.3v necessary for the cathode ray tube employed on this new chassis.

Full-wave recitation and filtering provides a 70vdc output from the filter to the vertical circuit. The 70v line is further filtered through two separate RC filters and provides 60v to the horizontal output and 30v for the remaining circuits.

Horizontal Sweep Circuit

The horizontal sweep circuit of the TS599 chassis is similar to several other Motorola transistorized horizontal output circuits. However, several modifications and additions are incorporated.



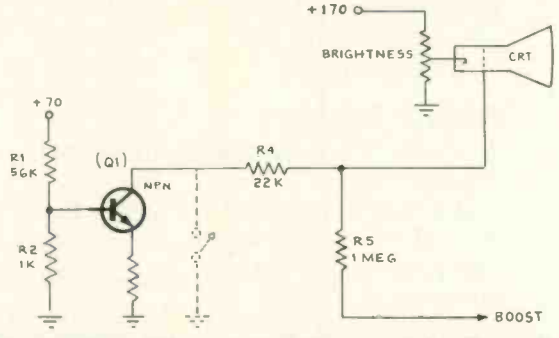
The positive going pulses generated during retrace are applied to two diodes, D1 and D2. Filter capacitors C1 and C2 provide the 170 and 400vdc outputs. The 170 line is used for the video amplifier and the 400v line supplies both the focus and spot killer circuits.

The horizontal coils of the yoke are tapped on the transformer primary, but dc decoupled by a capacitor so they are at ground dc. High voltage for the CRT is provided through a solid-state HV rectifier.

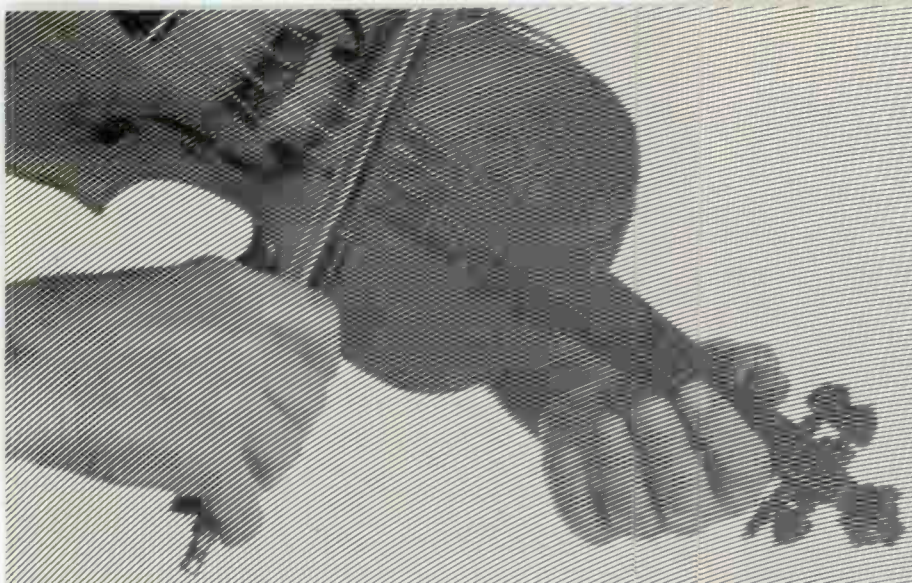
Spot Killer Circuit

The purpose of the spot killer is to eliminate the lingering spot on the CRT when the set is turned off.

With the receiver on, the diagram illustrates the spot



killer transistor Q1 is essentially a switch. The collector voltage of Q1 is derived from the boost voltage and in the base circuit, R1 and R2 form a voltage divider from a +70vdc supply and serve to bias Q1 into saturation. The



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ET/D TECHNICAL DIGEST

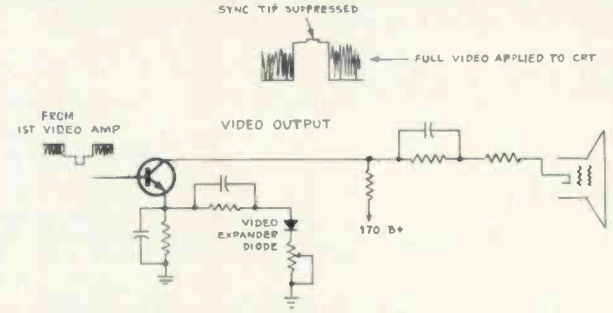
Q1 collector impedance is a very low value (essentially a short) as represented by the switch. R4, R5 and Q1 now act as a voltage divider and apply the correct grid bias to the CRT.

When the receiver is turned off, the voltage applied to the Q1 transistor base circuit decays faster than the boost voltage. As a result, Q1 is no longer forward biased and is essentially an open circuit. The "switch" is now open and there is no longer a voltage divider.

The boost voltage is applied through R5, to the control grid of the CRT. Control grid, G1 is now highly positive, at the same time the cathode voltage is near ground potential. As a result, the CRT conducts heavily and discharges any remaining charge at the anode and the spot is "killed."

Video Expander Diode

The video expander diode allows greater contrast on the picture tube. This is achieved by eliminating the sync pulses of the incoming composite video signal from the



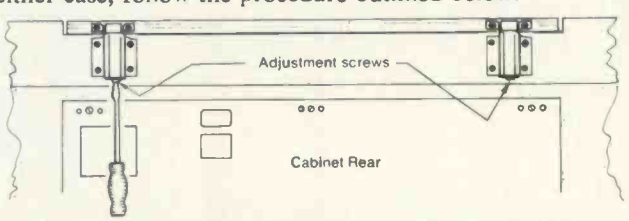
linear conduction range of the transistor.

The diode is in series with the contrast control and an RC circuit in the emitter return. The diode acts to bias the transistor just at the point of conduction for the pedestal level of the incoming signal, with the negative-going sync pulses below conduction. Sync pulses are 20 percent of the composite signal, which means that without this diode only 80 percent of the input swing can be for "black and white" information.

RCA VICTOR

Stereo VLT/VMT Series—Center Lid Opening

Instruments using the center lift lids may be received with the lids jammed in the closed position. In most cases, this is caused by either a small amount of "Spray Lacquer" binding the hinges or the foam block placed between the lid and latch (for shipment) has been inserted wrong. In either case, follow the procedure outlined below.



(1) Turn the adjustment screws (hinges) clockwise as far as possible (maximum tension). (2) Press down firmly on the lid to release the latch. (3) Open and close the lid several times to free the hinges. Then remove the foam block and clean any bits of foam out of the latch. (4) Readjust spring tension so that lid lifts 6 to 8in. when unlatched.

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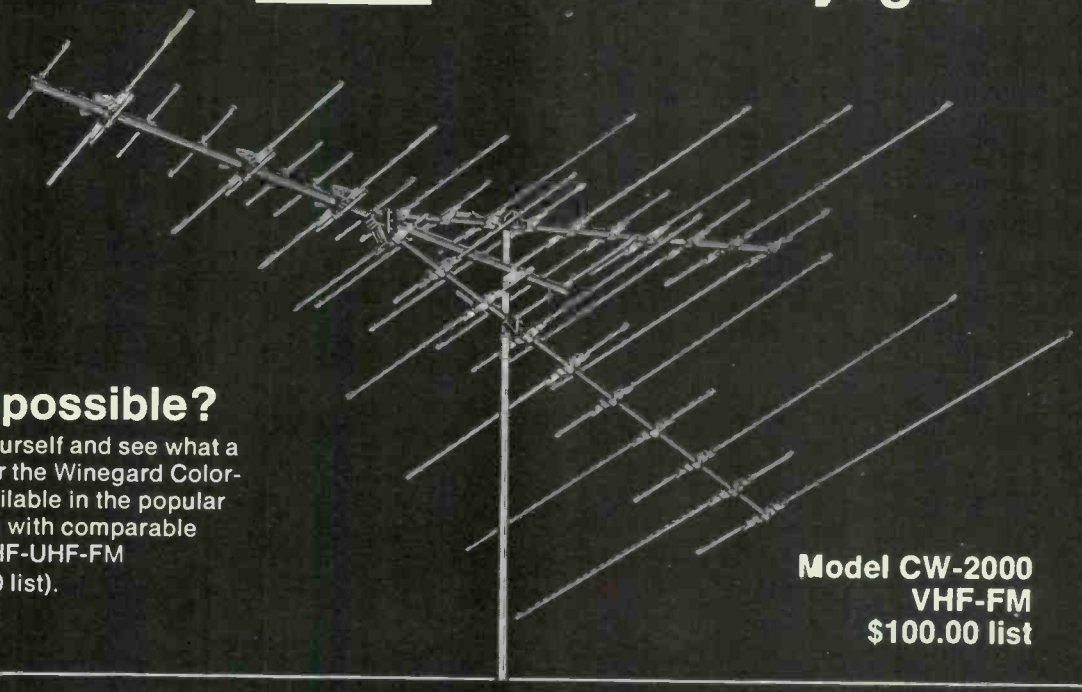

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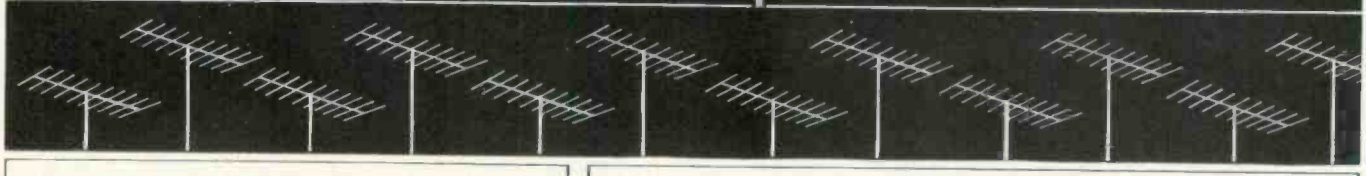
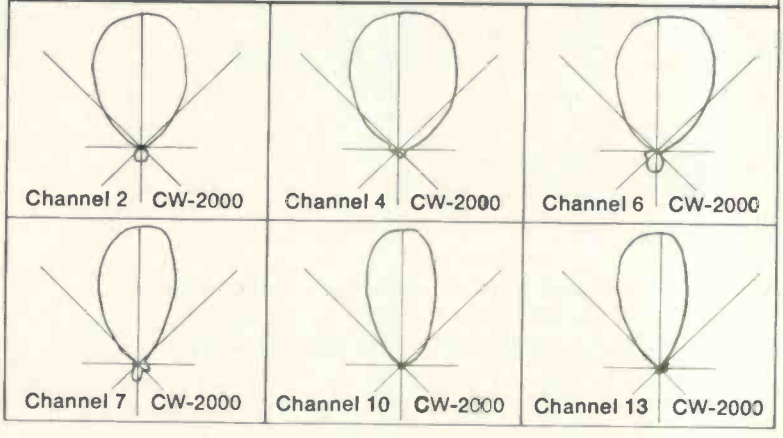
$100.00 list



example A:
CHECK DB GAIN

Channel	CW-2000	10-Elem. Yagi
2	7.2	7.8
4	7.2	7.6
6	7.4	8.0
7	12.2	10.8
10	11.4	11.0
13	12.0	11.5

example B:
CHECK DIRECTIVITY



example C:
CHECK FRONT-TO-BACK RATIO

CW-2000	CH. 2	CH. 4	CH. 6	CH. 7	CH. 10	CH. 13
DB	22	26	17	20	35	30

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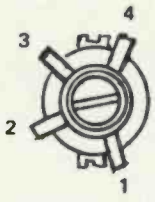
COLORFAX

The material used in this section is selected from information supplied through the cooperation of the respective manufacturers or their agencies.

MAGNAVOX

Focus Transformer Part No. 360957-6—Terminal Identification



There is apparently some confusion in the field concerning the identification of terminals on this transformer when it is used as a replacement for the 360957-5. There is a blue dot located between terminals 3 and 4, however, this dot is not always clearly visible. The best way to identify these terminals is to view the transformer from the rear as illustrated and count the terminals clockwise from one to four.

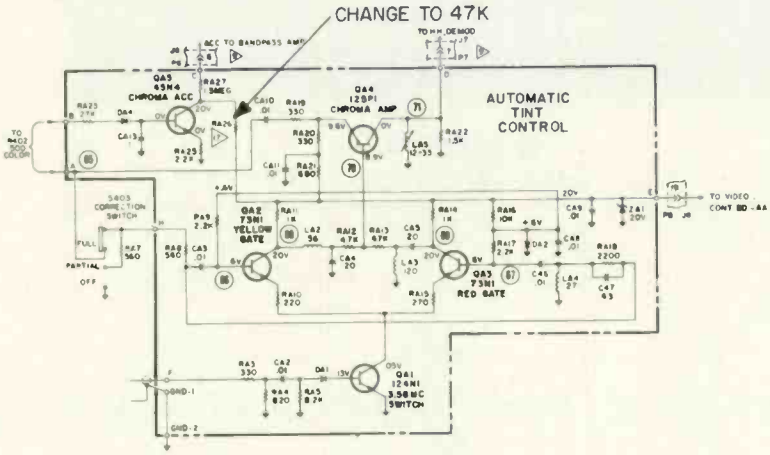
Color TV Chassis T935—Horizontal Retrace Blanking

Early production models of the 1T5007, which uses the T935 chassis, could exhibit a horizontal retrace blanking line on the left video of the screen. This line shifts in the opposite direction of the video information when the horizontal hold control is adjusted.

The problem can be corrected by adding a series network consisting of a 15K,½w resistor and a 1000pf, 500v capacitor between J13 (G1 of the CRT) and the junction of R406/C403. This circuit has been incorporated in later production.

Color TV Chassis T940—Increasing Range of ACC

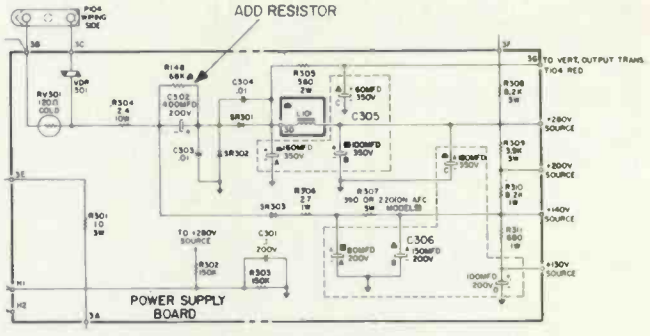
A recent production change has been made in the T940 chassis changing RA26 on the ATC board from 10K to 47K



in value. This change provides an increase in the range of the Automatic Chroma Control circuit to compensate for wider variations in chroma level in the transmitted signal.

Color TV Chassis T924/T939—Purity Shift

Some of these chassis have evidenced a tendency to shift purity when the instrument is turned on within a five minute period after having been turned off. The purity shift is not evident, however, if the set has been turned off for a period of time longer than five minutes. This problem can be eliminated by adding a 68K resistor across C302, in the power supply. This change has been made in later production of the T939 chassis.



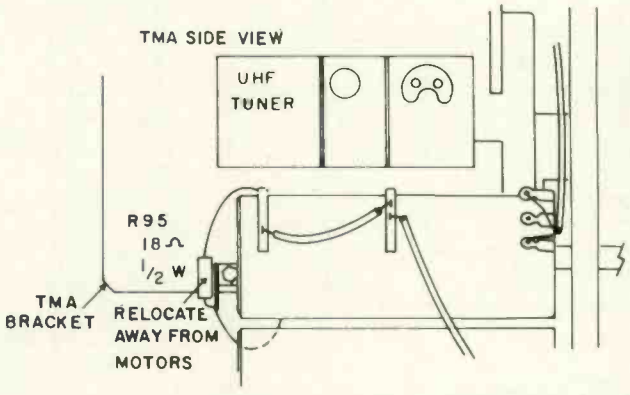
Remote Control Model 1C6313—Remote Sensitivity Control

If you should encounter a Model 1C6313, using the T939-06 chassis, on which the remote sensitivity control seems to have no effect, check the wiring of the control. If there is no connection to the center tap of the remote sensitivity control, connect a jumper wire between the center tap and the end terminal having the red wire connected to it.

RCA VICTOR

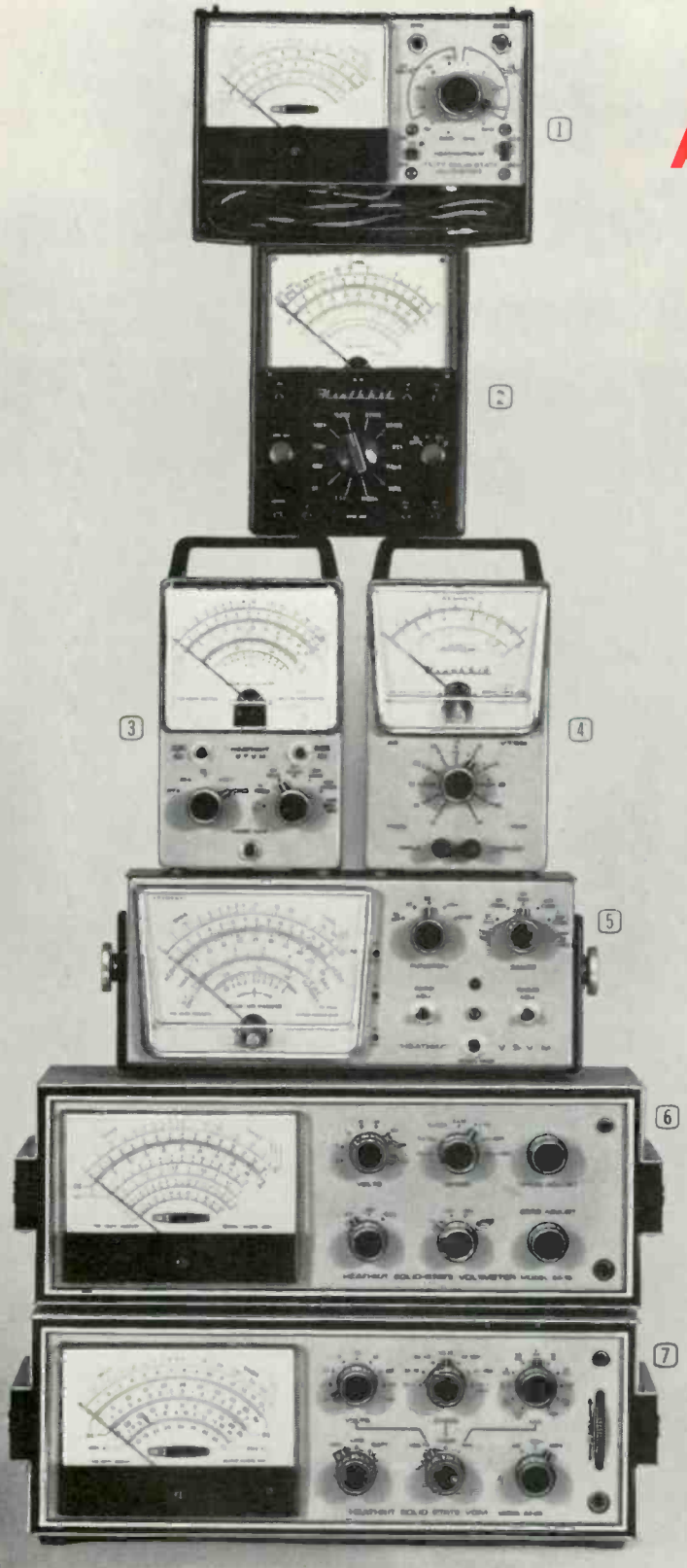
Color Remote Control TV "G" Series—Pilot Lamp Lead Dress

The remote color television receivers referenced to this bulletin use a twin-lead for power to the pilot lamp. In some instances (specifically after normal service operations and during reinstallation of the tuner mounting assembly), the "high" side of the lamp power lead could be accidentally "pinched" between the TMA bracket and chassis "shorting" the lamp to chassis. The following corrective steps are to be performed when the referenced receivers are serviced: (1) Make a visual check of the pilot lamp supply lines (twin lead) to find out if lead has been "pinched" or "shorted" by TMA bracket. (2) If lead has been pinched or shorted, remove TMA and place a "spaghetti" sleeve over the pilot lamp leads. (3) Check physical location of



pilot lamp series resistor R95 (18Ω ½w). This resistor, shown in illustration, may be located in close proximity to the color remote motor. Take corrective action necessary (relocate terminal board leads, and/or "body" of resistor)

continued on page 70



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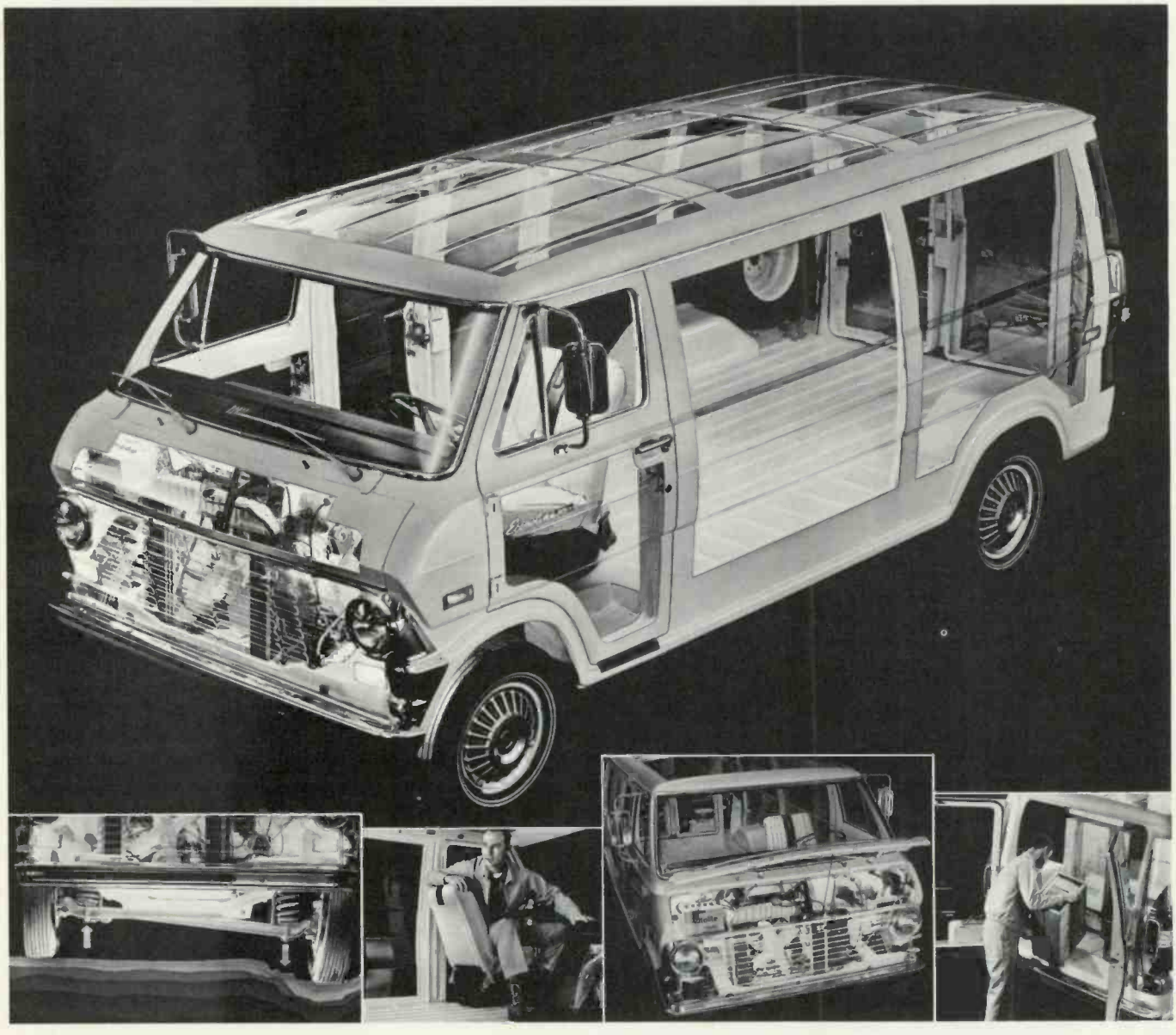

