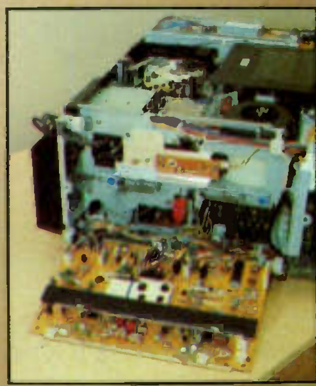
April, 1978 □ $2.25

Electronic Servicing

A HOWARD W. SAMS PUBLICATION

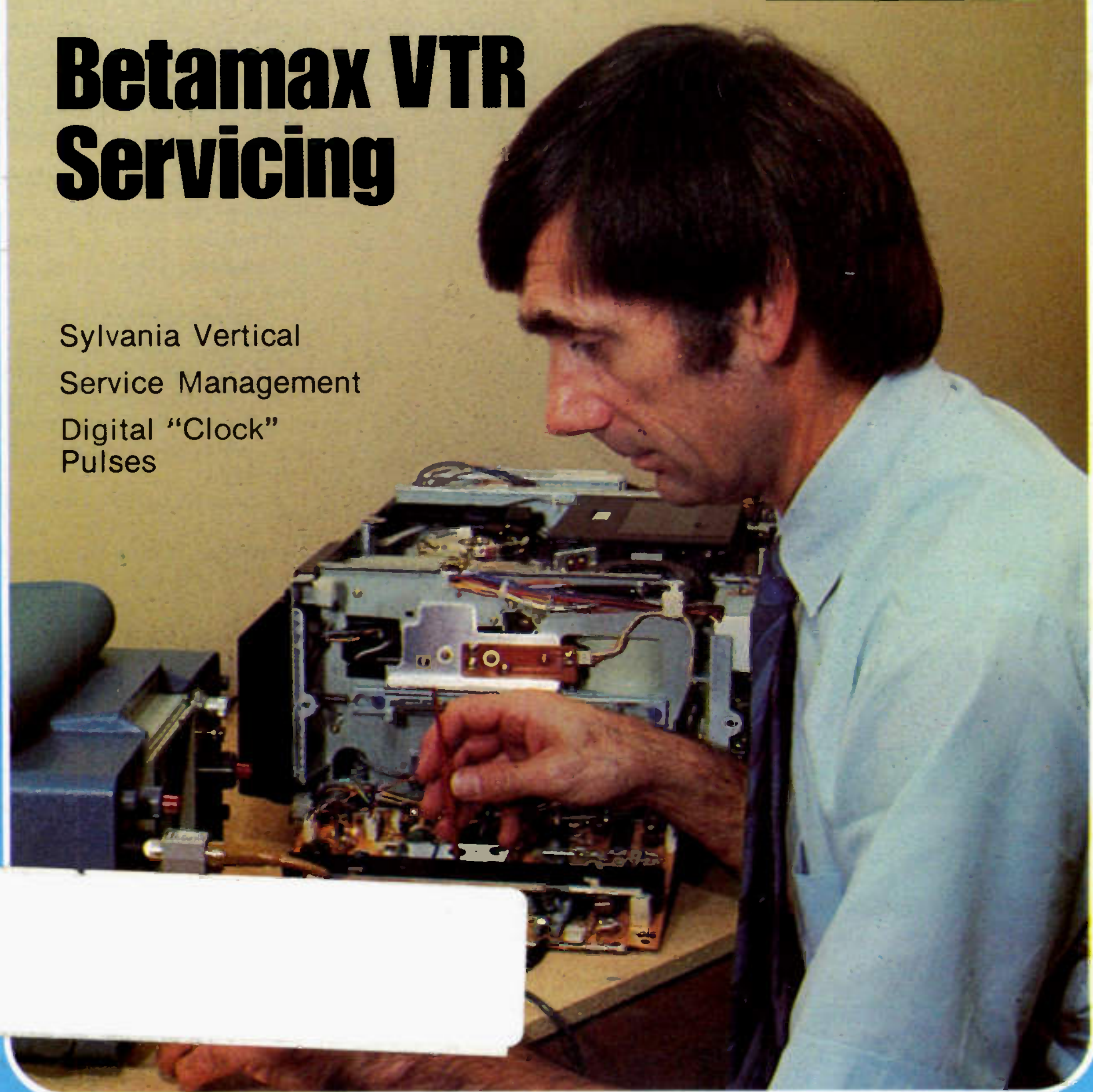


Betamax VTR Servicing

Sylvania Vertical

Service Management

Digital "Clock" Pulses



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Electronic Servicing®

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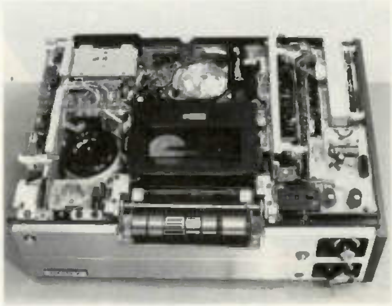

About the cover—Harry Kybett, author of the Betamax series, is pictured checking one of the HVCR machines. Other views of the Betamax are shown, also.

DEPARTMENTS

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Electronic Servicing

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2SA 473	.70
2SA 483	3.00
2SA 484	2.50
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2SA 490	.90
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2SA 497	1.60
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2SA 509	.70
2SA 525	.70
2SA 530	1.30
2SA 537A	2.25
2SA 539	.59
2SA 545	.59
2SA 561	.59
2SA 562	.59
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2SA 640	.59
2SA 643	.70
2SA 653	2.80
2SA 659	.59
2SA 661	.70
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2SA 666	.70
2SA 672	.70
2SA 673	.70
2SA 678	.70
2SA 679 SUB 2SA 744	
2SA 680 SUB 2SA 744	
2SA 682	1.50
2SA 683	.70
2SA 684	.70
2SA 695	.70
2SA 697	.70
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2SA 705	.70
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2SA 715	1.40
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2SA 725	.59
2SA 726	.59
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2SA 756	3.70
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2SA 844	.59
2SA 847	.59
2SA 850	.59
2SA 872A	.59
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2SB

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2SB 55	.59
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2SB 77	.45
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2SB 175	.45
2SB 176	.45
2SB 178	.70
2SB 186	.45
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2SB 337	1.60
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2SB 368	2.15
2SB 379	1.10
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2SB 405	.59
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2SB 415	.59
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2SB 435	1.40
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2SB 537	1.60