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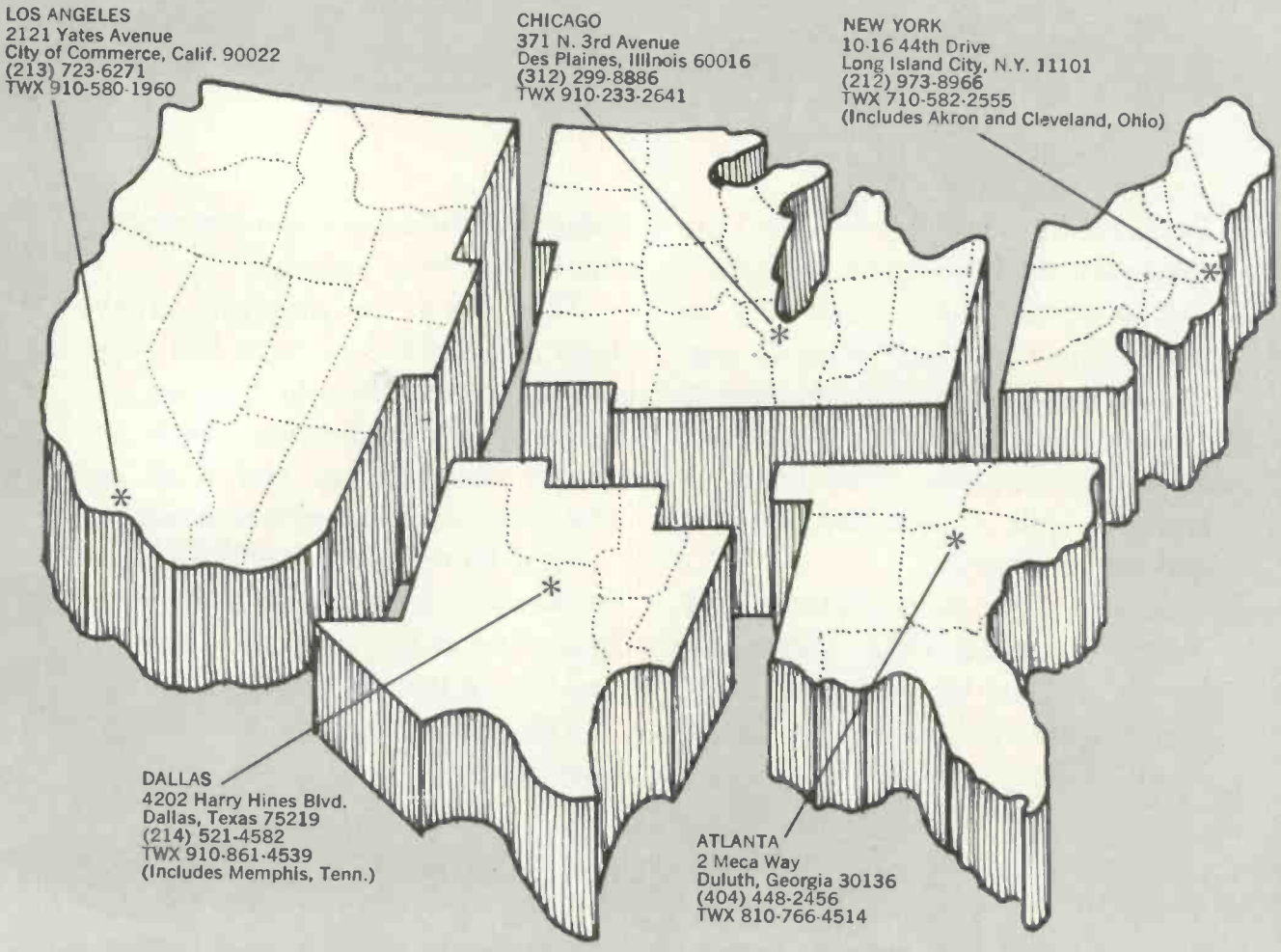

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Space contributed as a public service by this magazine.

ET/D **TEKLAB REPORT**

Receiver service by panel substitution has simplified troubleshooting—but in-depth servicing requires circuit knowledge

Introducing Motorola's Quasar II Color TV

■ Expanding the "works in a drawer" concept Motorola introduced the Quasar II, employing the TS-934 color chassis. The plug-in panel arrangement used in this chassis is similar to the TS-915/919 chassis which is the top of the line chassis.

The TS-934 hybrid chassis employs six mini-circuits that plug-in and are all solid-state with the exception of four tubes.

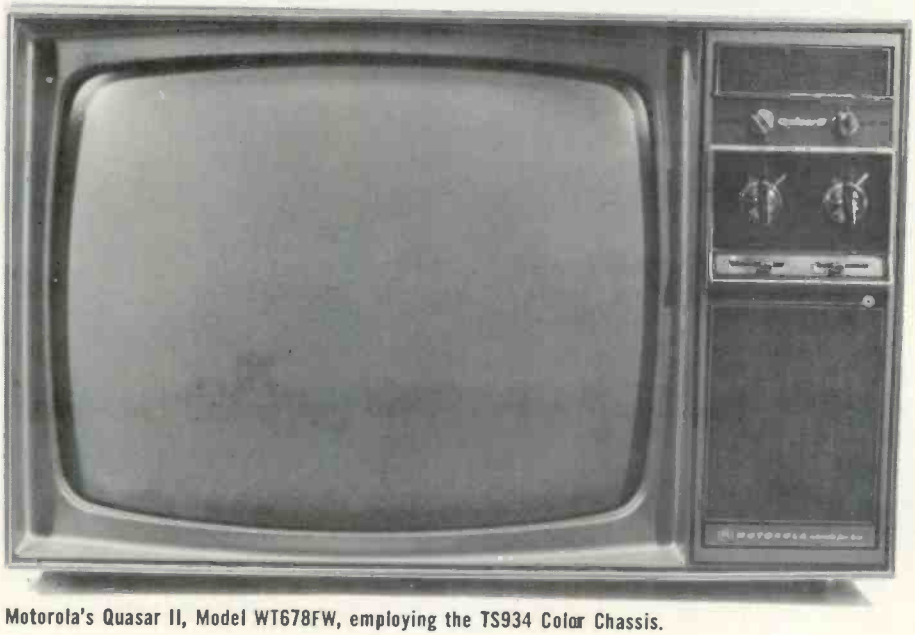
Tubes are employed in the vertical oscillator and vertical output, horizontal driver, horizontal output and damper circuits.

We found a number of important features employed on this chassis which include: Automatic Fine Tuning (AFT), transformer powered, solid-state HV rectifier, automatic degausser, integrated circuits used in the sound and color demodulators, regulated low voltage supply, automatic color control and double gated automatic control.

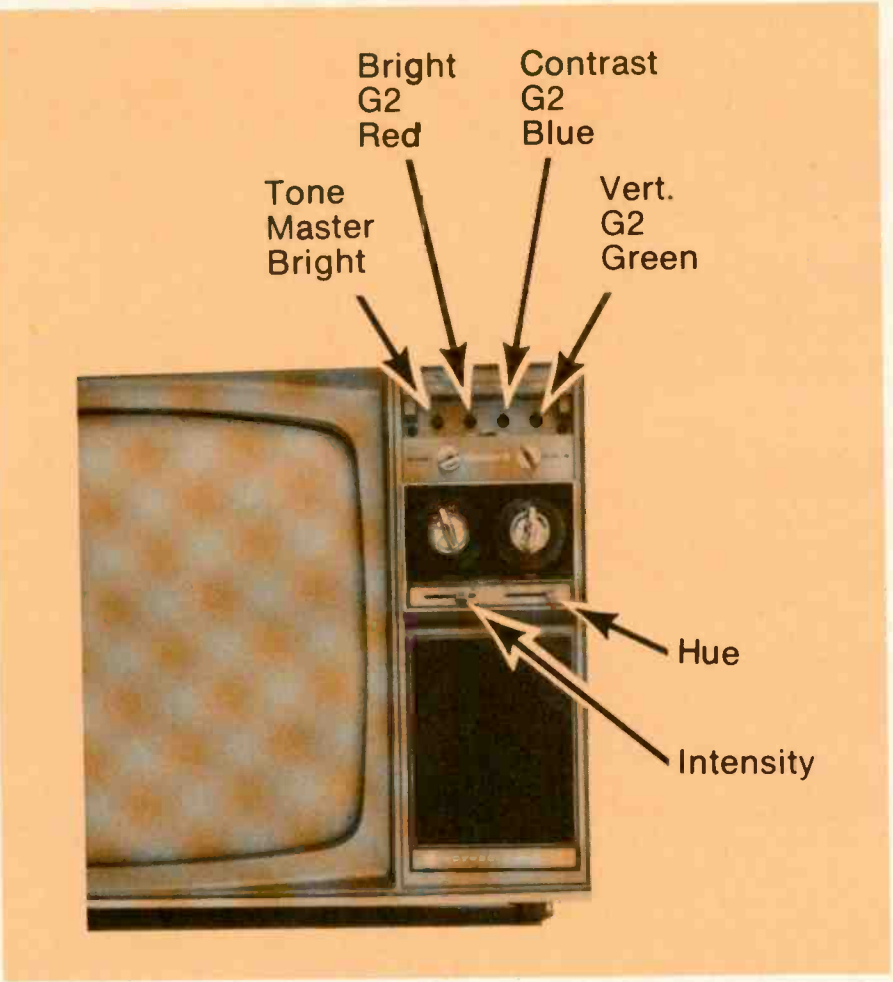
Viewing the set from the front we found the customer controls conveniently located on the front panel with the exception of the horizontal hold control which is located on the chassis but should seldom need adjusting, and the TINT control which is employed on the TS915/915 chassis is eliminated.

The chassis can be pulled forward for servicing, by removing one ¼ in. hex head screw near the ac interlock and releasing the chassis lock. This can be done without removing the back cover.

After we pulled the chassis forward a number of features were re-



Motorola's Quasar II, Model WT678FW, employing the TS934 Color Chassis.



A flip-down panel conceals the hollow shaft dual purpose controls. The two-color controls are the slide throttle type for the adjustment of the color and hue.

vealed of interest to the service technician. The convergence panel is up front, the tuner is placed in the open for easy cover removal if cleaning is needed, and by removing three screws the control panel swings open on a hinge for component and control replacement if needed. The tuner has provisions for 300 or 75Ω input.

The panels are conveniently located and all the panels can be removed with the chassis pulled forward and the components can be changed without removing the chassis from the cabinet.

If it should become necessary to remove the chassis, all wires have Molex connectors and by releasing a chassis lock the chassis can be removed from the slide rail mounting.

Viewing the set from the rear we found the low voltage transformer and horizontal output circuits mounted on a separate chassis in the center rear portion of the cabinet.

Many of the service controls that are adjusted during the set-up procedure are factory pre-set and normally require no adjusting. The controls in the HV circuits are cemented and require no adjustments, but if component replacement is necessary make sure you use exact replacement close tolerance parts.

Troubleshooting by panel replacement in home chassis servicing can be done if you carry a complete set of replacement panels.

The suggested exchange list price of the panels range in price from $6.50 to $18.00 apiece.

If you should decide to repair the panel circuits, you should have an idea how the circuits function. We will review the new circuits.

This month's TEKFAX schematic No. 1296 has complete coverage of the circuits used in this chassis.

POWER SUPPLY

The power supply shown in Fig. 1 employs voltage regulation on the 20v line supplying most of the transistorized circuits. The dc regulator panel providing this voltage operates from the 27vac winding on the transformer. This output is adjustable and uses a Zener reference and amplifier. A current limiter prevents the current from exceeding a predetermined maximum.

THE DC PATH

DC coupling is employed from the second detector through the "IC" all the way to the CRT. Forward bias for the first video amplifier is established by R1 and R2. The second video amplifier also conducts as a result of voltage applied to the base from the emitter of the first video amplifier.

It is important that the correct dc be applied to the "IC" as this is the bias voltage for the first stages in the "IC." The resistors R3, R4, R5 and R6 determine the voltage across the contrast control, the control being a part of this voltage divider.

Because these stages are direct coupled, a defect in the video amplifiers can cause a change in brightness, as well as a detrimental effect on video. An open video amplifier transistor, for example, will cause excessive brightness, whereas a shorted stage will reduce brightness.

ACC AMPLIFIER AND COLOR KILLER

The ACC amplifier, shown in simplified schematic Fig. 2, is the first stage of a solid-state switch and in the absence of a color signal neither stage conducts. When a color signal is being received, 3.58MHz CW signal from the crystal output amplifier is present at the ACC rectifier (in the amplifier base circuit). The resulting positive voltage turns on the ACC amplifier and the collector voltage drops. Direct coupled to the preceding stage, this negative going voltage turns on the killer transistor (PNP) and the collector voltage becomes positive. To improve the action of this circuit, it is made regenerative by a resistor from the collector of the killer and is returned to ground through the color intensity control. Positive voltage developed at the collector biases on the 2nd color IF amplifier and the gain in the 2nd color IF is determined by setting of the INTENSITY control.

Bias for the first color IF is set up by voltage dividers to provide maximum gain, but is automatically reduced depending on color sync amplitude. The dc voltage on the collector of the ACC amplifier is proportional to the amplitude of the

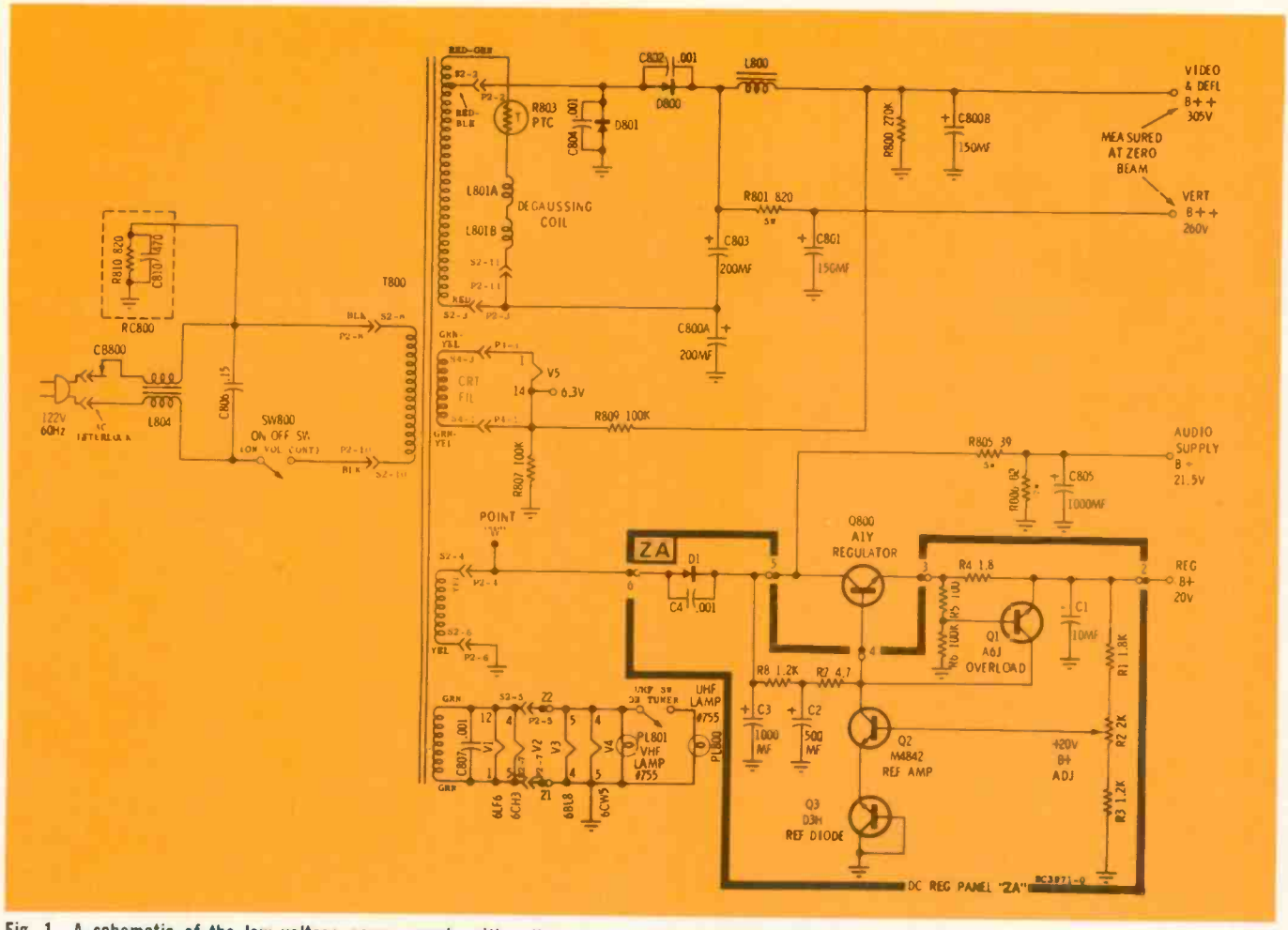


Fig. 1—A schematic of the low voltage power supply with voltage regulation on the 20v line which supplies most of the transistorized circuits.

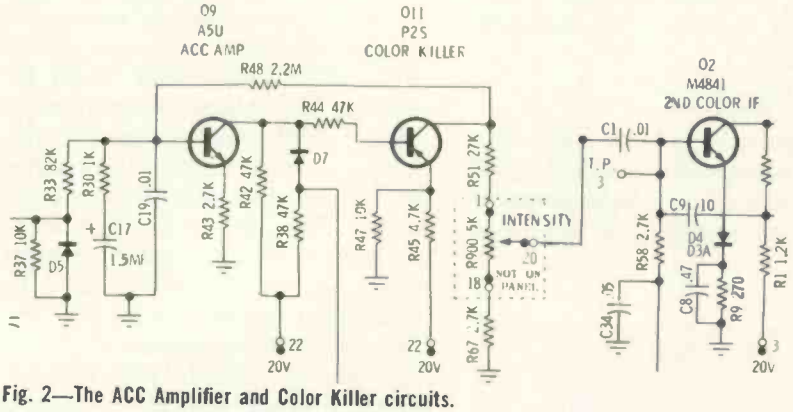


Fig. 2—The ACC Amplifier and Color Killer circuits.

3.58 CW signal applied to the ACC rectifier. As this amplitude increases, the collector voltage on ACC amplifier decreases, forward biases the ACC delay diode and reduces the gain of the first color IF.

CRYSTAL DRIVER, AMPLIFIER AND 3.58MHz OSCILLATOR

The crystal driver stage receives the 3.58MHz color sync signal from the gated color sync amplifier. This is an emitter follower stage and drives the crystal to supply a CW signal. The 4.7pf capacitor is approximately equal to the crystal capacity to cancel noise which could otherwise be coupled through the crystal capacity.

The Q is reduced to increase band width by placing a 390Ω resistor in series with the crystal.

The burst of color sync and the resulting output from the ringing crystal, is applied to the crystal output amplifier. This stage is degenerative (and dc stabilized) by the 100K resistor from collector to base.

The oscillator is a modified Colpitts, free running at about 3.58-MHz. It is locked in frequency and phase with the transmitted color sync when a color signal is received. A very small capacity is used to couple the 3.58MHz signal to control the oscillator. Output of the oscillator is taken from the emitter through a low impedance-isolation network to the phase splitter. Some phase correction is introduced by the 5.6μh choke.

The crystal output amplifier also supplies a 3.58 CW signal to the ACC rectifier to develop a positive dc voltage to turn on the ACC amplifier. The only adjustment in these stages is the 3.58MHz oscillator coil.

Next month we will review the Red, Blue and Green Video Output stages, the IC Color Demodulator, Horizontal Oscillator Driver and Output stages and the Audio IC Circuit employed in this new chassis.

High-Powered Tuner Amplifiers

by HOMER L. DAVIDSON

Some fairly simple servicing techniques can be developed by technicians that understand how these solid-state amplifiers function

■ Some of the amplifiers found in solid-state AM-FM tuners are rated as high as 50 to 500w. These deluxe stereo models may incorporate up to 50 transistors and 25 diodes, and their frequency response usually ranges from 25Hz to 22kHz.

Most stereo combinations use from 6 to 12 speakers, including horns and additional speaker jacks. These speakers may be in a combination cabinet or in separate shelf and console floor models.

The solid-state circuits are quite common throughout all AM-FM tuners. Some models do have additional features within the tuner circuitry. This service article, however, deals primarily with the audio portion of these units.

CIRCUIT ISOLATION

Before attempting to signal trace the defective stage of the audio amplifier, try to isolate the trouble to a given section. Should the tuner section be functioning properly, then the trouble must lie in the audio portion. See if the stereo phonograph plays through both audio channels. Also, see if the FM stereo multiplex section is functioning normally. For instance, if the stereo multiplex section is functioning and one channel is dead on phono position, suspect a defective phonograph cartridge. If the phonograph section is normal, but FM stereo music comes from only one set of speakers, suspect a defective multiplex section. Always try to isolate the trouble to a certain section of the AM-FM chassis (a block diagram of one such chassis is shown in Fig. 1).

Select the proper circuit diagram, isolate and locate the troubled section upon the diagram and chassis—most tuner-amplifier sections are stacked and these units must be separated if the audio portion is to be properly serviced. Always take a top and bottom layout view of the isolated section (Fig. 2), making sure you have the correct section before attempting to locate the defective component.

SIGNAL TRACING

A defective stage in the audio section can be located with either signal tracing methods or voltage measurements. An audio-signal generator (possibly of pencil-type design) should be used in locating weak- or low-signal conditions. Start with the volume control and go from collector to base of each audio stage. In high-grain pre-amplifier and driver stages, simply touch the pencil probe to the metal cover of each transistor and notice the gain of each audio transistor.

If the pre-amplifier (Fig. 3) and driver (Fig. 4) stages are not performing, start at the audio output transistors and work towards the volume control. Dead channels are easy to locate, while intermittent and low-signal losses are more difficult. Use a scope in conjunction with the audio-signal generator to locate a weak stage, comparing the weak stage with the good audio channel.

Many times when an audio-signal generator or VTVM test probe is applied to the base terminal of a suspected transistor, the stage will begin to function. Normally, this transistor is intermittent and should be replaced. Do not overlook the possibility of a second defective transistor in a directly connected transistor stage. *Be very careful not to short the base and collector terminals together with the test probe.*

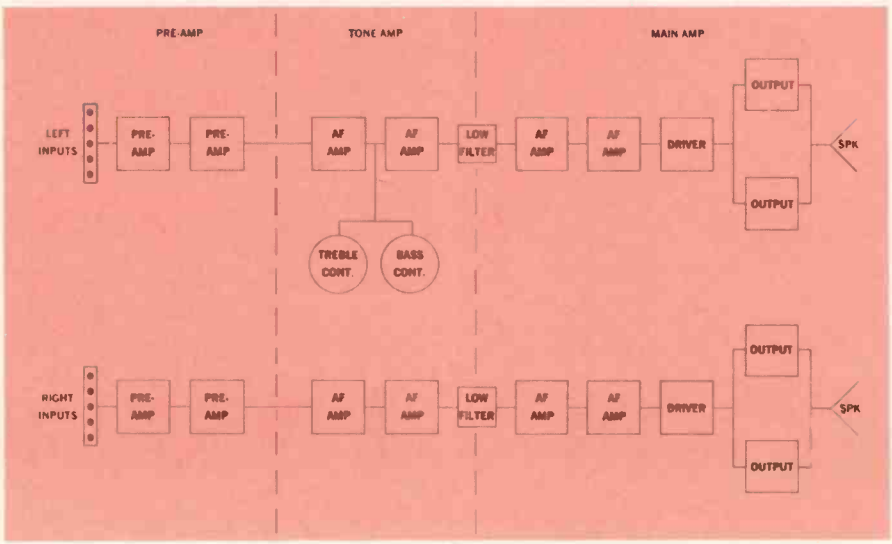
VOLTAGE MEASUREMENTS

After the defective stage has been located, take voltage measurements of the suspected transistor, using either a VTVM or FET VOM for correct low-voltage measurements (Fig. 5). When one transistor is defective, erroneous voltage readings will be noted on direct-driven transistors. This makes it much more difficult to locate a defective transistor with voltage readings in a direct-driven circuit. Generally, the transistor with the greatest change in voltage is the defective one. The suspected transistor should be removed from the etched board and tested.

Collector voltages in the pre-amplifier section will vary from 2.5v to 16v. Emitter and base voltage readings are from 0.12v to 2v. Remember that voltage readings taken in the pre-amplifier circuits are very low compared to those in the main amplifier section.

The audio-frequency and driver transistors have collector voltage readings from 2.5v to 35v, while some power output collector voltages may go as high as 75v. Emi and base voltages are from 0.12

Fig. 1—Block diagram of a typical solid-state stereo amplifier.



8v, while in the direct-driven circuits the collector terminal of the first transistor and the base terminal of the driven transistor have the same voltage.

Resistance measurements within these transistor circuits are not accurate. Base and emitter resistor measurements should be made with the transistor out of the circuit. Emitter resistors in the power output stages will vary from 0.18Ω to 0.47Ω. Always remove one end of a suspected diode or resistor to be sure of a correct reading.

CHECKING TRANSISTORS

In-circuit transistor testing may be accomplished in the pre-amplifier and driver stages without high-leakage indications. Even transistors in the direct-driven stages may show an open condition. Proper leakage tests on direct-driven transistors should be made with either the collector terminal or the entire transistor removed from the circuit board.

Many in-circuit transistor tests will show an open or shorted condition, but a small amount of leakage may not indicate the transistor producing distortion. When in doubt, replace the suspected transistor. Transistors cause about 75 percent of the trouble found in the audio section. When making transistor tests, make certain that the transistor polarity switch is in the correct position. Leakage readings are very high when the polarity is wrong.

It is best not to use an in-circuit tester on a suspected intermittent audio transistor. In many instances, when a beta tester is attached the intermittent transistor will "pop" on.

Several tests should be made before removing the suspected transistor. An intermittent transistor can be located by applying heat or squeeze spray. Always have the audio section operating when spraying the suspected transistor. Spray the transistor several times before removing it. Sometimes intermittent plastic transistors begin to act up when twisted. Double check the suspected transistor with a transistor test out of the circuit.

When one power output transistor has a shorted or leaky condition, always check the other power transistors. These transistors can be checked in the circuit with their collector terminal wire removed. Remember, power output transistor leakage readings are very low compared to other audio transistors. Properly matched audio output transistors will have close beta and leakage readings.

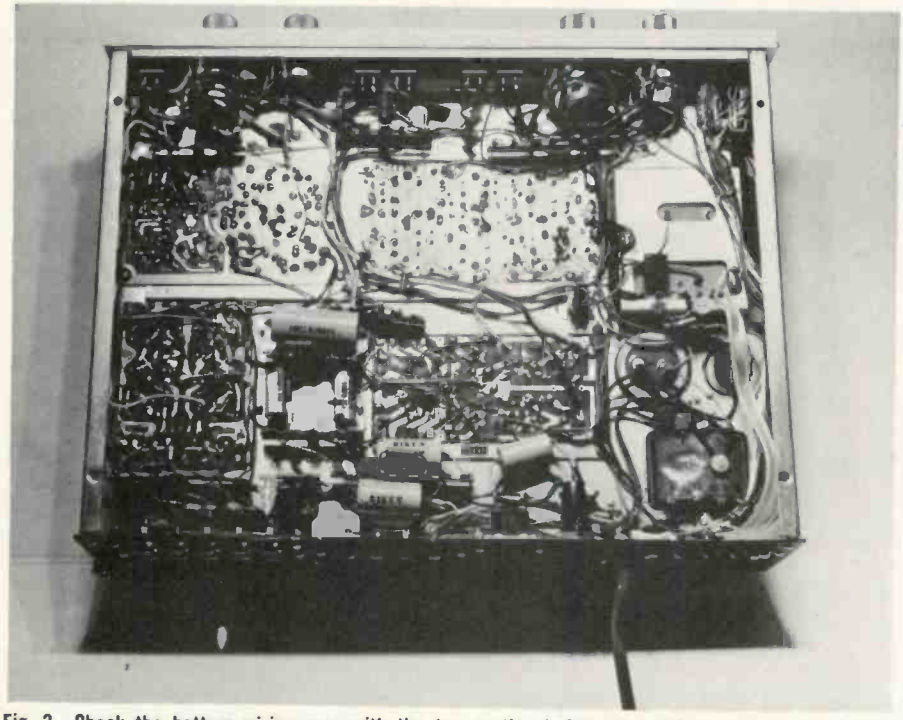
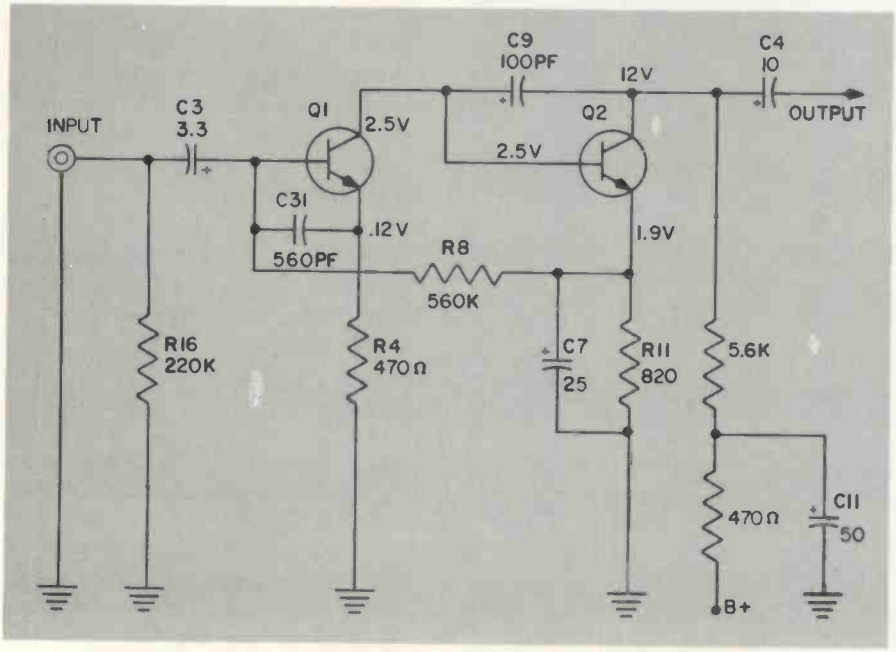


Fig. 2—Check the bottom wiring area with the top section before attempting to remove a defective component.

Fig. 3—A solid-state circuit in the left-channel pre-amplifier of a typical receiver.



TRANSISTOR REPLACEMENT

Always test the replacement transistor before mounting it on the printed-circuit board. Be very careful not to damage surrounding components when soldering connections on the etched board, and use a heat sink or a pair of long-nose pliers to protect the new transistor when soldering the small terminal wires. Make sure the replacement transistor terminals are not touching other components.

Apply silicone grease to both the power transistor and its heat sink. Check to see if a thin piece of insulation had been used between the transistor and heat sink. It should be replaced if a new one was provided with the replacement transistor. Replace the small plastic insulators (if found) between the transistor and

mounting screws. Before connecting the terminal wires, take an ohmmeter reading between the transistor body and metal heat sink. This may save hours of frustration. A short between the heat sink and transistor can produce distortion and arcing conditions.

Both power output transistors should be replaced when one is found to be shorted or leaky. When exact transistor replacements are not available, a matched pair of universal power transistors should be used. All power transistors should be checked in both stereo channels when one or more leaky transistors are found.

AUDIO DISTORTION

Extreme audio distortion is generally found in the power output stages. When very weak sound and extreme distortion occurs, it can usually be located by power transistor replacement. It is also helpful to check for visual signs of burned bias resistors around the power transistors, following the circuit from burned resistor to corresponding power transistor. Always check the condition of the base- and emitter-bias resistors when a shorted or leaky power transistor is found.

Very weak distortion can be located with an audio-signal generator and scope. After using these test instruments to locate the distorted stage, make voltage measurements and test the suspected transistor out of circuit.

When distortion is noted in the pre-amplifier or driver stages, comparison tests can be made against the good audio channel. Feed the same audio signal into both channels and take comparison waveforms of each stage, suspecting a defective transistor or bias resistor as the cause of distortion. A dried out or leaky coupling capacitor may also produce weak or distortion conditions. Distortion meters are handy test instruments for locating distortion problems, but they usually are quite expensive for the small service shop.

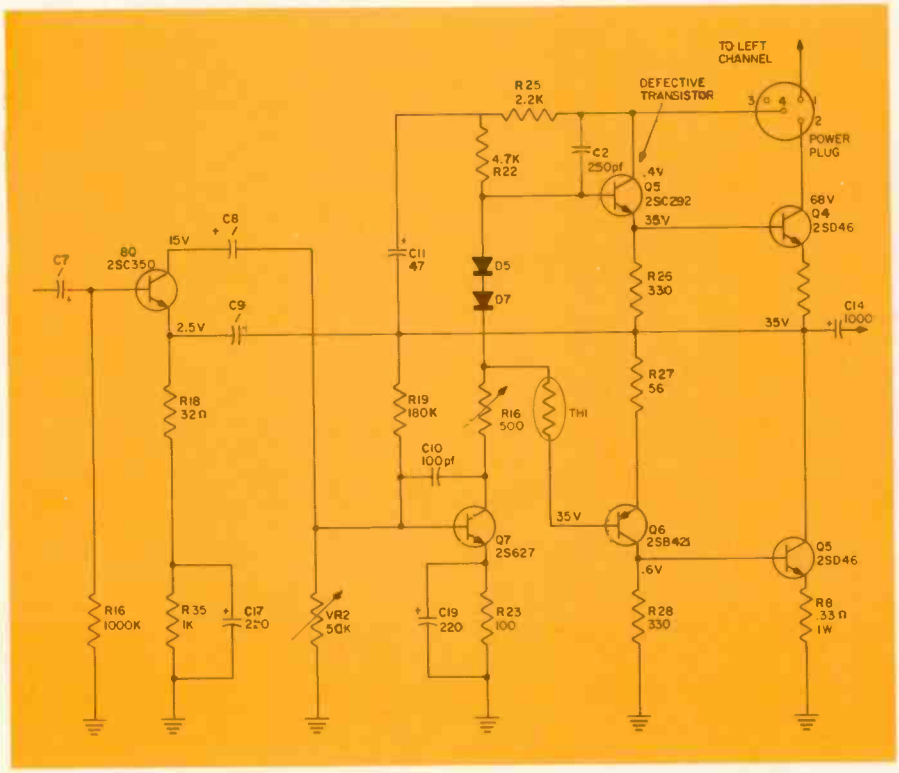
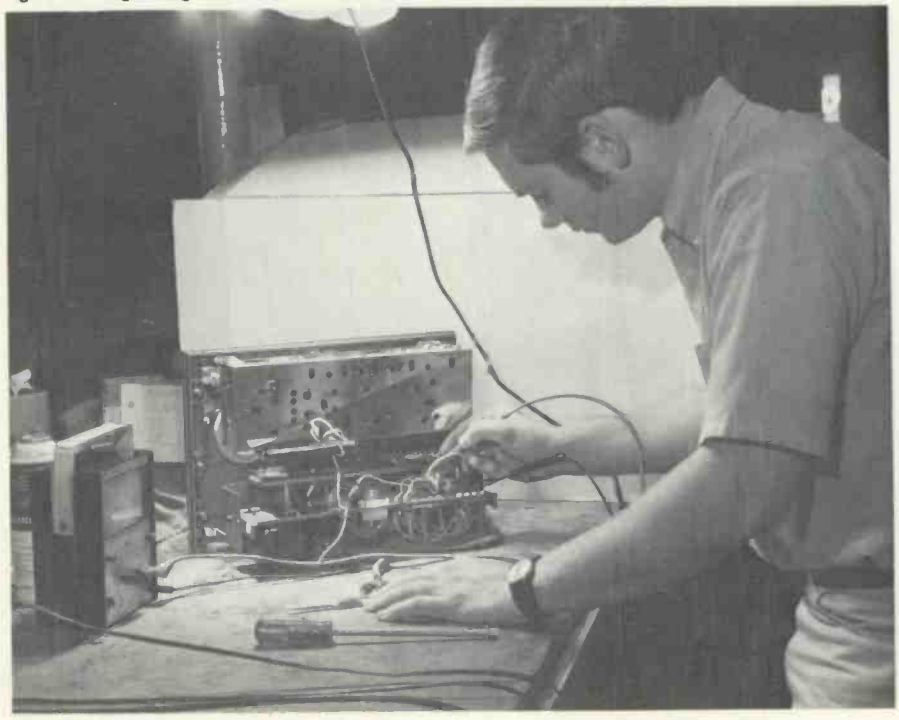


Fig. 4—A solid-state main-amplifier circuit in the right channel of a Kenwood Model TK88U receiver.

Fig. 5—Taking voltage measurements in the audio output stage of a General Electric chassis.



DEFECTIVE POWER SUPPLIES

Most tuner amplifiers have power supplies containing transistor and zener diode voltage regulation (such as the power supply shown in Fig. 6). They generally also contain a step-down transformer in either a bridge or fullwave rectifying circuit, using single or multi-section silicon rectifiers. A defective power supply should be suspected when no sound is heard in either audio channel.

Most power supplies are protected by low-amp fuses or circuit breakers. When fuses are being blown as the power switch is turned on, suspect a shorted silicon diode. Should the fuse blow after some sound has been heard, there is probably an overloaded condition in the circuits connected to the power supply.

If the power supply seems defective, check the condition of the silicon diodes. A good diode will measure 10Ω in one direction, with no resistance reading when the test leads are reversed. Always remove one lead of a suspected diode for

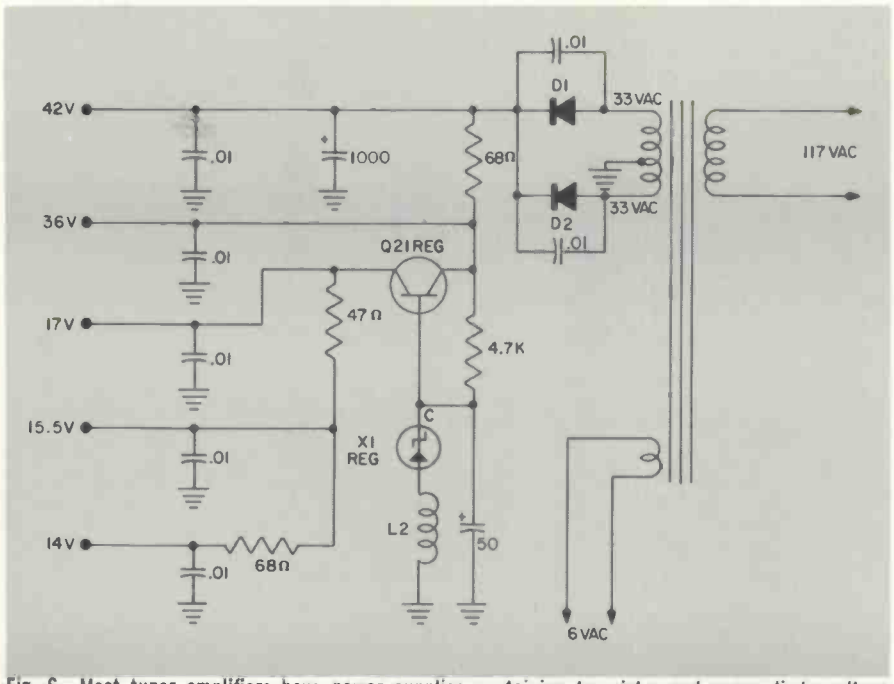


Fig. 6—Most tuner amplifiers have power supplies containing transistor and zener diode voltage regulation.

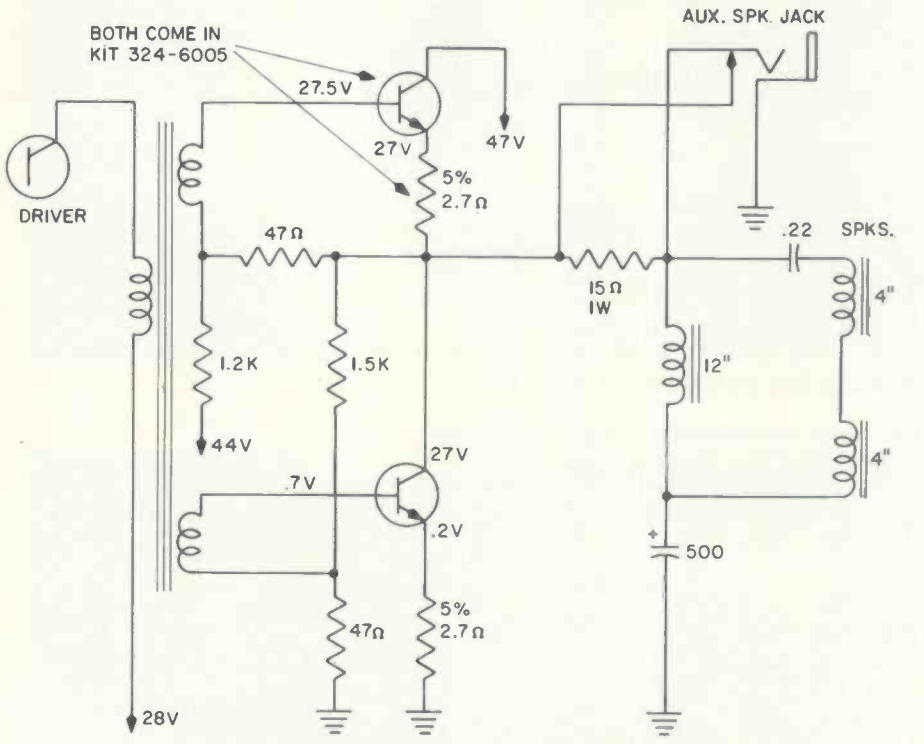


Fig. 8—The audio-output circuit in a Philco N255T chassis.

correct resistance measurement. Most silicon diodes will appear open or shorted, and one or more diodes may be damaged in a bridge-type circuit.

When overloading conditions exist outside the power supply, try to isolate the defective stage. Insert a current meter in the power supply voltage source and clip off each wire leading to tuner and amplifier circuits until the overload condition is indicated. Most overload conditions are traced to the power output stages of the amplifier.

Excessive hum in the speaker can be caused by a defective transistor or filter capacitor. With the volume control turned down, isolate the hum in either the amplifier or tuner. Most loud hum conditions are traced to the filter decoupling capacitor networks. Shunt a large electrolytic capacitor across the suspected filter

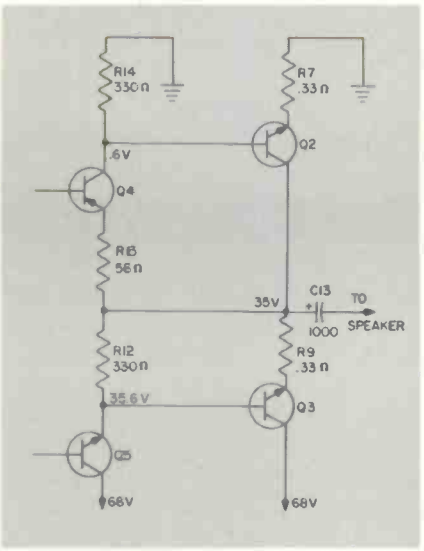


Fig. 7—A solid-state amplifier circuit in a Kenwood Model TK140 chassis.

network before turning the amplifier on—transistors in the power supply and audio circuits can be damaged when shunting a large capacitor when the power is on.

BLOWING FUSES

A Kenwood AM-FM Model TK88U would blow 2 amp fuses. The silicon diodes were checked and found good, and the overloading conditions appeared to be outside the power supply circuits. A 500ma meter was inserted in the power supply output and a heavy current was indicated. Each voltage lead was then removed from the voltage source until the lead containing the overload was found.

In this instance the overloading condition was in the push-pull output stages (Fig. 4). Power-output transistors Q3 and Q5 were removed from the circuit and measurements indicated that transistor Q3 had high leakage. Before replacing the output transistor, bias resistances were checked and a bias diode (D7) was found open. Its replacement solved the overloading condition.

DEAD RIGHT CHANNEL

The right channel in a Kenwood Model TK140 receiver was dead on both the FM and phonograph stereo positions. Signal injection indicated that the trouble was in the power output stages (Fig. 7). Transistors Q2 and Q3 were then removed from their heat sink and tested. Both power transistors had high leakage with low beta readings. These 2SD46-type transistors were replaced with RCA SK3027 universal-

type transistors, which corrected the problem.

IMPROPER LOADING

The owner of an AM-FM stereo Philco combination Model N255T had connected several outside speakers and damaged the solid-state amplifier. One power-output transistor was found open and two others had high leakage. The etched circuit board (Fig. 8) smelled of burned resistors.

Special output transistors were ordered from Philco as part No. 324-6005, each kit consisting of a transistor and a 2.7Ω emitter resistor. All suspected bias resistors were also replaced, and care was taken to make certain that all metal heat sinks were replaced and soldered to the correct terminals on the etched circuit board—a blob of solder could have destroyed the new transistors. Since the separate heat sinks were located very close together, they were insulated with some rubber silicone cement.

DISTORTED AMPLIFIER

A General Electric AM-FM Model RC8571 receiver was found to have excessive hum and only weak reception from one channel. The owner complained of something burning. Removing the solid-state chassis revealed a burned bias resistor (Fig. 9). The burned resistor was traced to its respective output transistor, which was removed from the chassis and found shorted.

Each audio-frequency direct-coupled transistor was tested in the circuit since these transistors may have become leaky and placed the wrong bias voltage on the base terminal of the final output transistor.

WEAK LEFT CHANNEL

Another problem was a weak left channel in an RCA RS-215A amplifier. Signal tracing with an audio signal generator and scope revealed a weak 2N2614 driver stage (Fig. 10).

The transistor was tested in the circuit and appeared normal. All voltage readings were good. Emitter- and base-bias resistors were of correct value. Even the audio-frequency direct-driven transistor was normal. But, when another electrolytic capacitor was shunted across the emitter bypass capacitor, the volume returned to the left channel. ■

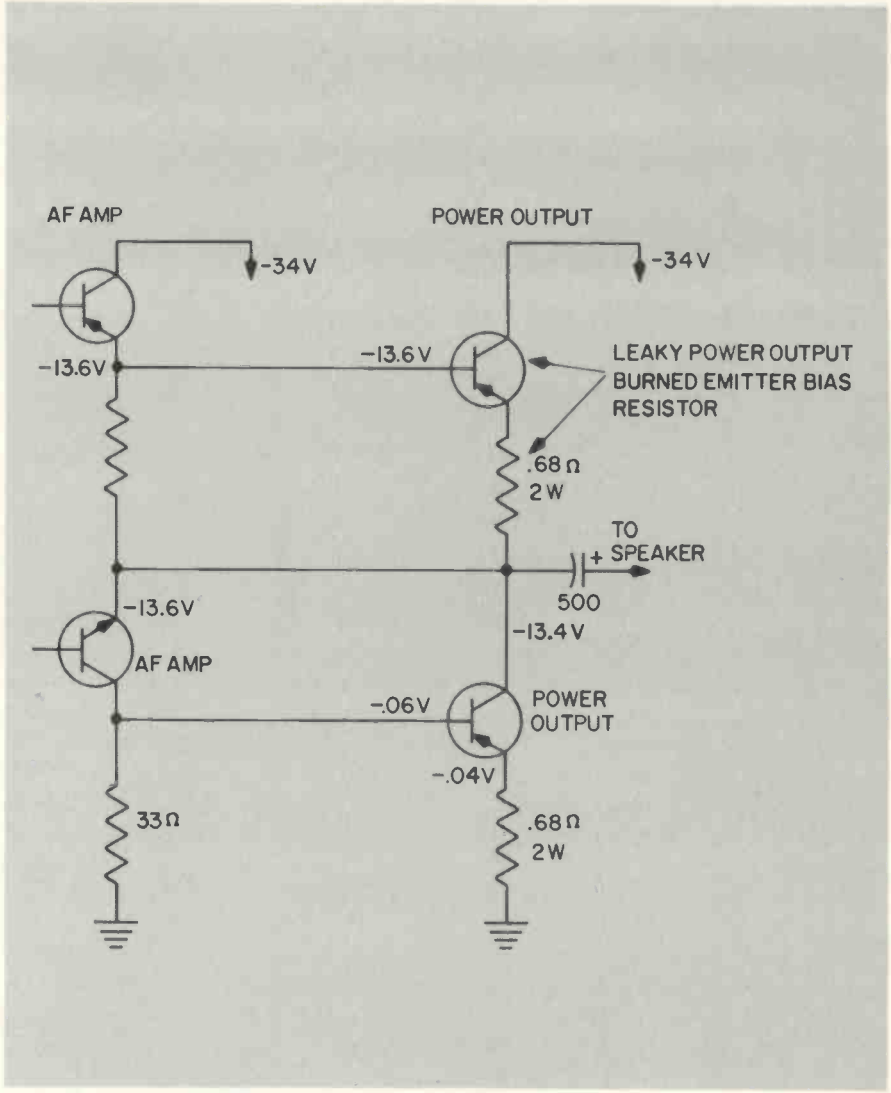
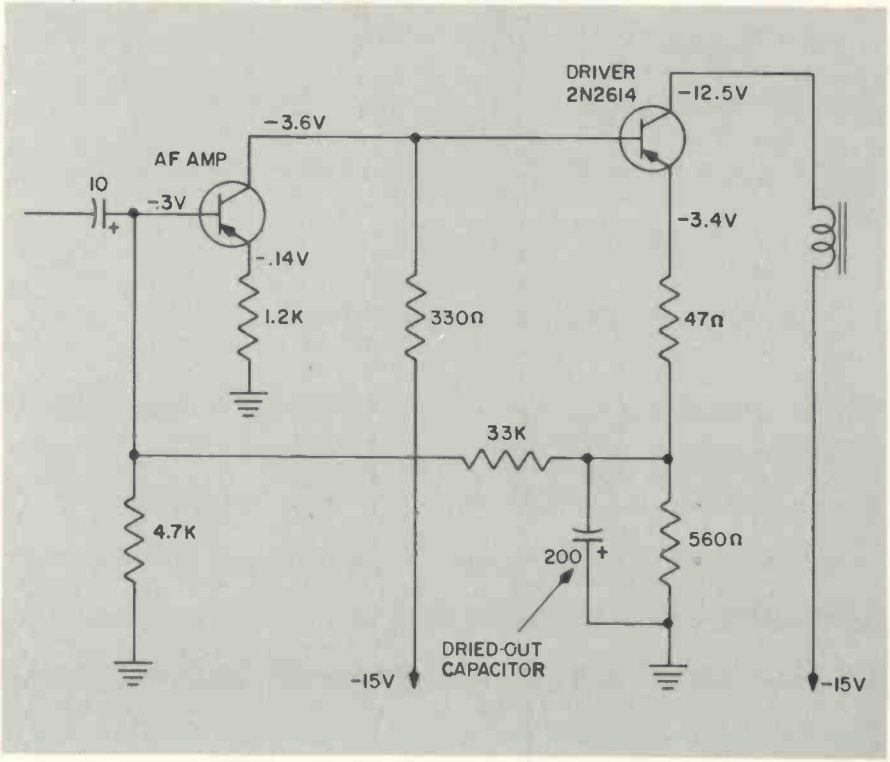


Fig. 9—The audio-output circuit in a General Electric RC8571 chassis.

Fig. 10—The final audio-amplifier stages in an RCA R-215 chassis.



The Long and Short of MATV Cables

by ROBERT SHARP and PAUL MILLER

Antenna systems may pick up distortion-free TV signals, but these signals can become significantly distorted unless they are transferred to receivers through a well designed cable system

■ For over 20 years television has had a tremendous impact on American life. The TV set has become as popular as the refrigerator and washing machine. Over 90 percent of the households own at least one set. Yet, despite this overwhelming acceptance, the wiring from the antenna to the set is generally still the same sort of jerry-rigged afterthought as when antennas first started sprouting from house tops in the days right after World War II.

This is incongruous. Even a house built in 1970 seldom includes a signal distribution system. Almost invariably, the new occupant himself installs an antenna on the roof (where no provision for such installation has been allowed) and runs a twin lead down into a window or through a wall. An apartment dweller must often depend on a portable "rabbit ear" antenna alone. For both, TV watching is usually restricted to one room and reception is poorer than it should be. Such treatment of a TV signal distribution system in this day and age makes about as much sense as running electric wires from a power line through a window, hooking it up to a light and saying, "Well, that takes care of our electrical needs."

But things are due for a change. VHF-only black-and-white TV receivers in the past could pick a signal out of almost any kind of antenna system and make something worthwhile of it. This is not so with a UHF signal: when it travels through a dirty old twin lead on a rainy night, for instance, its strength can be so dissipated that little remains to reach the set. Color sets are even more demanding. They require a strong, ghost-free, undistorted signal. It is surprising how many viewers will purchase an expensive color TV set and antenna, and then connect them together with lead-in wire in a manner that is electronically about as sound as baling wire and chewing gum.

The plain fact is that many home TV signal distribution systems are hopelessly outdated. The consumer, architect, antenna-system installer and builder must recognize that the time is long past due for a change in thinking. They must be sold on the benefits of a quality master antenna television (MATV) system technologically in tune with today's more sophisticated receivers, antennas, transmitters and broadcast equipment—and which complements the tremendous role TV plays in today's entertainment, communications and educational activities. The technology, materials and equipment *are* available.

MATV systems have been around for years. However, because they have frequently been poorly designed and installed, their quality has often left a lot to be desired. A very large market exists for well planned and properly installed MATV systems in hotels, motels, apartment buildings, hospitals, nursing homes, schools, dealer showrooms—and the home. The home is the biggest untapped MATV market.

MATV SYSTEMS

An MATV system has one antenna or antenna system serving numerous sets (or outlets). The system is designed so that the sets can be tuned to different channels at the same time without affecting one an-

The authors are electronic wire and cable product development engineers at Belden Corp.'s Technical Research Center.

other, allowing each set to receive satisfactorily strong and clear signals on all channels. This month's article will concentrate on the cables involved in such a system. Hardware and system design will not be covered this month except where they relate to cable selection.

TWIN LEAD

Most consumer TV sets offer only one type of input—300Ω twin lead. This is a carryover from the early days of television when the first simple antennas required lead-in wire of this impedance. The familiar twin lead helped perpetuate the 300Ω standard because of its low cost and ease of installation. When clean, dry and carefully installed, the simple twin lead is still the most efficient (lowest loss) lead in for VHF *or UHF* on the market—and that includes coax.

As TV technology progressed and we moved into the UHF channels and more complex color transmission, loss problems with the simple twin lead became apparent and spurred the development of improved twin leads.

Foam encapsulated types, such as Belden's 8285, cut losses by providing a layer of low-loss cellular plastic between the insulated conductors and the outer insulation—the surface exposed to conductive contaminants.

Later, shielded versions of the foam encapsulated types, such as Belden's 8290, were developed. Their mylar shield reduces interference from ignition systems and electrical gear. This shield also permits running the 300Ω line through or next to metal, permitting installations not possible with regular twin leads.

COAXIAL CABLE

Paralleling the evolution of the 300Ω twin lead were the 75Ω coaxial cables (Fig. 1) now widely used in CATV and MATV systems. (The 75Ω impedance was chosen because coaxial cables are most efficient for their size when produced for this value.) These cables are descendants of the cables developed during World War II for military communications and radar. In fact, MATV and CATV cables are still so closely allied to their military counterparts that they are commonly identified by their military specification RG/U designations.

It should be remembered, however, that commercial cables for TV distribution are really RG/U *type* cables. (It is common in the industry to refer to commercial coaxial cables as RG/U *type* cables, while referring to MIL spec varieties as plain RG/U cables.) Commercial cables are modifications of MIL spec cables, specifically tailored to meet the needs of MATV. Designed primarily for low signal loss, the commercial cables are less expensive since they are not designed to meet military specifications more stringent than those required for commercial use. Furthermore, MIL spec cables are only available in solid polyethylene insulation, braided shields, non-contaminating black vinyl jackets and to meet one set of electrical characteristics.

Quality commercial 59/U *type* cables, on the other hand, are more satisfactory for the requirements of TV signal distribution, feature a range of electrical characteristics and are available in solid or cellular (foam) polyethylene insulations, braided or film-supported foil shields and have vinyl or polyethylene jackets—in black, white or colors.

Since the purchaser is not protected by the test documentation of a MIL spec, the quality of a 59/U *type* cable (or a 6/U or 11/U *type* cable) can be subject to variations depending upon a manufacturer's integrity. Buying from a manufacturer with a reputation for quality is the best assurance of receiving a quality product.

[Editor's Note: When checking through a recent industrial catalog, we noted three types of 59/U cable produced by one manufacturer under different manufacturer type num-

Table I—Comparison of MATV Coaxial Cables.

RG TYPE	CONDUCTOR, GAUGE AND TYPE	POLYETHYLENE INSULATION AND DIAMETER, INCHES	SHIELD TYPE	JACKET TYPE AND DIAMETER, INCHES	APPROX. WEIGHT PER 1,000 FEET, POUNDS	NOMINAL ATTENUATION, db PER 100 FEET CH. 13	CH. 83
59[a]	22, Solid Copperweld	Solid, 0.146	Braid	PVC, 0.242	35	5.0	10.9
59[b]	22, Solid Copperweld	Foam, 0.146	Braid	PVC, 0.242	34	4.2	8.6
59[c]	18, Solid Copper	Foam, 0.180	Duofoil	PVC, 0.242	24	3.2	6.8
11[d]	18, Stranded Copper	Solid, 0.285	Braid	PVC, 0.406	93	3.1	7.1
11[e]	14, Solid Copper	Foam, 0.285	Braid	PE, 0.405	81	2.3	5.2

Belden [a]8241, [b]8221, [c]8228, [d]8238, and [e]8213

bers. One (59[a] in Table I), listed under MIL-C-17A, reportedly had a low-loss, flexible polyethylene inner jacket, covered with a copper-braid shield and a black plastic outer jacket. It was rated at 73Ω impedance and 21.0pf capacitance, the listed price being $19.95 for a 500-ft spool. The other two cables were listed as special-purpose, low-loss coaxial cable suitable for community TV cable systems. They reportedly have stable electrical characteristics, even with changes in temperature and frequency. One was rated at 75Ω impedance and 17.3pf capacitance, the listed price being $23.65 for a 500-ft spool. The other (59[b] in Table I) was rated at 75Ω impedance and 16.3pf capacitance, the listed price being $21.30 for a 500-ft spool. (The 59[c] cable in Table I was not yet listed in the catalog.) Types 11/U were also listed in the catalog. One (11[d] in Table I) had the same military classification number as the first (59[a]). It was rated at 75Ω impedance and 20.5pf capacitance, the listed price being $11.85 for a 100-ft spool (we assume that 500 ft would cost about $55.00). The other (11[e] in Table I) was listed (like 59[b]) as general purpose coaxial cable. It was rated at 75Ω impedance and 17.3pf capacitance, the listed price being $62.50 for a 500-ft spool. The 300Ω shielded twin lead (described earlier in this article) was listed at $47.90 for a 500-ft roll.]

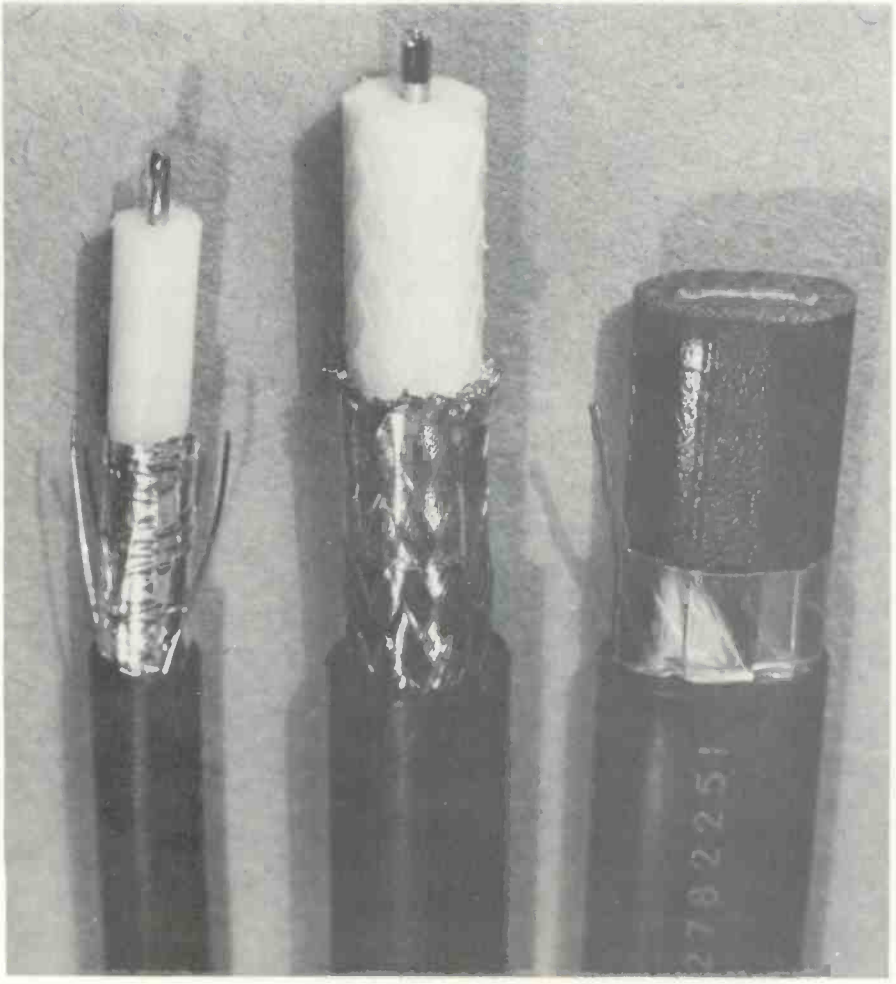
Electrical loss characteristics of the numerous commercial coaxial cables vary widely. For instance, a new 59/U *type* cable (59[c] in Table I) with the same outside diameter as MIL-C-17 RG-59B/U (0.242 in.), but with a foam core approximately the same size as a 6/U cable, has only about 60 percent of the MIL spec cable's losses. Additionally, its losses are only 80 percent of those of the average 59/U *type* and about equal to those of the larger, 0.332-in. diameter foam 6/U *type*.

COAXIAL CONNECTORS

There is some confusion among users over conductor sizes in coaxial cables. For example, Belden manufactures commercial and government spec 59/U cables in four conductor sizes. Most common is the 22-gauge conductor, supplied in foam and solid insulated commercial types. This manufacturer also supplies a foam commercial type with a 20-gauge conductor and a solid MIL spec variety with a 0.023-in. diameter conductor (between 22- and 23-gauge). However, the conductor size by itself means little to the user as long as his connectors fit. (It is best to buy hardware that will accept all conductor sizes presently produced, thereby covering all eventualities.) Most important to the user are the loss characteristics of the cable, conductor size being only one determining factor.

When ordering connectors and other hardware, be certain they are compatible with the cable insofar as the female part will accept the conductor size and the connector body will accept the particular cable.

Fig. 1—Comparison of shielded twin lead and coaxial cables.



INSULATION AVAILABLE

In general, foam polyethylene insulated cable is preferable to the solid type for MATV. The cost is only slightly higher, it is lighter, more flexible, easier to install and offers the lowest signal losses. The availability of low-loss foam cable has accelerated the trend in recent years toward the generally superior "on-channel" UHF MATV distribution system.

The only advantage of a solid polyethylene insulated cable, besides its slightly lower cost, is its greater toughness. It is more crush-resistant and the conductor is less likely to be moved off center when the cable is bent sharply (which is not a recommended practice).

TWO SHIELDS

In the past most MATV cables had braided copper-wire shields, which do a reasonably good job of protecting the signal from electrical disturbances. However, some of the newer cables feature film supported foil shields, which in several ways are superior to braid shields. They provide 100 percent coverage (which no single braid shield can do), and they are thinner, which allows more space to be devoted to conductor and insulation—resulting in lower losses. They also block contaminants, which could pass through a braid shield to attack the insulation and possibly alter a cable's elec-

trical characteristics. Foil-film shielded cables are also easy to terminate.

TWO JACKETS

Coaxial cables for TV-signal distribution are supplied with jackets of either polyethylene or vinyl, vinyl being the most popular and acceptable for MATV. Compared to polyethylene, vinyl is softer, more flexible, easier to terminate and flame retardant. It will also accept paint better and is supplied by some manufacturers in three colors. Polyethylene (available in black only) is seen most often on CATV cables where its relative lack of stiffness at low temperatures and its outstanding resistance to sunlight, weathering and abrasion from tree branches is helpful.

Another thing to consider when purchasing a coaxial MATV cable is whether it has been sweep tested by the manufacturer. Sweep testing is a quality control operation for detecting faults that may cause excessive signal losses on certain channels.

TWIN LEAD OR COAXIAL CABLE

Theoretically, an MATV cable system could be made up of either 300Ω twin lead or 75Ω coaxial cable. In practice, the systems are almost 100 percent coaxial cable.

This is not to say that twin lead should never be used. A very simple MATV system, with four sets or outlets, could be made up with a four-set coupler and carefully routed twin lead. In a location where signal strength is adequate and where interference is minimal, this system would be inexpensive and serviceable. Such a system could be installed in a home in the suburbs.

For a slight increase in cost, such a system could be improved with the use of a shielded twin lead to eliminate interference and secondary signal pickup. The shielding also permits routing near conductive objects or installation in conduit. In areas where the signal strength is weak, an antenna-mounted amplifier, attic or basement amplifier-coupler could be added to boost signal levels and permit the use of additional couplers and more outlets.

[*Editor's Note: Shielded twin lead generally has less signal loss than the coax and there are fewer problems of ghosts resulting from impedance mismatching.*]

COAXIAL CABLE OFFERS VERSATILITY

Although a shielded twin lead system, like the one just described, can do an excellent job, there are practical and economic limits restricting its use in an MATV system. Shielded twin-lead is more expensive and harder to route than plain twin-lead or 59/U *type* coaxial cable. It doesn't take too many feet before coaxial cable and matching transformers are less expensive than a shielded twin-lead system.

For all but small, uncomplicated systems, coaxial cable is the most practical answer. It is the lowest cost form of shielded TV lead. Handling, routing and pulling in conduit are easy because of its round configuration, flexibility in all directions and lack of stiffness or bulkiness (at least in the 59/U size). Additionally, it is easier and faster to install and terminate than a shielded twin lead.

But most important, a wide variety of hardware is available for coax-amplifiers, splitters, mixers, multiplexers, taps, attenuators, filters, connectors, single-channel antennas, converters, etc. The availability of such hardware makes complex signal processing and balancing possible for the larger MATV installations carrying numerous channels. System design can be approached with confidence because electrical characteristics can be accurately determined. Furthermore, the systems can be quickly installed.

Because of these advantages, the balance of the article will deal exclusively with systems containing coaxial cable.

SELLING THE SYSTEM CONCEPT

MATV distribution systems are becoming as important to modern buildings as electric-power distribution systems; and, therefore, they should be included right from the start in the electrical planning. Equipment, riser and tap locations should be determined early and space provided. MATV dealers and contractors must get to know architects and builders and educate them in the potential of MATV systems.

GOING-ON CHANNEL

The trend in MATV is toward on-channel systems in which the

TV CHANNELS TABLE

Channel No.	Freq. Range	Channel No.	Freq. Range
VHF		UHF	
2	54-60	41	632-638
3	60-66	42	638-644
4	66-72	43	644-650
5	76-82	44	650-656
6	82-88	45	656-662
		46	662-668
FM-98 mc	88-108	47	668-674
7	174-180	48	674-680
8	180-186	49	680-686
9	186-192	50	686-692
10	192-198	51	692-698
11	198-204	52	698-704
12	204-210	53	704-710
13	210-216	54	710-716
		55	716-722
UHF		56	722-728
14	470-476	57	728-734
15	476-482	58	734-740
16	482-488	59	740-746
17	488-494	60	746-752
18	494-500	61	752-758
19	500-506	62	758-764
20	506-512	63	764-770
21	512-518	64	770-776
22	518-524	65	776-782
23	524-530	66	782-788
24	530-536	67	788-794
25	536-542	68	794-800
26	542-548	69	800-806
27	548-554	70	806-812
28	554-560	71	812-818
29	560-566	72	818-824
30	566-572	73	824-830
31	572-578	74	830-836
32	578-584	75	836-842
33	584-590	76	842-848
34	590-596	77	848-854
35	596-602	78	854-860
36	602-608	79	860-866
37	608-614	80	866-872
38	614-620	81	872-878
39	620-626	82	878-884
40	626-632	83	884-890

Table II—Frequencies Assigned VHF and UHF Television Channels.

UHF channel signals are not converted to VHF but are distributed and fed to the sets at their transmitted frequencies. (Table II lists the frequencies assigned the VHF and UHF television channels.) The availability of lower-loss cables and all-channel hardware, plus the predominance of all-channel TV sets, makes the conversion from UHF to VHF unnecessary. An on-channel system is obsolescence proof since it can easily be expanded as new channels come on the air. The cost of converters is eliminated; and additionally, sound traps to prevent interference between adjacent VHF channels, when UHF channels are converted to VHF, are unnecessary.

SELECTING THE CABLE

Loss characteristics are the major consideration when determining the type of coaxial cable to be used. Every cable type has its own characteristic curve, which details losses in decibels (dB) per 100 ft in relation to frequency. (A sample set of characteristic curves is shown in Table III.)

Generally, the larger the cable the lower the losses. Foam polyethylene insulated types offer lower losses than similarly sized solid polyethylene insulated types. But loss char-

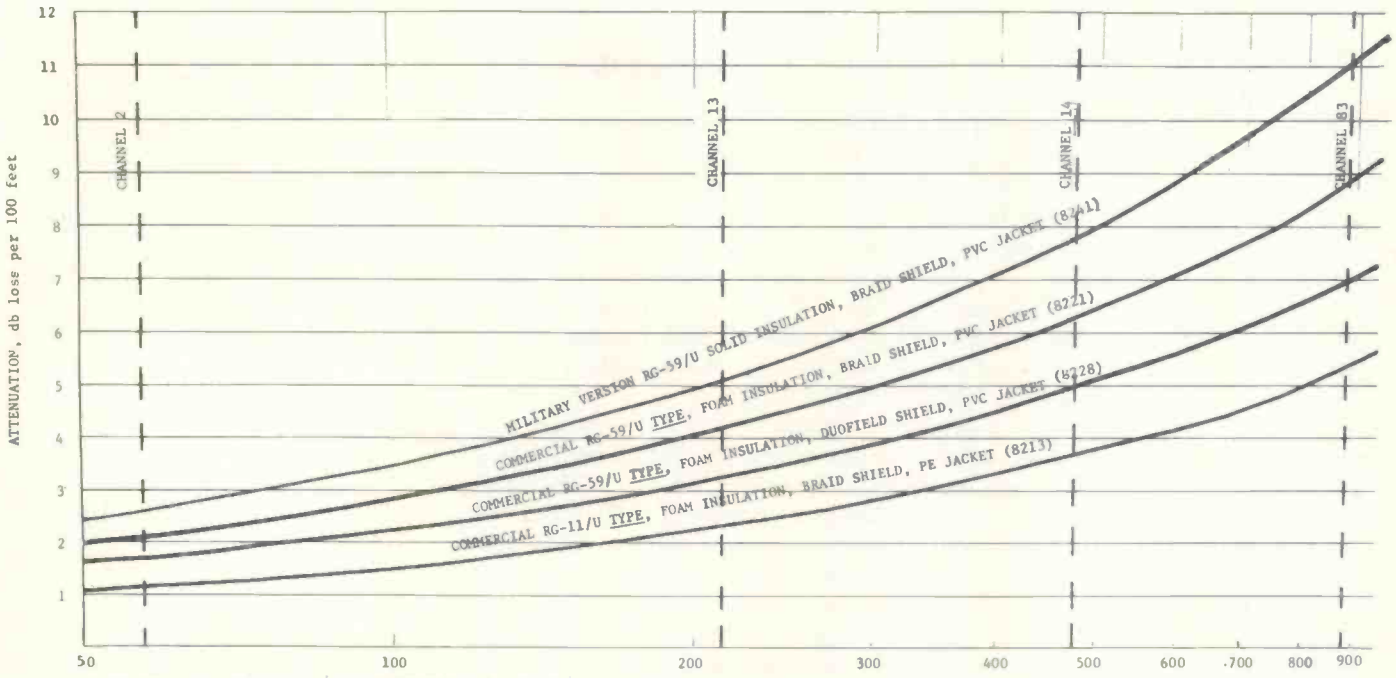


Table III—Loss Characteristics of MATV Coaxial Cables.

acteristics can vary considerably even among foam types of the same size.

Signal losses also increase as their frequency increases, roughly in direct proportion to the square root of the frequency. As an example, cable losses at 400MHz are roughly 20/30ths (or ⅔) the losses at 900 MHz.

Cable losses increase directly with length. A cable section twice as long as another of the same type has twice the decibel loss. When calculating cable losses, the decibels are simply added. If the run is 400 ft and the cable has a loss characteristic of 7dB per 100 ft at the frequency in question, the total loss will be 28dB.

Always be sure to calculate losses at the frequencies for Channel 13 and Channel 83 (where losses are highest for their particular bands) even though no transmitters may be broadcasting in your area on these higher channels. In this way, provision is made for new stations.

ASSUME 59/U TYPE CABLE

When making calculations to determine what cables to specify for an MATV distribution system, it is best to assume that a 59/U *type* cable of the most efficient design will be used, unless it is known from previous experience that a larger size cable will be necessary. For most jobs an ultra low loss 59/U *type* cable will be adequate.

Unlike 60Hz electrical wiring, the load, or number of TV sets to be hooked on the line, has no effect on the size cable needed. It does not make any difference whether the length is feeding one set at the end of a system or is the main trunk for hundreds of sets.

The use of larger, more efficient 6/U and 11/U *type* cables is seldom necessary except for systems with very long runs. Their cost is high—an 11/U *type* cable lists at about three times the price of a similarly constructed 59/U *type* cable. Furthermore, they are stiff, bulky, harder to run and require larger, more expensive conduits.

On many smaller MATV systems, the designer quickly realizes that cable losses can be small compared to the losses in certain hardware. Even so, it is still wise to choose as efficient a cable as possible to provide maximum capacity for future extensions. Also, the amplifier specified can be of minimum capacity, and balancing will be easier since differences in signal levels at the taps will tend to be minimized.

CALCULATE CONSERVATIVELY

When calculating losses, always figure that the TV set requires 1000 to 2000μv at 75Ω to operate, and then work your way back from the farthest set to the antenna. Modern TV sets can operate with signal levels as low as 150μv, but this value should not be used in your calculations. This provides a safety factor for possible TV set and distribution system deterioration through age. Under certain environmental conditions, such as high temperatures, coaxial loss levels can exceed the nominal values used for calculations. By calculating with a base of 1000 to 2000μv at the set, any such system degradation will not be noticed.

PURCHASE WISELY

When purchasing cable, be sure to obtain a type that is primarily designed for MATV systems, or for CATV systems as an alternative. CATV cables, with polyethylene jackets, are designed for outdoor use and are inherently stiffer and harder to terminate.

Be careful not to accidentally order an MIL spec cable since you will be paying for documentation of tests that do not apply to the characteristics that are important in an MATV system.

"Precision video" cables should also be avoided since they are intended for entirely different applications. Again, the cost would be way out of line as far as MATV is

concerned, and the quality would be unnecessary.

INSTALLING THE CABLE

Coaxial cable, unlike unshielded twin lead, can be routed either in or out of conduit. Be sure to check local codes concerning conduit requirements. In any case, never install coaxial cable in the same raceway or conduit as power cable.

Always remove the cable from a spool by rotating the spool rather than by taking it over the end of the spool. When reeling over the end, one revolution of twist is put into the cable for every turn taken off the spool. This will cause the cable to kink (which can damage it) and make pulling the cable more difficult.

When pulling a braid-shielded cable into a conduit, always tie the braid, rather than the center conductor, to the pulling device. On the other hand, when pulling foil-shielded cables, the drain wires should be tied to the center conductor. Special caution should be exercised when pulling by the center conductor in order to avoid stretching it. If necessary, use a pulling lubricant to ease the job. Make sure that the label on the lubricant states that it can be used with the cable jacketing material.

If possible, before pulling a cable during the winter months, warm the cable to room temperature. The vinyl jackets common to MATV cables tend to stiffen when cold, which makes the cables more difficult to pull and can result in damage to the jacket.

Never jerk the cable or permit it to kink. Do not allow it to be scuffed, nicked or cut so that water, moisture or contaminants can get beneath the jacket and have a chance to attack the insulation and shield.

The minimum bend radius for an MATV cable varies according to whether it is being pulled into conduit or stapled to a wall. A 59/U *type* cable should not be pulled through a conduit containing a bend of less than 5 in. radius. If the cable is being stapled to a wall where no flexing or pulling is done, the radius can be reduced to 10 times the cable diameter.

If the cable does not have to be run through a conduit, it is easier to just staple it to a wall or run it through clips. A staple that fits the cable with a round crown should be used, taking care without crushing it. The staple should never constrict the cable since that might cause signal reflection problems.

Do not be too precise when spacing staples. They should be placed randomly rather than at measured intervals. Standing-wave reflections may result on one of the TV channels if staples are installed at measured intervals that happen to correspond to the wavelength of the signal received.

Do not run the cable through any areas where the temperature may become greater than 180°F. Polyethylene insulation will soften at this temperature, with the conductor possibly shifting off center. This would result in an impedance change in the cable and possibly degrade the picture.

Generally, if the MATV system is to be installed in a building located within 15 miles of a transmitter, use coaxial cable right up to the TV set before converting over to 300Ω twin lead with a matching transformer. [*Editor's Note: Some of the more recent TV sets have 75Ω tuners and the coaxial cable can then be plugged directly into the set without using a matching transformer.*] Signal strength from a nearby transmitter can be so high that a short length of unshielded lead can pick up a ghost-producing signal.

TERMINATING COAXIAL LINES

Always remember that the end of a coaxial line must be terminated with its characteristic impedance—either in a specially designed termination, a tap or other device that produces the same effect. A coaxial cable cannot be just cut off and left hanging because the signal will then bounce back down the cable and create ghost reflections in all of the sets.

It is a good idea to wear safety glasses when making up connectors. Occasionally the end of a conductor must be snipped off and the little fragments of wire can be extremely dangerous. The center conductor of an MATV cable is frequently copper-covered steel rather than solid copper, and the snipped fragment usually flies off like a bullet. Even a "soft copper" conductor fragment can result in the loss of an eye. ■

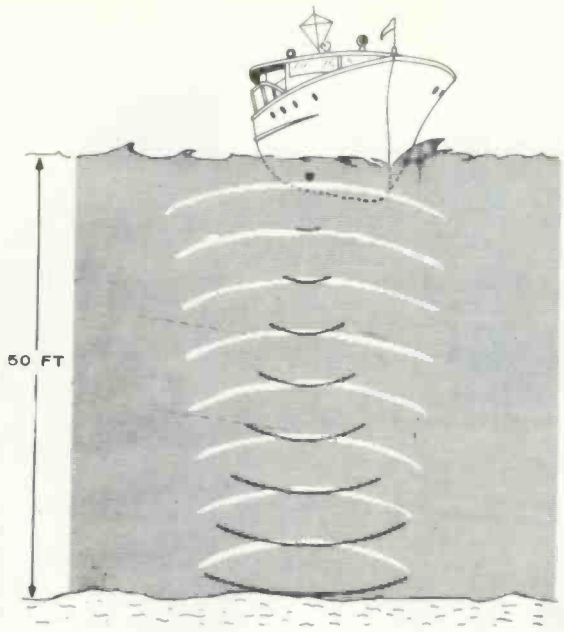


Fig. 1 shows depth-finder pulse being transmitted and "reflected" back from the bottom to provide a depth indication. (Courtesy Heath Co.)

Electronic Depth-Finders

If your service shop has room for additional business, you might consider marine electronic sales and service including the popular depth-finder or depth-sounder units which are designed to operate on almost any size boat.

■ One of the biggest booms in the country today is pleasure boating. Everyone is taking to the woods with tents, trailers, campers and boats to fish their favorite area or enjoy a weekend in the sun. And right along with today's sportsman goes his desire to communicate. Where he used to take a portable radio, he now carries a compact battery operated TV. In fact, many sportsmen today consider units such as marine two-way radio and direction finders essential to their boating activities whether for fun or fishing.

Another boon to boating which has gained considerable popularity is the depth-sounder or fish-finder type of equipment. Actually, these are the same instrument in most cases as their operating characteristics provide for an "echo" or reflected signal any time the transmitted signal hits a sufficiently solid underwater object.

The instrument operates somewhat like a sonar set which, in general terms, could be considered as an underwater radar. It operates on the principle that sound waves in water travel at approximately 4800 ft per second. This speed will vary depending on the salt content and the temperature of the water. Sonar equipment such as used on ocean-going fishing boats are calibrated or compensated for the water temperature or thermal layers at various depths. However, most of the instruments normally found on pleasure craft are not concerned with these factors as operation is limited to relatively shallow fresh water areas.

The depth-finder or fish-finder instrument uses a "transducer" as its transmitting and receiving antenna. It is normally the most delicate part of the system and should be handled with care. The transmitter puts out a signal consisting of pulses at a frequency of 200kHz, which are transmitted into the water through a special element in the transducer. The transducer acts much like a radio speaker except that, instead of moving air, it moves water. The pulses are actually directed into a narrow beam as shown in Fig. 1. The pulses are sent out and reflected to be picked up by the transducer. The time it takes for the pulse to go out and then return is measured and calibrated on the instrument's meter in terms of feet.

We indicated that sound in water travels at approximately 4800ft per second or .000208 seconds per foot.

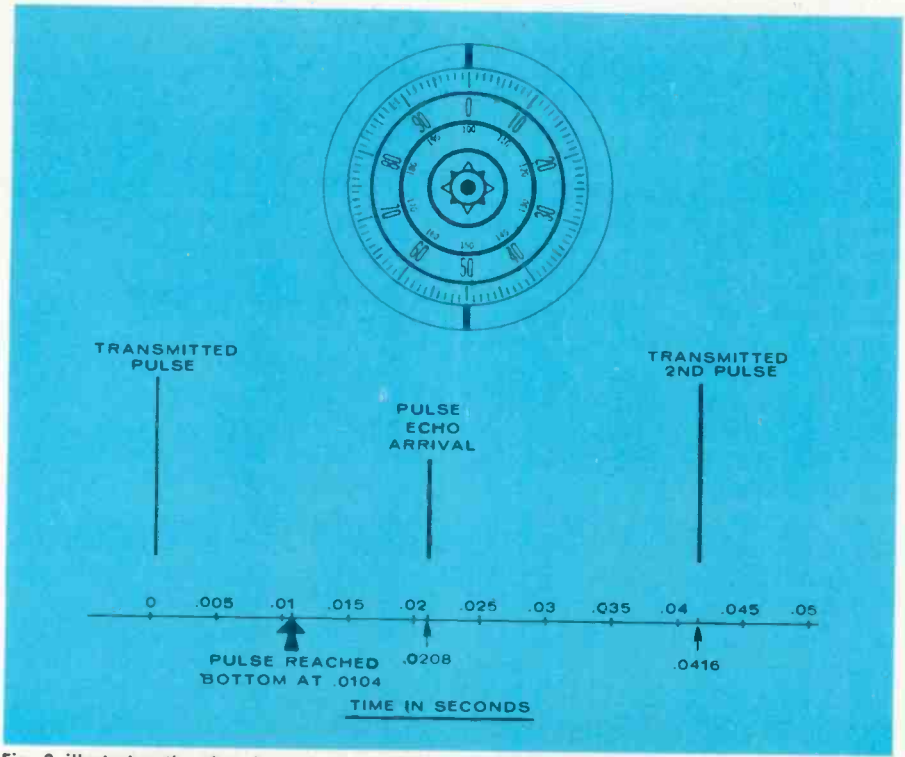


Fig. 2 illustrates the time lapse between the transmitted and received signals which determine the distance in feet from the transducer to the reflecting object. (Courtesy Heath Co.)

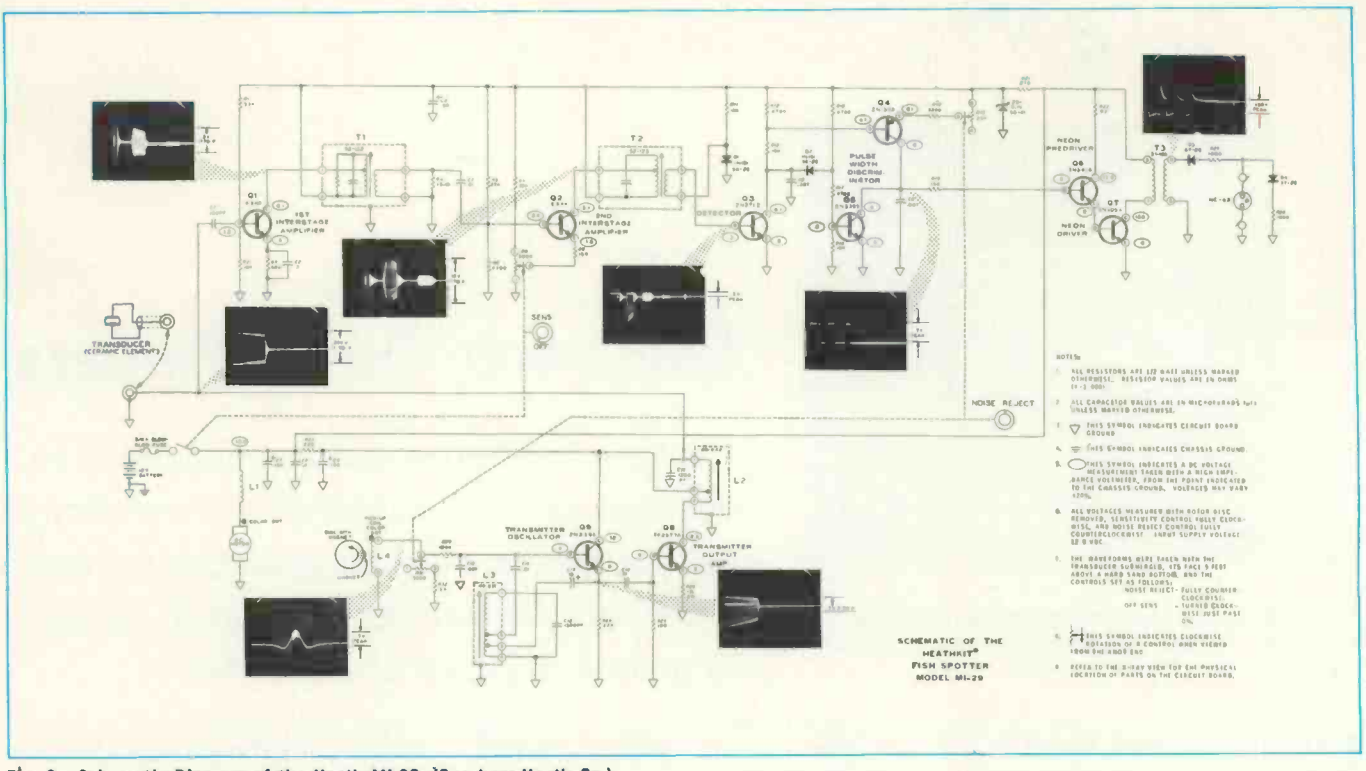


Fig. 3—Schematic Diagram of the Heath MI-29. (Courtesy Heath Co.)

Supposing then, that we are operating a depth-finder on a lake over a spot 50ft deep. The time for the pulse to go to the bottom will be 50 times .000208 or .0104 seconds (104 milliseconds). Since the signal must also reflect back to the transducer, the round trip time is 2 times .0104 or .0208 seconds. The diagram in Fig. 2 shows how this would appear if we could see the pulse go out and return.

TYPES OF "DEPTH-FINDERS"

The accompanying photos show several types of depth-finding or fish-finding instruments. The Raytheon Model DE-732 Fathometer is a solid-state depth-sounder designed to operate from 12vdc. Since it is transistorized, the current requirement is low, approximately 200ma, and this means it can be operated from a boat's 12-volt electrical system or from a 12-volt lantern battery. The unit is housed in the indicator assembly shown with the transducer and power plugs at the rear.

The Sonar Model D120 Depth Indicator is a tube operated unit for 12 or 6vdc and provides readings to 250ft. This unit uses a flashing type of indicator and can be used for locating fish, wrecks and other objects. The instrument has two scales, an outer scale for depths to 125ft and an inner scale for depths to 250 ft. The second revolution of the indicator is provided for the 125 to 250 ft depths. The D120 operates from a heavy-duty power supply and a synchronous motor. A 115Hz vibrator determines the motor speed. The circuitry consists of a 200kHz power oscillator, a wideband amplifier and a magnetically controlled keying amplifier.

The transducer is a ceramic element housed in a machined bronze casting and encapsulated. It also has provision for either through-the-hull type mounting, or it can be mounted externally on the transom. The indicator includes plug-in jacks for the dc power source and cabling to the transducer. Since this is a tube operated instrument, the power requirements are somewhat higher than those of the solid-state units, but still nominal for most installations. It requires approximately 2¾ amps for 12-volt operation and 5.5 amps for 6vdc use. The instrument weighs 6½lb.

Allied Radio's new Model KG-711 Ultrasonic Depth Meter is a Knight-Kit instrument, which is designed to operate on eight self-contained flashlight ("C" size) batteries or from the boat's electrical system. The unit has a gimbal mounting bracket for the meter and comes with a transducer mounting assembly. Specifications indicate operation to 200ft on hard bottom and 100ft on soft bottom.

The Heath MI-29 Fish-Spotter is a transistorized unit which will read depths to 200ft on two scales. It is completely portable as it operates from two self-contained 6vdc lantern batteries and comes with a suction cup transducer mounting bracket. The carrying case is waterproof and also floats if accidentally dropped overboard. Storage space is provided for the transducer and cable in the case. This instrument has nine transistors and five diodes to produce a 200kHz pulse frequency. The power required of the lantern batteries is between 80-100ma for a nominal battery life of 80 hours.

CIRCUIT DESCRIPTION—TRANSMITTER

The schematic diagram of the Heath MI-29 is shown in Fig. 3 to illustrate the operation of depth-finder or fish-finder instrument. The circuit can be divided into two parts, transmitter and receiver. A brief explanation of how the circuits operate will help you do a more efficient service job.

The rotor disc assembly is rotated by the motor and has a permanent magnet mounted on it. Each time the magnet passes the pickup coil, L4, it induces a current in the coil. This current flows through L4 and

Raytheon DE-732 fathometer depth-sounder is a transistorized unit for reading. (Courtesy Raytheon Co.)

The Sonar Model D120 Depth Indicator is tube operated for use on 6 or 12vdc and provides readings to 250ft on two scales. (Courtesy Sonar Radio Corp.)

The Heath Model MI-29 Fish Spotter is transistorized and completely for tube using self-contained lantern batteries for operation in depths to 200ft. (Courtesy Heath Co.)

produces a pulse which is applied through R31 and R29 to the base of the oscillator transistor, Q9. The pulse causes Q9 to conduct and when it conducts, the oscillator operates at 200kHz. This signal is then coupled through C13 to a small portion of the oscillator coil, L3. This signal is stepped up and coupled back through C15 to the base of Q9, which completes the feedback loop and causes oscillation.

The oscillator operating frequency is determined by the tuned circuit of L3 and C12. The control, R31, adjusts the amplitude and duration of the oscillator trigger pulse, which subsequently determines the duration of the transmit signal. The 200kHz signal is coupled through C14 to the transmitter output, Q8, where it is amplified and coupled to the output coil, L2. Here the voltage is stepped up to approximately 200 volts (peak-to-peak) and coupled to the transducer where it is converted to a mechanical, ultrasonic signal. Since the output signal occurs only when the magnet rotates past L4, the transducer is free to receive reflected signals through the rest of the rotor-disc's arc.

CIRCUIT DESCRIPTION—RECEIVER

The receiver circuits operate continuously whenever the MI-29 is turned on. The transmitted signal is reflected from the bottom or from some other submerged object. This reflected signal is picked up by the transducer and changed back into an electrical signal. It is coupled through C1 to the base of Q1 where it is amplified and coupled to the interstage transformer, T1.

From T1, the signal is coupled through C3 to the base of Q2 for further amplification. The gain of transistor Q2 is controlled by the SENSITIVITY control, R8, which in turn, varies the amplitude of the signal to the interstage transformer, T2. The signal from T2 is coupled directly to the base of Q3. Transistor Q3 is connected in a detector circuit with R13 and C5. R11 and D1 bias Q3 so it will pass only the positive portion of the applied signal. The detected signal at the collector of Q3 is in the form of a square wave pulse. This pulse is then coupled through R13 to the base of Q4 which is normally biased off. It is biased on by the pulse at a level set by the NOISE REJECTION control, R15.

When transistor Q4 conducts, C6, which is connected to the collector of Q4 begins to charge. When the charge on C6 reaches approximately 1.2vdc, transistors Q6 and Q7, which are normally biased off, will conduct. The output signal from Q6 and Q7 is then coupled through the output transformer, T3, where it is stepped up to sufficiently fire the neon lamp. Noise pulses, even though high in amplitude, are generally too short in duration to charge C6 and bias Q6 and Q7 into conduction. This insures that the neon lamp will not flash and indicate false readings. The charging time of C6 can be controlled by changing the resistance of the NOISE REJECT control, R15. At the end of the signal pulse, Q3 is again cut off and its collector voltage increases. This increases the bias voltage of Q5 and causes it to conduct, which then discharges C6. Diodes D3 and D4 in the secondary of T3 keep the negative voltage produced by the collapsing magnetic field of T3 (at the end of a pulse) from firing the neon lamp.

INSTALLATION

The installation of electronic depth-finder equipment varies slightly between the various manufactured types, but all require mounting a transducer and control or indicating unit. The different mounting configurations normally concern only the installation of the transducer.

The Raytheon DE-732 has three transducers available: a through-hull mounting type, transom mounted type and one to mount in sailboat fore-foot. The Sonar Model D-120M allows for two mounting configurations: either through-hull or transom. The Heath MI-29 is a portable instrument and designed to be moved if necessary from boat to boat so it is the simplest of all to install. It comes with a transducer mounting bracket attached to a suction cup unit for attachment to the transom or hull of any boat. The Heath Company also manufactures a Model MI-19 Depth-Sounder, which can be purchased for through-hull or transom operation in a fixed installation. The difference between the MI-19 and MI-29 is that the MI-29 is made to be completely portable for the fisherman and so

has internal batteries and a movable transducer assembly.

The diagrams in Fig. 4 and Fig. 5 show the two common types of fixed transducer mountings. The transducer cable to the indicator in all cases is a fixed length and cannot be changed regardless of how long it is. When the installation is planned, it should be made so that the cable will reach. Any extra cable can be rolled up and taped out of the way. As shown in the diagrams, the transducer should be mounted above the level of the bottom of the keel. This will afford some degree of protection for the transducer face. A through-hull installation should be made with the transducer located slightly forward of amidships. It should in all cases be mounted so that its face is parallel to the water line. Through-hull installations should be located away from any other through-hull opening which could cause turbulence around the transducer. Be sure to pick a mounting spot which will allow room inside the boat for securing the transducer mounting hardware and for routing the cable. The transducer cable should be routed away from the boat's electrical system if possible as it can pick up noise.

If noise does show up, it should

The Knight Model KG-711 Ultrasonic Depth Meter kit operates on either eight self-contained "C" batteries or from the boat's electrical system for depth indications to 200ft on hard bottom. (Courtesy Allied Radio Corp.)

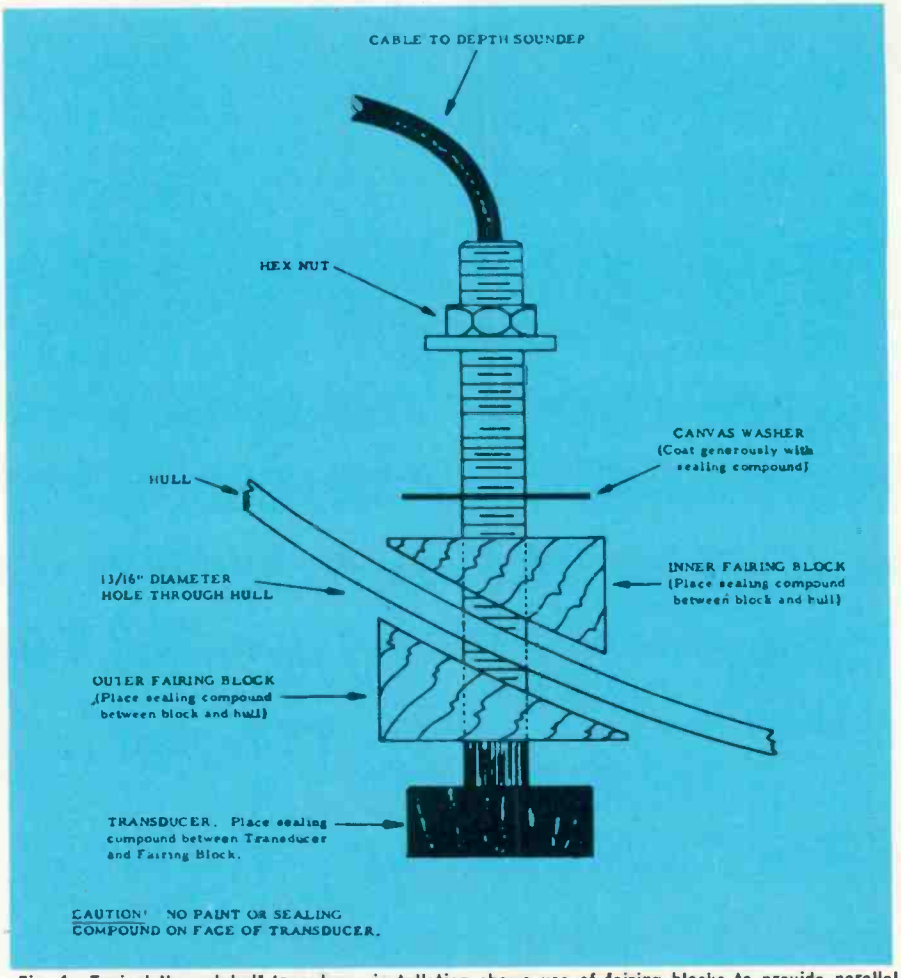


Fig. 4—Typical through-hull transducer installation shows use of fairing blocks to provide parallel mounting. (Courtesy Raytheon)

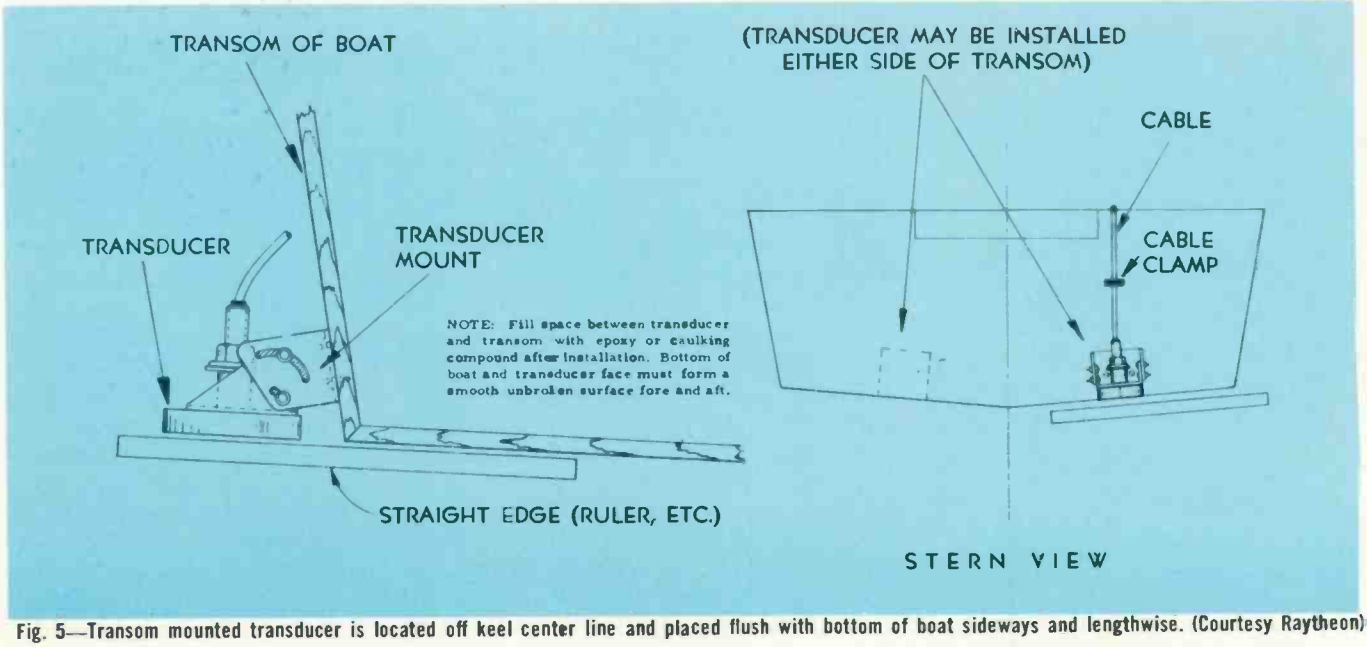


Fig. 5—Transom mounted transducer is located off keel center line and placed flush with bottom of boat sideways and lengthwise. (Courtesy Raytheon)

be handled much the same as automobile noise in a two-way radio system. Bond all electrical grounds and metal-to-metal contacts. Make good ground connections and check all ignition fittings.

If the transducer installation is to be a transom mounted system, be sure that the transducer is secured parallel to the water line. On boats with one engine, place the transducer mounting at least fifteen inches to one side of the centerline. If the boat has two engines, the transducer should be placed exactly on the centerline.

When mounting the indicator unit, it is best to place it where it is out of the glare of the sun even though some of the meter units are shielded. The indicator mounting brackets should always be set for the best viewing angle. Power connection for most of the depth-finders is simply a matter of connecting two leads to the 12 or 6vdc source. A power cable is provided with all of the instruments discussed in this article.

MAINTENANCE

The amount of maintenance required on the instruments outlined in this article is relatively small. Normally, it will be limited to an occasional indicator lamp replacement and slip-ring cleaning. Replacement of the indicator lamp in the Raytheon DE-732 is accomplished by simply removing the rotor assembly and inserting the new lamp in the fahnstock clips. The rotor is accessible by removing a couple of screws on the back of the indicator and three on the printed circuit board. The only other maintenance on this instrument is to be sure that the magnet is in line with the center of the rotor for maximum pulse amplitude.

The Sonar Model D-120M requires periodic cleaning of the commutator rings. The rotating indicator arm is accessible after removing the four corner screws in the dial hood. The rotor arm is fastened to the motor shaft with a set screw. Loosen the set screw, remove the rotor arm and carefully clean the arm commutator ring. The indicator lamp, which is neon, is held in place on the indicator arm by a spring clip. The lamp electrodes are pressed into small spring clips. The replacement

continued on page 91

TEST LAB REPORT ET/D

EICO Model 240 Solid-State FET-VOM

Here's how to have the latest in a solid-state voltmeter and still save a few bucks

■ It takes a fast-moving technician with a fairly hefty budget to keep his shop equipped with the many new test equipment items introduced in the past several years. Even that old 'work-horse' of test equipment, the vacuum tube voltmeter, has been updated with solid-state circuitry and is now called by the initials EVM, SSVM or FET-VOM. One way for the technician to make his equipment buying dollars stretch a little farther is through the assembly in his own shop of one of the kits now being offered by several manufacturers.

We recently assembled EICO's Model 240 Solid-State FET-VOM in the ET/D laboratory at a savings of around $20 from the factory wired price. For a few hours of work and the use of a few shop tools, we wound up with a modern, totally transistorized FET-VOM.

The Model 240 features an ac power supply for bench work and a battery supply for field use. Its semiconductor circuitry provides flexibility for not only the servicing of vacuum-tube equipment, but a low 1 volt dc full scale for semiconductor circuit testing. Voltages as low as .02 volt dc are easily and accurately read with good indication available down as low as .01 volt. Direct readings may be made up to 1000 volts dc and with the addition of an HVP probe (not supplied with the kit) readings can be extended to 30,000 volts dc.

The seven ac ranges cover the complete gamut of voltage measurements from 1 volt rms (full scale) to 1000 volts rms (full scale). The meter scales are calibrated in both rms and peak-to-peak to enable accurate conversions. Covering the frequency range from 25Hz to over 2MHz, you can perform most required ac measurements with the ac portion of the 240.

Seven ohmmeter ranges are available to read up to 1000 megohms. A low voltage supply is used in the ohmmeter section to avoid accidental damage to semiconductors in the equipment under test. However, this voltage is high enough for use in testing both diodes and transistors.

An FET-input semiconductor, differential amplifier, tight voltage regulation and close-tolerance resistors seem to provide stability and

EICO Model 240 solid-state FET-TVM

. . . for more details circle 900 on Reader Service Card

accuracy in all ranges. No warm-up is required with the 240 and the FET input circuit is protected by semiconductor circuitry.

HOW THE FET CIRCUIT WORKS

The high input impedance feature of the field effect transistor (FET) used in the 240 allows for testing of the low voltages of solid-state circuits.

The FET circuit is shown in basic form in Figure 1. It consists of a differential amplifier formed by npn silicon transistors Q2 and Q3. If both transistors are matched and the same base bias is applied to each, there will be the same voltage developed at the emitters of both transistors. In this case, the meter will indicate zero. Note that the base current of Q3 is kept constant by the voltage divider consisting of R20, R21 and the resistance reflected at the base at Q3. Transistor Q2, however, uses a field-effect transistor as a voltage-variable resistor. In its base bias network, it forms a voltage divider in conjunction with R17.

When a dc voltage is applied to the gate of the FET, its channel resistance, acting as the base bias resistor for Q2, varies. This affects the base bias of Q2. A change in the base bias of a transistor produces a change in the current flowing through it. This, in turn, causes the voltage drop across R18 to vary with the gate voltage of the FET. The meter will then indicate the voltage difference between the emitters of fixed Q3 and variable Q2.

Because too great a voltage swing at the gate of the FET can cause its junction to burn out, some form of voltage limiting is required at the gate. This is the function of silicon transistors Q4 and Q5. Note that the bases of these transistors are not used and they act as high-quality temperature compensated zener diodes. When the voltage at the gate of the FET exceeds the base-emitter breakdown voltage of the transistors (about 9 volts) in either direction, the transistors clamp the gate voltage to 9 volts.

The remainder of the circuit in the 240 is conventional VOM. The resistor divider networks are calculated to permit the proper voltages

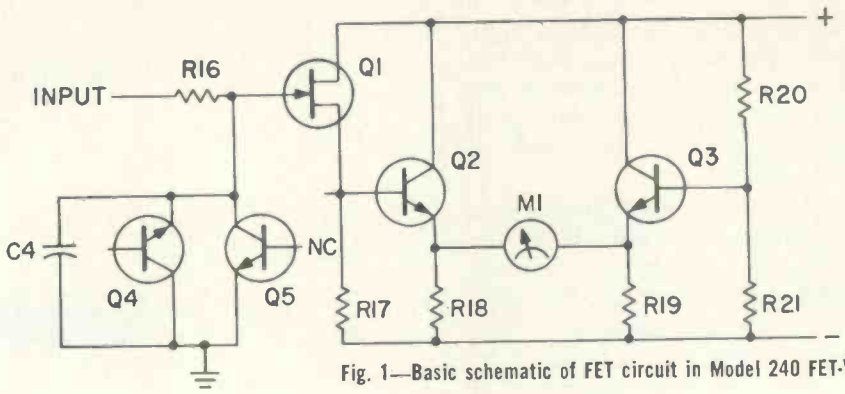


Fig. 1—Basic schematic of FET circuit in Model 240 FET-VOM.

to be fed to the FET for the various ranges. A pair of silicon diodes in a peak-to-peak double circuit act as rectifiers to convert input ac voltages to the required dc to operate the FET.

Assembly of the 240 kit is fairly easy, instructions are quite thorough, and if you follow them carefully and recheck your work at each step, you should end up with a professional looking and working FET-VOM.

We would suggest to the manufacturer, though, that one small line be added to the assembly manual about removing the meter shunt wire during assembly. Even someone with experience in assembling electronic equipment could forget to remove this shunt before trying to operate the meter. We know. We forgot.

SPECIFICATIONS

DC Voltmeter: Range: 0 to 1, 3, 10, 30, 100, 300, 1000 volts either + or —; input resistance: 11 megohms; accuracy: ± 3%; range can be extended to 30,000 volts using an HVP.

AC Voltmeter: Range: RMS—0 to 1, 3, 10, 30, 100, 300, 1000 volts; P-P 0 to 2.8, 8.5, 28, 280, 850, 2800 volts; input impedance: 1 megohm; accuracy: ± 5% of full scale (with sine-wave input signal); frequency response: ± 1dB from 25 Hz to 2MHz. Can be extended to 250MHz using RF probe.

Ohmmeter: 0.2 ohm to 1000 megohms in seven ranges.

Meter: 4½in., 200μa movement.

Power Supply: transformer isolated, silicon rectifier, zener regulated, 1.5 volt battery for ohmmeter function, three 9-volt transistor radio batteries for portable power. Overall dimensions: 8½in. high, 5¾ in. wide, 5in. deep, weighs 6lb. Kit price, $59.95; wired, $79.95. ■

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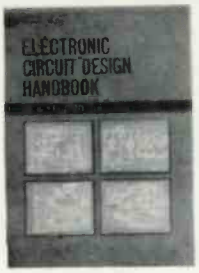

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Motorola Color TV Service Manual

This brand-new all-in-one handbook covers all models using the TS-907 through TS-924 chassis — including the all-transistor TS-915/919 chassis — all the information you need to know about setup, alignment troubleshooting, etc., slanted specifically to unique Motorola characteristics. In addition to general data, there's specific information on each chassis, detailing special features, test-point locations, individual alignment procedures, setup kinks unique to each chassis, CRT replacement instructions, troubleshooting tips and modifications, etc. Also, there's a BIG 18-page foldout section with complete schematic diagrams for ALL Motorola Color chassis. 160 pps., BIG 8½" x 11" size, plus 18-page schematic foldout section. Long-life vinyl cover.

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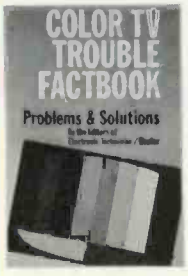
Color TV Trouble Factbook



Here's a complete guide to color TV troubles and solutions, arranged by make and model, a low-cost, all-in-one reference handbook every TV service technician should own. The information it contains may easily save you hours of time repairing a "tough-dog" color TV. Included are details concerning repetitive troubles, field-factory changes, new and unusual circuits and descriptions of how they work, special adjustment procedures and other such pertinent service information. The content is arranged by brand names, covering every major make of color TV receiver produced in the past several years. Models and chassis covered are arranged in alpha-numerical order. 176-pps. Hardbound.

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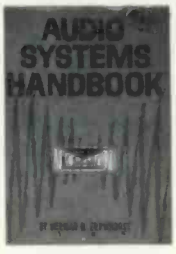
Audio Systems Handbook



Complete reference and guide to audio system design, encompassing home entertainment, commercial sound and studio installations. Chapter 1, covering amplifiers and amplification, explains db and impedances, level limitations, insertion gain, plus a host of other basics necessary for practical system design. The author goes to great lengths to impart an understanding of these vital ingredients as they apply to overall operation. The same may be said of the treatment in succeeding Chapters on equalizers, mixers, filters, distribution systems, program sources, commercial systems, studios, and loudspeaker systems. 192 pps., 125 illus. Hardbound.

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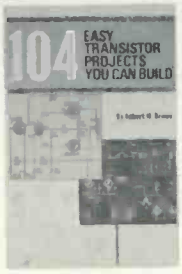

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continued from page 40

to position body of resistor in a location at least two to three inches away from any of the remote control motors (i.e., color, tint, volume). This action may involve a simple relocation of the terminal board further rearward on the TMA bracket. Resistor R95 is accessible without pulling the TMA or chassis.

It is recommended that all service technicians carry sleeve "spaghetti" and small, isolated-type terminal boards when making in-home service calls on referenced receivers.

SYLVANIA

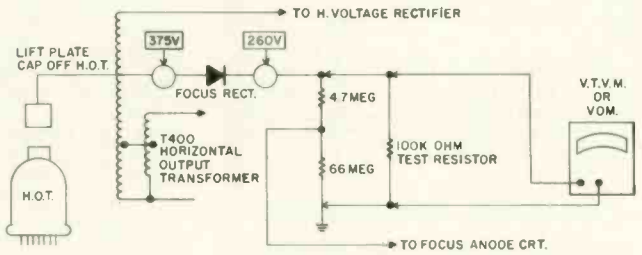
Color TV—Testing the Focus Rectifier

One problem confronting the TV technician is finding a method to check color TV focus rectifiers either in the home or shop.

Normally, the technician usually checks the raster scan line sharpness while adjusting the focus to determine the rectifier's merit, then moves on to the next decision.

Obvious failure usually generates a very pungent odor, smelling of burned selenium, or show scorched spots along the cell's outer covering.

Focus rectifiers, like many other type electrical components, can look normal and be right on the money in its capability to generate the correct focus anode voltage. However, there are times when a focus rectifier may seem normal, but when used as a replacement part, proves no better than the defective one, producing the original symptom.



Circuit tests for a focus rectifier are somewhat different than a power diode or signal diode due to the high voltage required to forward bias the cells into conduction. An in-circuit testing procedure other than the visual CRT inspection is needed.

There is a focus rectifier testing circuit built into every color TV chassis, whereby the rectifier's merit can be determined. It means simply, to use the circuit formed by the horizontal transformer, focus rectifier and voltage divider in the following manner. (1) Remove the horizontal output tube from socket. (2) Shunt a 100K (one to two watts) across the divider to ground (4.7M and 66M ohm resistors). (3) Place a voltmeter across the 100K resistor (use 500vdc scale as a protective measure). (4) Turn on the TV power. (5) Note the voltage drop across the 100K resistor. (6) Move the voltmeter probe to the rectifier's other end (anode). Note the voltage. (7) The focus rectifier's merit factor should be over 60 percent as figured in the following way:

$$\frac{E\ 100K}{E\ anode} = F\ merit\ X\ 100 = F\ merit\ percent$$

The rectifier with the highest merit factors are the best.

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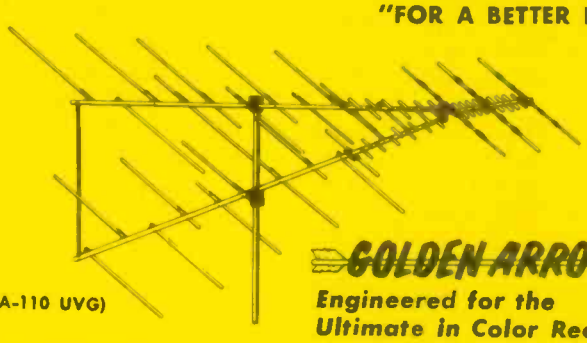

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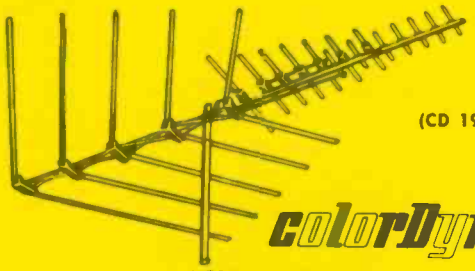

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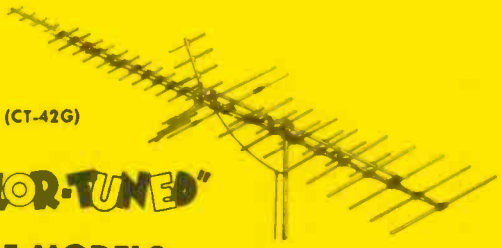

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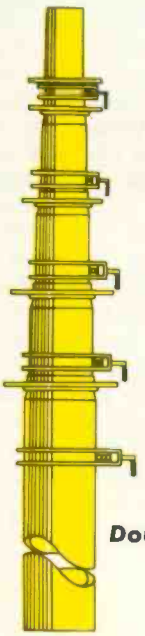

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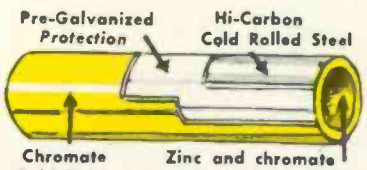

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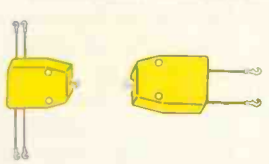

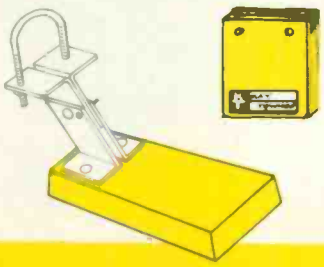

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ET/D DEALER SHOWCASE

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

COLOR TV 703

Finished in dark pine

An Early American television console is among five color television sets and a B/W model introduced. The

CF722N is finished in dark pine and has a 23in. picture measured diagonally (295sqin. viewable). It includes Sylvania's Color Bright 85 high contrast picture tube and the Gibraltar chassis designed for maximum reliability. The television has the Instant Color feature which assures a picture seconds after the set has been turned on. Also included are automatic fine tuning control (AFC) and lighted channel indicators. Manufacturer's suggested list price for the CF722N is $579.95. Sylvania.

BIAS SUPPLY 704

Three separate bias supplies

Announced is a bias supply for color TV alignment. The company's earlier model, BE113, provided only two

negative output 20v supplies. The BE156 supply meets the demands of the TV manufacturers by providing three separate 25v supplies that can be switched positively or negatively as indicated in the alignment instructions. Tube operated receivers require negative voltages while most solid-state receivers specify positive voltages. The seventh range of negative zero to 75v has been provided to meet the specifications of the manufacturers who use 67.5v to bias the chroma amplifiers during alignment. The seven-in-one bias supply is said to be universal so that it can be used with any sweep and marker generators. All three supplies are well filtered at 1/10 of one percent ripple and have little or no interactions between them. Price is $24.95. Sencore.

CCTV CAMERA AND MONITOR 705

Automatically adjusts to line voltage variations

An all solid-state circuit television camera and 9in. monitor designed to meet the need for an economical yet reliable CCTV system is introduced. The new units are compatible with existing systems and offer the same quality as the heavy duty industrial CCTV system. The camera incorporates the latest space-age technology with all components, except the vidicon and deflection assembly, on a sin-

gle snap-out circuit board for optimum serviceability. The camera includes standard features not generally available with low-cost units such as three-in-one lens kit for wide, medium and tight angle viewing and no external or exposed controls except a simple on/off switch. Once installed and adjusted, the unit cannot be accidentally misadjusted. The camera is designed to automatically adjust to line voltage variations typically encountered in large plants and industrial buildings. The unit also has a 24vac operational capability which often eliminates the need for power line and conduit installations. The camera provides 650 lines horizontal resolution and is equipped with an RF output which permits hook-up to any standard broadcast TV receiver. Ideal for retail stores, banks, manufacturing plants, transportation companies or any CCTV application with a standard indoor environment, the camera is priced at $625 and the 9in. monitor $175. Motorola.

TV CARTON/DISPLAY 706

Converted in seconds into a dealer display

A specially designed shipping carton for six portable television sets that can be converted in seconds into a dealer display case is introduced. The

three-color, self-contained display/shipping carton requires only three square feet of floor space and contains 9in. models in white (1), red (2), avocado and white (2), and walnut grain (1) cabinets. The header display card, when set in place, reads as follows: "Take me along. New 1970 Admiral Quality Playmate 9 Portable TV. The anytime, anywhere, television set. . . . In sparkling decorator colors to brighten every room in your home. Designed for the patio, bedroom, family room, den, kitchen and workshop." The upper front of the carton is scored, and when removed, it displays a row of three receivers. There is also room for displaying three additional units out of their cartons. Admiral.

INSULATING SPRAY 707

Coating withstands up to 30kv

An improved high voltage insulating spray is announced. The aerosol spray is based on the original insulating formula developed and sold to TV technicians for more than ten years under the name NO-ARC. Reportedly, it has been impossible to use the

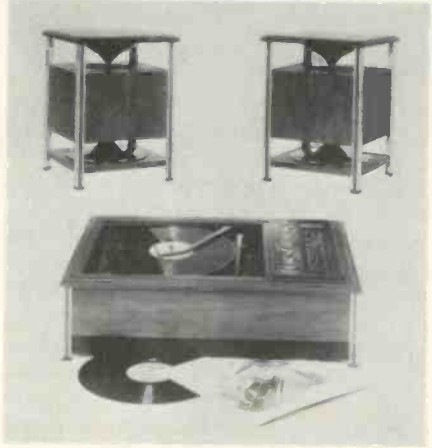
original NO-ARC formula in aerosol form because when it dried, it clogged the valves. The aerosol leaves a tough, thick, smooth protective red insulating coating capable of withstanding up to 30kv. The spray is excellent for

stopping arcing and corona shorts in high voltage circuits, especially on color chassis. The aerosol is also recommended for "potting" components as well as waterproofing and insulating printed circuit boards and exposed wiring. NO-ARC is available in an 8 oz can for $2.79 net. Chemtronics.

STEREO SYSTEM 708

With omni-directional speakers

An Astrosonic custom stereo radiophonograph that features duo omni-directional speakers is introduced. The new dimension in omni-directional speakers is designed to project stereo



sound in every direction. The unit is equipped with the Air-Suspension speaker system. Speakers are completely isolated from their environment so that the cones literally "float" back and forth for superb response, eliminating feedback and distortion. Two deflector cones disperse sound a full 360 degrees from top and bottom of each speaker system. The modular

ET/D DEALER SHOWCASE

custom unit is in walnut with metal trim. The speakers measure 11in. long, 11in. deep and 15in. high. The tuner-changer unit is 25in. long, 16in. deep and 8¼in. high. A Micromatic record player with diamond/sapphire stylus handles records with precision and greatly lengthens record life. Constant turntable speed is provided by a synchronous four-pole motor. Additional features: muting switch which eliminates noise during change of records; automatic shut-off which turns off the player and amplifier after the last record has played; tone-arm brush to prevent record wear; and lock-down latches that permit moving the component without damage to the player. Included are 45 rpm adapter and dust cover. The tubeless solid-state radio brings stereo FM, noise-free monaural FM plus powerful AM radio. A tuned RF state on FM provides optimum sensitivity and selectivity. The 20w (EIA) solid-state amplifier contributes essential power and flexibility to provide undistorted music reproduction with maximum total purity. Audio control functions include separate variable bass and treble plus compensated loudness and stereo balance controls. A no-drift FM Automatic Frequency Control (FM/AFC) keeps FM stations "locked-in" and an indicator light shows when stereo FM is being received. Auxiliary connections include input and output jacks for component tape recorders and players, as well as jack for stereo headphone. The Astro-Sonic Component FM/AM Radio-phonograph System (Model 1E9274) has a retail price of $279.90. Magnavox.

VIDEOTAPE SYSTEM 709

Complete low-cost system

A videotape system package is introduced. The VR-50 record/playback system comprises a ½in. video

tape recorder, crystal controlled vidicon camera and an 8in. receiver/monitor. The video tape recorder is a ½in. unit made by Sony for General Electric. It is compatible with all other Sony ½in. VTR's, including battery operated portables. Completely solid-state, the recorder is a helical scan type with two video heads and one audio head. The camera is the solid-state Model VX-922, with crystal controlled 15,750Hz horizontal frequency. It features 550 line resolution, dual focus, 4000 to 1 automatic light compensation and a 25mm f1.8 lens. Completing the package is a Sony CVM 51UWP-9in. receiver/monitor. This unit can be used to pick up off-the-air broadcasts and process them for videotaping. It can also be used as a playback monitor. The package is easy to operate because it plugs together with ease and most controls are automatic. It can be used for taping broadcasts off-the-air, as well as the pickup of the vidicon camera. If a microphone is added, sound and picture are recorded simultaneously with good synchronization. The VR-50 package sells for $595. GBC.

CASSETTE STEREO 710

Features a fast forward/fast rewind

An addition to the line of car stereo players is a cassette stereo tape player, Model CS-204. It features a fast forward/fast rewind control and uses

the same pre-recorded cassettes that are in such widespread use in home stereos and portable cassette players. The cassette car stereo is turned on automatically when you insert the cassette through the dustproof door. The cassette is ejected automatically when the end of the tape is reached, or it can be removed at any time by pushing the reject button. This also serves to turn the unit off. There are separate volume, and tone controls, plus a balance control. An indicator lamp glows when the set is on. The unit is all solid-state and operates from a 12v car battery. The lightweight, compact unit mounts easily under the dash with a mounting bracket provided. Specifications: Power Source: 12v car battery (neg. ground); Output: 10w (each channel); Frequency Response: 40-10,000Hz; Track system: 4 track, 2 channel; Tape speed: 1⅞ ips; Semiconductors: 19 transistors, 1

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diode, 4 thermistors; Dimensions: 7⅞ in. W x 2¾ in. H. x 6 11/16in. D; Weight: 6¾ lbs. Price $89.95. Hitachi.

SPEAKERS 711

Dome cap provides directivity of high ranges

Announced is the release of the Imperial series of full-range custom speakers. The line consists of wide range single cone speakers, custom designed and engineered for studio and home. Each speaker is individually handcrafted to exacting specifications and tolerances. The speaker reportedly will deliver sound quality equal to the finest two and three speaker systems. Cone shaping techniques, together with Barium Ferrite magnets for high magnetic flux, deliver true sound to all input levels. The special dome cap at the apex provides directivity of the high ranges. The Imperial line consists of: FR-4A, 4in. speaker with 16oz Barium Ferrite magnet. FR-5A, 5in. speaker with 20oz Barium Ferrite magnet. FR-6A, 6in. speaker with 24oz Barium Ferrite magnet. FR-8A, 8in. speaker with 36oz Barium Ferrite magnet. All of the speakers develop a claimed basically flat audio response at all levels

of input. Dealers will be supplied with an attractive walnut counter display for point of sale merchandise. Speco.

CASSETTE TAPE RECORDER 712

Features hidden miniature microphone

Introduced is the Model 110 Cassette-Corder featuring a built-in hidden electret condenser microphone. The unit is light weight, compact, easy to operate and features the Sonymatic Recording Control which automatically adjusts varying sound levels to a constant volume when recording. It also features an auxiliary high level input for recording from radio, television, telephone pick-up or other high level sources. In addition, an End-of-Tape-Alarm gives an audible warning signal when the end of the cassette has been reached during recording. The unit measures 5½ x 2⅜ x 9⅜ in. and weighs less than five pounds. It has a piano-key-type push-button release and cassette ejector for quick and easy access to tape cas-

settes, as well as piano-key-type push-buttons for other control functions. The unit may be operated with either a built-in snap-on battery pack containing four "C" cells or a rechargeable nickel cadmium battery pack.

The unit includes a cardioid microphone with remote start and stop switch, earphone, leather carrying case and a 60-minute tape cassette. Price $99.50. Sony.

DESOLDERING TOOL 713

Self-cleans tip when loaded

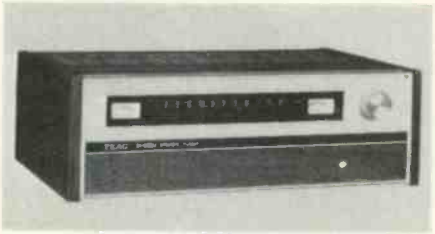
Introduced is a low-cost desoldering tool. The Soldavac is within the price range of everyone, yet it offers similar features of the industrial desoldering tools. The high vacuum desoldering action is accomplished by release of a spring loaded plunger. The tool is reloaded by pushing forward on the plunger tab until latched. To desolder,

simply position the tip of the loaded Soldavac tool lightly against a heated solder joint and depress the trigger lever. Molten solder is instantaneously drawn up into the barrel by the high vacuum stroke. The desoldering tool made from lightweight, durable plastic is easy to handle and it self-cleans the tip each time it is loaded. Retail price $2.95. Edsyn.

STEREO TUNER 714

Employs five gang tuning capacitor

Introduced is the Model AT-200U Stereo Tuner which incorporates a five gang tuning capacitor in its front end as well as three field effect transistors. The front end is designed with emphasis on sound quality, selectivity and sensitivity. This unit incorporates hybrid IC's and mechanical filters in the IF stage. It also has an active filter for sub-carrier elimination, a high-

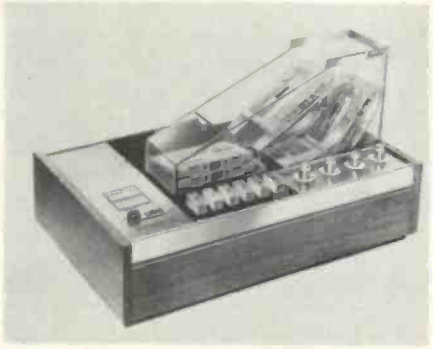


blend noise canceler circuit, and an adjustable FM separation circuit. TEAC.

CASSETTE CIRCULATOR 715

Ideal accessory for continuous play

A cassette "circulator" a snap-on device that gives continuous playback capacity to automatic cassette changers, is announced. The CC6 circulator—a simple but ingenious device with no moving parts—makes possible 12 hours of non-stop, no-repeat playback and then starts the cycle over again. It functions with four to six cassettes, automatically flips each for second-side play, and re-stacks the cassettes for playing again. A cassette moves into the changer's playing chamber and, when finished, is pushed forward by the next cassette. The fourth cassette nudges the first 'over the hill' and it slides down and back into the playing stack. Styled in tinted plastic and standing five inches high, the circulator is simply snapped on for instant use. It is compatible with Norelco cassette changer models 2401,



2401A, and 2502, as well as Bell & Howell models 332 and 337, and the Ampex Micro 90 and 95. List price is $19.95. Norelco.

TELEVISION/FM/AM RADIO 716

Rechargeable battery provides 3.5 hours of viewing

Introduced is the Pandora Model TR-425BA. At the touch of a button, a 5in. TV screen pops up from a streamlined carrying case. The unit is

crafted in midnight black with silver trim. It contains a built-in FM/AM radio—making it a complete portable entertainment unit weighing 12½ lbs. The colloid-type batteries fit inside the set but contains no liquid—the chemical is "suspended" in a colloid gell, with never a worry about leakage. The receiver features overnight recharging and provided 3.5 hours of viewing on a single charge. The battery has a life-span of more than 500 hours. The unit features up-front slide-rule tuning for UHF, an up-front 3½ in. dynamic speaker and personal earphone. The aluminized picture tube with the coil

heater insures long tube life. $179.95. Panasonic.

CASSETTE TAPE 717

Frequency response from 30 to 20,000 Hz

Introduced is a tape cassette called Super Dynamic SD tape. The cassette offers high fidelity reproduction claimed from 30 to 20,000 Hz, with a virtually flat response curve from 50 to 10,000 Hz. This is made possible by a new type of gamma ferric oxide developed especially for high fidelity reproduction. The tape features greatly improved signal-to-noise ratio; it also substantially reduces head wear. All remarkable properties of tape are based on a combination of new magnetic materials, a special binder system and coating technique as well as an exclusive surfacing process. The

new ferric oxide formulation employs a needle-like particle shape as compared to the rectangular shape of standard tape oxides. This permits eight times greater density of magnetic particles, improving resolution and reducing sound distortion. The new binder system reduces cross modulation and static charge. There is no shedding of magnetic coating, so drop-outs are eliminated. The thickness of the magnetic coating is controlled to .001 mm, resulting in low level fluctuations. The tape is packaged in the C-60. TDK.

718 CARTRIDGE TAPE RECORDER

Features hidden cartridge bin

The Bainbridge, Model RS-820S, 8-track stereo cartridge tape recorder with FM/AM and FM stereo radio is

introduced. It features a hidden cartridge bin and four full-range dynamic speakers with 32w of output. The unit

features solid-state design, ac bias and erase. An accidental-erasure guard stops the tape automatically at the end of the last channel. In the selection of FM stations, the AFC control locks in signals to assure drift-free reception. Sliding volume, balance, bass and treble controls are offered. Retail price $349.95.

BATTERY DISPLAY 719

Self service convenience saves space

Announced is a transparent plastic battery display which saves restocking time and counter space. At the same time it stimulates battery sales with self-service convenience. Impulse carded merchandise is held in removable side hangers. Batteries are gravity fed into position with every sale. Ideal dis-

play for high-traffic areas—reusable and an eyecatcher as a single display or side-by-side units. Stocks flashlight (both "C" and "D" sizes), penlight and transistor batteries. Burgess.

HEAD DEMAGNETIZER 720

Built into cassette cartridge

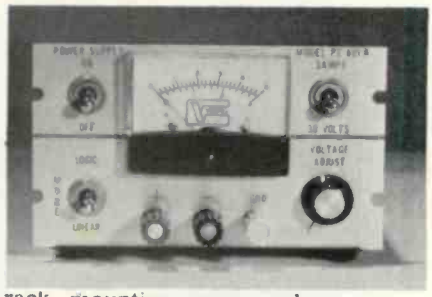
A demagnetizer which removes excessive magnetic buildup from cas-

sette-equipment heads is introduced. A flat, mylar-copper laminate lead wire permits closing the cover of the player. Other features include a pilot light and operation on standard current. The Model TD-10 lists at $8.30. Robins.

POWER SUPPLY 721

Solid-state construction

Introduced is a power source for almost any digital, linear or total system application. For digital application the Model PZ-801-A employs a high efficiency power conversion circuit to provide output currents to 5a or 25w from 0-25 volts. Regulation is claimed better than .2 percent and ripple less than 10mv. With the flick of a switch, the unit becomes a regulated (.1 percent) low ripple (1mv) 0-25v, 1a source for linear or general purpose applications. The unit features a 10-turn voltage control, rear panel remote sensing and programming, electronic current limiting, floating output, versatile bench or



rack mounting case, and one year warranty. Only silicon diodes, transistors and integrated devices are used. Price is $78. Viking.

ET/D NEWS OF THE INDUSTRY

Fairchild DuMont Announces Implosion Protected CRT

A computer readout CRT with implosion protection is announced by DuMont Electron Tubes, a division of Fairchild Camera and Instrument Corp.

According to E. W. Swenarton, division sales manager, this tube is certified to meet the Underwriters Laboratories, Inc. testing criteria for bonded frame picture tubes.

This tube, the DuMont Type KC2827P31M has been extensively tested for performance, life, and safety. The close spacing between operator and terminal in most applications dictate strict safety requirements. This tube is but one of a series of terminal oriented system display tubes that range in size from 2¾ by 3⅜ in. up to 16½ by 20½ in. with resolution capability up to 40,000 distinct spots per square inch of screen.

The tube can be mounted in any position and can be driven by highly efficient transistor and/or IC circuits. Design parameters include low heater power, zero power low voltage electrostatic focus and low magnetic deflection power. The small 20mm diameter neck contributes to the overall small size and performance. DuMont can design any size and shape CRT to meet your requirement of mechanical, electrical or safety designs. Price is under $40.00 for production quantities. Samples can be obtained in three to five weeks, ARO. Fairchild.

Color CRT Sales Up in 1969

Color television picture tube unit sales were up 1.3 percent to 6,255,000 units in 1969, according to figures released by the EIA Marketing Services Department.

Sales to the renewal market increased 19.3 percent to 765,000 units, while exports were up 54.9 percent to 175,000 units, EIA statistics show.

Unit sales of TV picture tubes were down 6.5 percent during 1969, totaling 11,232,000 units compared with 12,018,000 units in U.S. factory sales during 1968.

Monochrome TV picture tube sales amounted to 5,077,000 units valued at $80.5 million during 1969, a decrease of 14.7 percent and 9 percent respectively from unit and dollar sales during 1968. Dollar sales decreases were registered by sales to original equipment manufacturers, the renewal and export markets.

Belden to Expand Electric Cord Plant

Belden Corp. will expand its Electric Cord Products Co. manufacturing plant at Franklin, N.C. The announcement was made by Robert W. Hawkinson, president of the Chicago-based company.

He said a 17,000sqft addition will be constructed as part of the company's present 46,000sqft plant, which has been in production since 1966. "The expansion will increase Belden's cord manufacturing capacity by 25 percent at Franklin. Scheduled for completion in the third quarter of 1970, this major project reflects our confidence in the appliance cord market, particularly in the original equipment segment," Hawkinson said.

The expansion will add 50 to 60 employees to the Franklin plant's current employment of approximately 190.

The expansion is the second major capital expenditure announced by Belden. On March 3, the company disclosed plans to construct an insulation compounding facility adjacent to its Jena, La., plant. The automated, $3 million facility, scheduled for completion in the second quarter of 1971, will produce insulation used at the company's transportation products and electrical lead wire plant at Jena and at other company plants.

Belden's wire, cable and cord products are used in electrical, electronic, transportation and consumer markets. In addition to its plants in Franklin, N.C., and Jena, La., Belden has plants in Chicago, Richmond, Ind., and Pontotoc, Miss. A manufacturing subsidiary, General Wire and Cable Co., Ltd., has two plants in Cobourg, Ontario, near Toronto.

RCA Plans to Provide Service For All Makes of Television

RCA has announced plans for the establishment of a new subsidiary company to provide servicing of all makes of television sets and other home entertainment units.

Anthony L. Conrad, Executive Vice-President, Services, said the new company will operate independently of the RCA Service Company branches, which will continue to concentrate exclusively on the servicing of RCA products and Whirlpool appliances.

"The decision to service other brands was based on extensive internal studies and governmental agency consumer reports which indicated an expanding need for service in the entire consumer products industry," Mr. Conrad said.

The new company will be initially established in selected urban areas and gradually expanded to operate on a national scale. Present plans call for the first of the new service centers to be opened in the Philadelphia area by mid-year, with the San Francisco area listed for late September.

TV, Radio and Tape Equipment Have Record Sales Year in 1969

1969 total U.S. sales of consumer electronic products, including domestic label and foreign label imports, were released by the Electronic Industries Assn.'s Marketing Services Department. Television, radios and tape equipment sales hit all time highs. Phonograph sales were only slightly below their record year of 1968.

Total television sets sales were 13,307,889 compared with 13,211,206 sets sold in 1968, which was the industry's next best year. Color TV sales were 6,191,307 sets in 1969 vs. 6,213,347 sets in 1968, and monochrome TV 1969 sales were 7,116,083 sets vs. 6,995,736 sets in 1968.

Total U.S. radio sales passed the 50 million unit mark for the first time. Radio sales were up 9.6 percent in 1969,

ET/D NEWS OF THE INDUSTRY

totaling 51,352,742 units vs 46,832,140 in 1968, and personal radio sales of 39,413,857 units also was a record year—and radios with FM exceeded AM only radio sales for the first time ever. Auto radio sales of 11,938,885 units in 1969 were slightly behind the record 12,509,841 sold in 1968.

Phonograph sales of 6,320,248 in 1969 were slightly below the 1968 total of 6,494,612.

Although EIA's total U.S. sales figures for magnetic tape equipment (a category which includes reel to reel, cartridge and cassette units) are incomplete, tape recorder and cassette sales increased 24.3 percent over 1968—6,929,527 vs. 5,573,145. Also tape cartridge player imports doubled in 1969, indicating a record year in the entire tape equipment category.

Color TV Ahead Consumer Electronics Off

Distributor sales to dealers were generally off the October 1968 pace. However, color television, auto radio and portable and table phonograph year-to-date sales were slightly ahead of 1968, the Electronic Industries Assn.'s Marketing Services Department reported.

Distributor sales of color television sets to dealers were down 22.5 percent during October as compared with sales during the same month the year before. In October, 506,358 sets were sold to dealers, compared with 653,691 the same month last year, EIA reported. Color TV sales to dealers were 4,568,602 sets for the year-to-date, 1.4 percent ahead of the 4,507,537 sets sold in the same period in 1968.

Monochrome TV sales in October, at 442,161 sets, were down 17.7 percent from the 537,250 sets sold in the same month last year. Total TV sales to dealers, on a year-to-date basis were down 3.2 percent; 8,692,808 in 1969 to 8,977,045 sets the first ten months of 1968.

Total phonograph sales decreased 16.4 percent in October over the same month a year ago and is now 1.1 percent behind a year-to-date basis.

Total radio sales to dealers declined in all categories and are now running 6.6 percent behind on a year-to-date basis.

Essex Acquires Fort Wayne Tool & Die, Inc.

The acquisition of Fort Wayne Tool & Die, Inc., by Essex International, Inc., was jointly announced by Walter Probst, Essex chairman, and Richard G. Nill, president of Fort Wayne Tool & Die.

The firm joins Essex as a wholly owned subsidiary of the company and will continue its operations on an independent basis under Nill's direction. All production and sales personnel of Fort Wayne Tool & Die will be retained and all manufacturing processes will continue at its Engle Road plant in Fort Wayne.

Founded in 1940, Fort Wayne Tool & Die is a pioneer innovator and manufacturer of the automatic stator winding equipment used by electric motor manufacturers.

The acquisition was described by Essex as part of the company's long standing program of servicing the total electrical industry in depth with raw materials, components, finished products, as well as with production oriented equipment.

Essex International, Inc., is a broadly diversified producer of electrical products and controls, metal products and plastics. The firm operates 96 plants in the U.S. and Canada through 10 manufacturing and marketing divisions.

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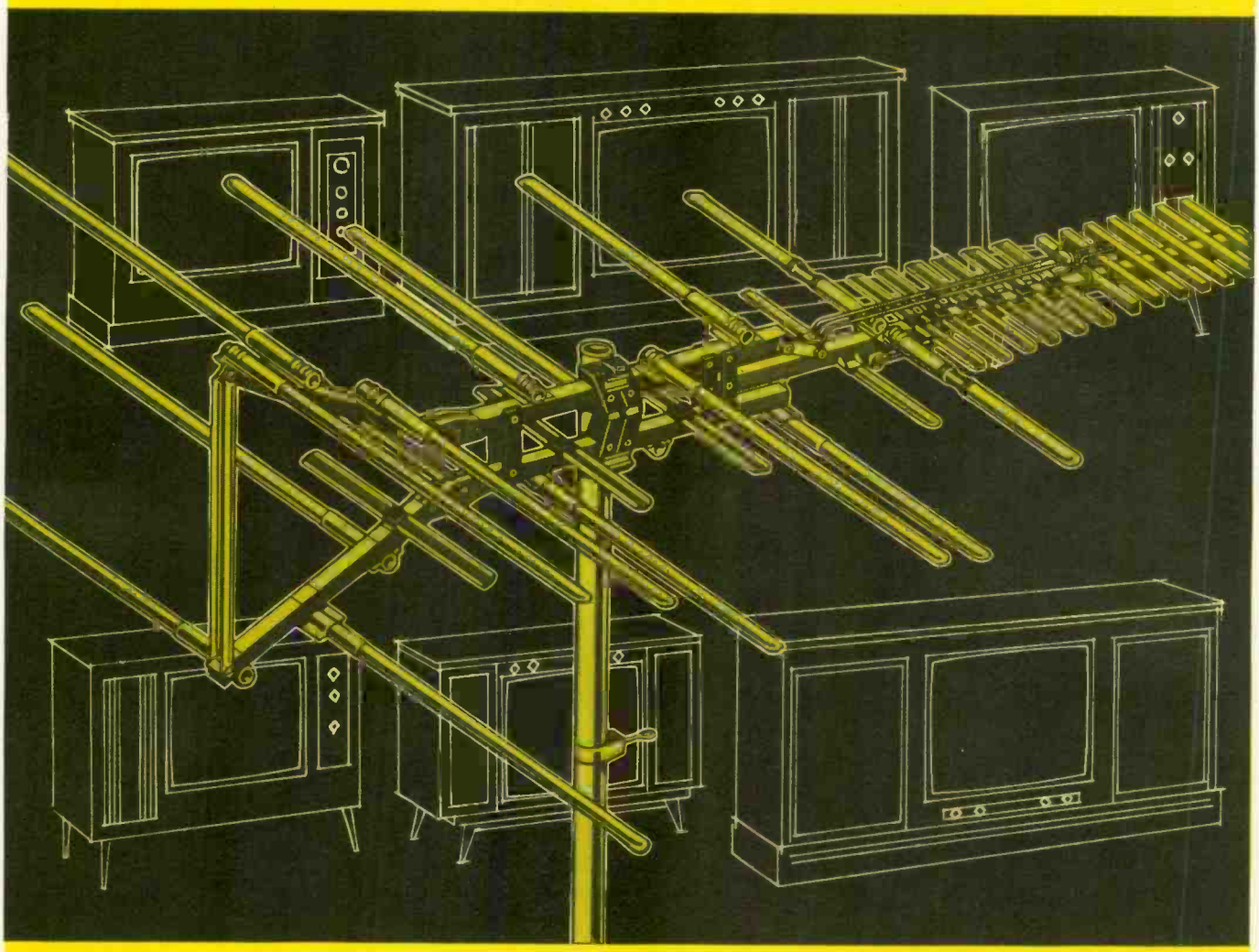

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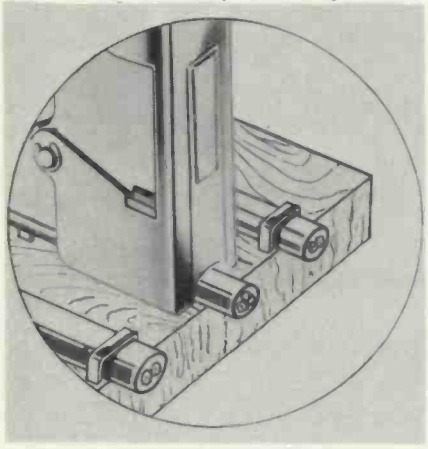
STAPLES 722

Chemically coated to improve holding power

Announced is the development of a special chemical coating process, designed to greatly improve the perform-



ance and holding power of their T-75 Staples.

The new staple, to be known as "Grip-Tite," is for use in the T-75 Staple Gun Tacker, a model specially designed for fastening any wire or cable up to ½in. in diameter.

Reportedly the improved staple drives deeper, penetrates more flush and provides many times the gripping power of plain staples without this special chemical coating.

The staples are available in 9/16, 5/8 and 7/8in. leg lengths, each size individually boxed. Arrow.

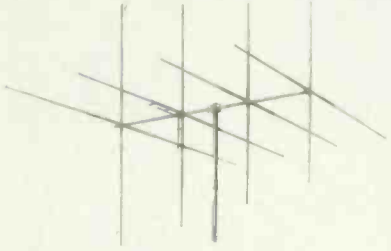
CB ANTENNA 723

100w of power from a 5w CB set

Announced is a CB base station called the Boss 404.

The antenna uses yagi beam design with tapered elements to focus signal into a narrow beam, only 52deg at the half power points. Operating in both the horizontal and vertical modes, the antenna reportedly will produce a signal with an effective rated power of 100w from a 5w CB set.

The absence of gimmick wires which distort radiation patterns permit this antenna to achieve optimum spacing with a 17ft boom. The antenna can be rotated with a low-cost rotator instead of the expensive units generally required for ham antennas with similar performance. Aircraft aluminum construction with heat-



treated boom and elements allows the antenna to withstand 90 mph winds.

The optimum spaced elements produce maximum front-to-back and front-to-side ratios greatly reducing interference. Precision horizontal and vertical gamma-match feeds, identical to those used on A/8 ham antennas, produce a VSWR of less than 1.5 to 1, and 1 to 1 if the user likes to fine tune.

The antenna lists for $99.95. Antenna Specialists.

GOZINTA 724

Cleans controls without removing chassis

A tool designed for effective cleaning and lubricating controls on TV and auto radios, from the front panel is introduced.

It is manufactured from an aluminum alloy with female threads machined on one end. This adapts to the bushing of the control after the knob is removed. A plastic valve extension is contained on the other end, which will pressure-fit the usual aerosol valve of contact cleaners.

Pressure on the valve will force-clean the control. An adapter is supplied for car radios, which eliminates the necessity of removing the radio from the car.

The Gozinta, Model No. WJL and car radio adapter is packaged with a

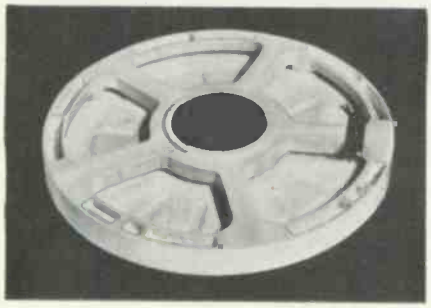
three-ounce aerosol can of Lubrite. Dealer price is $2.67. Workman.

SPEAKERS 725

Round design utilizes flat plastic panel

Announced is the addition of a series of flat plastic speakers. Designated as the "Roly-Poly" series, the speakers feature a round thin silhouette construction which permits exact RETMA replacement of the cone speaker equivalent. Constructed entirely of polystyrene material, they offer the advantages of wide range hi-fi reproduction, low distortion, bi-directional wide angle dispersion and high sensitivity. Light in weight, impervious to moisture and climatic conditions and with minimum depth, the speakers are ideal for all hi-fi applications, public address, industrial, automotive, build-in, and replacement service.

A typical unit in the series is the Model RP8. Diameter of this model is 8in. and overall depth is 1in. Frequency response is 40Hz to 20,000Hz, and power handling capacity is 10w RMS, 20w peak. Sensitivity is 90dB/M for one watt electrical input. Directional characteristics are essentially



cardioidal with bi-directional dispersion. The unit uses an electromagnet movement and standard impedance is 8Ω although other impedances are available on order. The speaker can operate at full ratings over the temperature range of −20°F to +175°F. Weight is 1 1oz. Magitran.

VIDEO/RF SELECTOR—CONTROL CENTER 726

No external power is required

The Model CCV3, a three-position control center that has many uses in video or RF layouts is introduced.

Typical uses allows control of three TV cameras and a monitor, or three monitors and one camera; or for switching low-power RF antenna systems.

The "push-ON" and "push TO RELEASE" switches allow the user to optionally select any of the equipment described.

The unit uses standard "M" type (SO-239) connectors on input and all outputs. The easy access connectors are located on the rear of unit. No external power is required for operation. No internal resistor is used to

affect impedance matches. Cross talk between adjacent channels is negligible.

It has a rugged construction and decorator styled to be placed with any of the newest video and audio equipment. Size: 5⅝ in. x 2⅛ in. x 3 9/16 in. Priced at $19.95. Alcoswitch.

DIGITAL MULTIMETER 727

Low voltage sensitivity of 1μv

Announced is the accuracy of a digital display, coupled with unmatched low-voltage sensitivity of 1μv per digit, is available for the first time in a medium-priced 3½ digit dc multimeter.

With its wide range of voltage, resistance, and current measuring capability, the Model 160 reportedly offers as much dc versatility as is likely to be useful in any field other than basic research.

DC voltage range of this instrument is reportedly ±1μv per digit on the most sensitive range to ±1000 volts maximum, in seven decade ranges. Also, an ac/dc probe is available. Accuracy, over all ranges, is ±1 digit, or ±0.1 percent of the reading at any range.

Instrument circuitry is designed with a buffer amplifier at the front end instead of the input chopper found in many other meter circuits. The input impedance is 10M on all but its lowest range, where it is 1M. Use of the buffer amplifier also makes it possible for the unit to drive a recorder. The analog recorder output jack is located on the back panel of

the instrument. Recorder output is ±1 volt, at up to 1ma.

Normal-mode rejection characteristics are excellent, providing a rejection ratio of 80dB at a voltage of line frequency or twice line frequency on the most sensitive range. This value decreases to 60dB on 1kv P-P or higher ranges. Common-mode rejection is greater than 140dB, or up to 1kv P-P.

Settling time to rated accuracy is 2sec.

The unit spans a resistance range from the lowest reasonable values that can be measured using two-terminal leads (0.1Ω per digit), to almost open-circuit readings (2,000M, full scale), in eight decade ranges. Accuracy is claimed within ±0.3 percent of readings, or ±1 digit on the 100Ω to 1M range, decreasing to ±10 percent on the 100M range. The 1,000M range, intended for relative resistance measurements only, gives ±50 percent accuracy, satisfactory for these purposes.

Operated as an ammeter, it is capable of excellent accuracy in measuring current all the way from well down in the field-effect transistor leakage current range, up to 2a—as much dc current capability as is likely to be of interest in normal bench use. Scale range is ±0.1na per digit to ±2a full scale, in eight decade ranges. Accuracy is ±0.2 percent of reading, or ±1 digit for all ranges. Input resistance is 100K on the 0.1μa range, decreasing to 0.1Ω for the 1a range.

Temperature stability is reportedly ±0.3μv per degree centigrade, ±1μv per day after a 30-minute warm-up. Temperature extremes will not produce a zero shift down through the 100mv range. Even on the most sensitive range, in the typical air-conditioned lab, no more than a one digit zero shift (1μv) will occur in the course of an average day.

A rear panel switch permits a choice of grounded or floating input. Resistance between circuit ground and chassis ground is greater than 100M, shunted with a 0.01μf capacitor. Circuit ground may be floated up to ±500v with respect to chassis ground, for the most exacting measurements.

Function and range selection positions on the single knob control are arranged for maximum ease of operation. Voltage and resistance reading sectors, usually the most frequently used, are adjacent.

The 160 operates on 105/125v or 210/250v, 50 or 60Hz and is therefore usable nearly anywhere in the world. Power consumption is 15w. The unit measures 3½ x 8¾ x 11in. and is priced at $545. Keithley Instruments.

VTVM 728

Large meter with mirror scale

Introduced is the Model 1700C, an advanced design VTVM that will meet the technician's most rigid requirements. It has a large 6-in. wide-view meter, mirror scale, with highest quality components utilized throughout. Wide frequency response on ac voltage for compatibility with color TV

servicing. FM multiplex troubleshooting and general industrial application. Double jewelled, inspected D'Arsonal

movement with individual side and tail weights.

This VTVM weighs 5lb and is 8½ x 6 7/16 x 4½in. Priced at $49.95, wired. Kit form $39.95. Mercury.

VIDEO DISC RECORDER 729

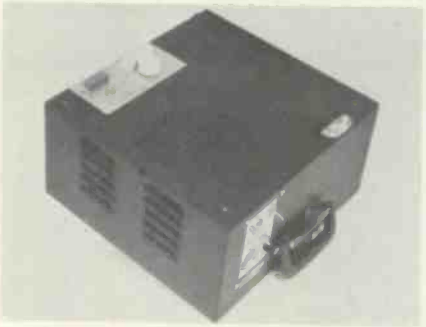
Plugs into CCTV or monitoring system

A low-cost, instant playback, slow motion and stop action video disc recorder which can be plugged in to any CCTV or video monitoring system is introduced.

Called the 1310 Video/Disc Recorder, the unit records a 10 or 20sec segment, either direct from camera or from a videotape recorder, for immediate playback at speeds adjustable from 2 frames per second to 60 frames per second. During playback, any one of 60 frames can be stopped and held indefinitely for study or analysis. The recorded segment can also be transferred back to the videotape recorder to provide a video program combining "live action," slow motion, and stop action.

The unit has been thoroughly field tested and features pushbutton controls designed so that if the operator pushes the wrong button, or any wrong sequence of buttons, the operation of the recorder will not be affected.

Applications for the recorder are seen in instructional systems, security and surveillance, CATV, process control, Q.A. monitoring, equipment and materials testing, tape recorder checkout, and other applications where the



addition of instant playback, slow motion and stop action increases the versatility of CCTV and video monitoring systems.

Weight of the recorder is 34lb com-

ET/D NEW PRODUCTS

plete, and all components are housed in a portable case. Dimensions are 8 in. H x 13¼ in. W x 14½ in. D and power equipment is 115vac, 60Hz. Newell.

FM ATTENUATOR TRAP 730

Attenuates FM band by 20dB

A MATV trap which attenuates the entire FM band by 20dB is introduced. Reportedly the first unit of its kind, the new FM attenuator trap is designed for use in broadband MATV systems. Strong FM signals are attenuated before they are fed from the antenna to the headend amplifier to eliminate cross modulation in the low VHF band (Channels two to six) and second harmonic beats in the high VHF band (Channels seven to thirteen).

Designated Model 8488, the unit is compact, rugged and easy to install and designed to pass all VHF channels without attenuation.

It provides a 20dB attenuation across the entire FM band and channel six is reportedly virtually unaffected.

The trap has less than 1.5dB attenuation at 88MHz, which is the edge of channel six. VSWR is good at 1.2 to 1.

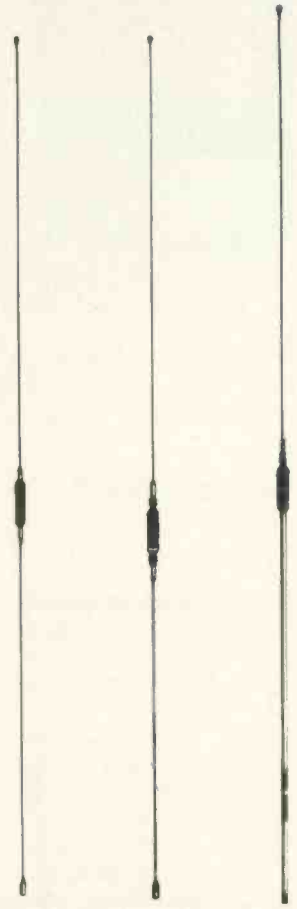
While the trap does not pass UHF frequencies, it can be used in an '82' channel system. It is simply installed directly before the VHF input to the head end amplifier. List price $12.50. JFD.

CB MOBILE ANTENNA 731

VSWR of 1.5 to 1 or better

Introduced is the Lancer 500 Series, designed for the CB'er looking for the classic features, styling and performance previously available only with much higher priced mobile antennas.

Each of these antennas (Models 500A, 500B and 500C) is designed with a deluxe high "Q" coil resulting in reduced mechanical height while reportedly maintaining power capa-



bility up to 500w. Each high impact, solid-state, polystyrene coil is permanently sealed against moisture. Models 500B and C feature a machinated capacity coupler that works with the loading coil to extend the skin area of the radiator for increased antenna efficiency.

An exclusive guying device located just above the coil reportedly prevents antenna lay-back at top highway speeds. The antenna is factory pretuned to minimum VSWR of 1.5 to 1 or better with feed point impedance of 52Ω and the ¾ in. critical adjustment may be made after mounting.

For lowering, the Model 500C has a break-over (hinge) feature so that antenna may be lowered and secured from either trunk or bumper mounting position.

Each antenna is topped with a static ball which reduces corona effect and prevents loss of power.

Antennas come complete with top quality, corrosion-resistant materials, along with detailed, easy-to-follow installation instructions. Mosley.

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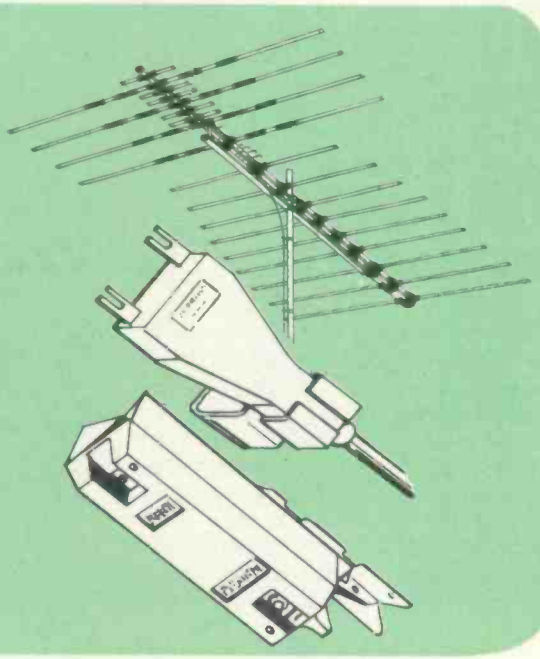

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Silicone Products 400

A 44-page book lists the complete line of silicone industrial products. The book is divided into four sections —RTV silicone rubber, greases and compounds, fluids, and insulating varnishes. Each section contains a product and property listing, suggested application techniques and recommended procedures for handling specific materials. The silicone grease and compound section also has a table of Federal stock numbers that correspond with GE's product numbers. General Electric.

TV Coaxial Cable 401

An illustrated data sheet on coaxial cable for UHF/VHF home color television reception is published. This sheet describes the advanced design of Dura-Color RG-59/U type cable, part no. 5750. Dura-Color is 100 percent shielded, the shield consisting of a mylar film coated on both sides with aluminum foil and four stranded tinned copper drain wires for conductive continuity. This type of shield is electrically more stable and is highly resistant to moisture. The cable accepts standard F type 59/U connectors. The low loss capability and other outstanding characteristics are described in illustrated form. Also included are descriptions of two 75Ω Dura-Color kits, one for UHF and VHF reception and the other for UHF or VHF reception. Columbia.

Product Testing 402

"You've Seen It a Million Times," a leaflet explaining the significance of the Underwriters' Laboratories label, is being offered free of charge to interested parties. Large quantities are available to organizations and firms for distribution to their employees or customers. The brochure is designed to acquaint the consumer with some basic facts about Underwriters' Laboratories, Inc., and the testing activities behind the familiar UL seal. UL.

Tape and Accessories 403

An illustrated, multicolor, 40-page catalog—a complete guide to cassette, cartridge and reel-to-reel tape and audio accessories is published. The catalog is not only the biggest ever issued in its 15-year history, but it also represents the broadest line of comparable products available from any one manufacturer. In addition to cassette, cartridge and other tape-recorder products in various sizes and price ranges, the catalog incorporates phono accessories, patch cords, adaptors and XL and XLP audio connectors. A front-page index and parallel presentation make it easy to find any of the hundreds of individual products. These range from brushes to splicers, and from all-U.S.-made cassettes and other tape formats to such amateur and professional electronic devices as demagnetizers. Robins.

Wire, Cable and Electronic Products 404

An illustrated 63-page catalog is available featuring wire, cable and electronic products. Complete and extensive delineation has been made regarding all types and construction of wire and cables used by the communications trades. Pictorially depicting wire and cable as well as electronic products, this IDS/MATV equipment catalog has a handy thumb-thru index as well as a complete alpha-numerical index. Vikoa.

Solid-State Components 405

Published is a new short form catalog containing: Junction FETs, MOS FETs, Dual FETs, Multi-Channel FET Switches, Current Limiters, Voltage Controlled Resistors, Digital Integrated Circuits, Linear Integrated Circuits, Integrated Drivers, and Driver/Switch Combinations. Siliconix.

Capacitors 406

A line of welded-construction, nonpolarized capacitors are added to the expanding variety of aluminum electrolytic capacitors. The new units, type TNPW, have welded connections joining the risers, and external leads assure a low dissipation factor and freedom from intermittent or open circuits. They offer a complete range of capacitance values from 1.0 to 100μf and are available in voltages of 25, 35 or 50v. Price: under $.10 to $.40 each, depending on type and quantity. The new capacitors are fully described in I.E.C. Capacitor Bulletin EC81. International.

Test Instruments 407

A test equipment catalog (Bulletin 2080) which introduces five new instruments and gives complete operating specifications for equipment serving needs for industrial electronic and electrical testing including radio and TV servicing, communications, automotive, air conditioning, refrigeration and heating is available.

The Model 202 ACCU-LOG is the first VOM with maximum accuracy anywhere on a quasi-logarithmic scale. The logarithmic portion of the seven-inch scale gives consistent percent of reading accuracy, while the linear portion permits easy zero-adjust.

Model 603 portable chart recorders are available in ac voltage, ac current, dc voltage and dc current measuring ranges. Other special features including a 110vac event channel, pressure sensitive recording paper and four built-in, switch selectable chart speeds, make this a useful instrument for monitoring power consumption or voltage fluctuations.

Two multi-testers (Models 256, 257) measuring voltage, current, capacitance and resistance, a current leakage tester (Model 229) and a solid state VOM (Model 313) round out the list of new items in Bulletin 2080. Simpson.

Electronic Electrical and Hobbyist Books 408

The 1970 catalog describing over 125 current and forthcoming books covers the following subject areas: Schematic/Servicing Manuals; Broadcasting; basic technology; CATV; electric motors; electronic engineering; reference; television, radio and electronics servicing; audio and Hi-Fi hobby and experiment; test instruments and transistors. Among the new and forthcoming titles featured is the revised edition of the "Tube/Transistor Substitution Guide." Tab Books.

Sub-Miniature Indicator Lights 409

The 56-page Selector Guide aids in the selection and procurement of more than a million and a half indicator lights, readouts and illuminated push button switches. Data is given in illustrated sections and each section is devoted to indicators by size (Sub-Miniatures, Miniatures, Large) or by product groupings. Separate sections of the guide are also devoted to illuminated push button switches and readouts. Four indexes, including one with military cross-references, assist the user in obtaining the desired information. Dialight.

Tools 410

A 24-page, fully illustrated catalog offering several new, unusual and extremely useful hard-to-find tools is available. The catalog contains precise and detailed descriptions and applications of each tool in this unique collection. The tools are rarely sold by industrial distributors or stores. Among the many new items offered are tungsten carbide saw blades, miniature riffler files, torch lamp, miniature screws, nuts, bolts, washers, stainless steel pliers and hard chromed needle files. Also included are wood

working tools, electronic tools, jewelers' tools, diamond pencil and glass cutter, unusual solders, rust remover, hard-wire cutters, glass drills plus scores of other versatile hand tools and small power tools. Brookstone.

Miniature Lamps 411

A 21-page catalog containing valuable basic design information, technical discussions of the various parameters involved in lamping and a useable cross reference guide to lamp substitution is available. The catalog features a revised layout of technical data on each lamp, giving the all-important design voltage for each lamp first, allowing the engineer to tailor his selection to the voltage required. The technical discussion section of the catalog will serve as a valuable piece of reference information for the engineer working with lamps. Chicago Miniature Lampworks.

DEPTH FINDER . . .

continued from page 63

lamp can be simply and quickly installed in the same clips after removing the defective lamp.

The Heath MI-29 maintenance provides for cleaning the slip-rings and in addition has a motor speed adjustment. The slip-rings can be occasionally cleaned using lighter fluid or other solvent. The service manual also states that if, after long periods of use the motor governor no longer maintains the correct speed, it may be necessary to clean the governor contacts. This simply involves removing the small piece of vinyl tape covering the access hole on the motor housing and applying a couple of drops of good contact cleaner or solvent.

The motor speed adjustment on the MI-29 is more critical and should not be tampered with unless you have checked all other possibilities for motor speed variation. The accuracy of the unit depends on the motor speed. If the motor speed is at fault, remove the vinyl tape covering the access hole located on the motor housing. Rotate the motor by hand and find the adjustment screw in the hole. Place the transducer in water with a known depth, then turn the unit on and note the reading. Turn the indicator off and turn the adjustment screw very slightly. Take another depth reading and keep re-adjusting the unit until it reads the correct depth.

GENERAL HINTS

When installing or repairing these instruments, keep in mind that the transducer is a delicate part of the unit and must be handled with care. All of these units operate from battery-power and any deviation from normal operation should first lead to a check of the battery condition. Depth accuracy is determined by the speed of the motor, which is also determined by the condition of the battery. Noise is one of the depth-finder's worse enemies and shows up as intermittent flashes on the indicator. Noise will be random, in other words, at no special depth. This could mean ignition shielding of some type is required. Basically, the depth-finder units are easy to install and service providing you understand their operation. It could be a comfortable and profitable introduction into marine electronics for your shop.

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