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2SB 541	4.40
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2SB 557	3.40
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2SB 564	.70
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2SB 600A	7.00

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2SC 184	.59
2SC 781	.59
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2SC 460	.59
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2SC 1908	.59
2SC 1909	3.90
2SC 1913	1.20
2SC 1945	5.60
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2SC 1973	1.10
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2SC 2076	.59
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2SC 2092	3.90
2SC 2098	4.90

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2SD 77	.90
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2SD 141	1.40
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2SD 143	2.80
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2SD 180	2.50
2SD 187	.59
2SD 188	3.00
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2SD 205	1.40
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2SD 218	3.40
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2SD 288	1.40
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2SD 314	1.20
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2SD 325	1.10
2SD 330	1.00
2SD 341	5.60
2SD 350	5.90
2SD 352	.90
2SD 356D	1.10
2SD 357D	1.00
2SD 358	1.30
2SD 359	1.00
2SD 360	1.20
2SD 361	1.00
2SD 370 SUB 2SD 427	
2SD 371S	2.80
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2SD 388A	4.40
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2SK 58	3.60
2SK 61	1.40
2SK 68	1.30
3SK 22Y	2.55
3SK 35	2.25
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3SK 41	2.50
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3SK 48	5.90
3SK 49	2.50
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AN 214Q	3.00
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AN 234	4.90
AN 239	7.00
AN 240	2.15
AN 241	2.80
AN 245	4.90
AN 247	4.40
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AN 274	3.40
AN 277B	2.40
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AN 315	3.70
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AN 348	3.70
AN 362	3.00
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BA 521	3.70
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HA 1159	5.80
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HA 1312	3.90
HA 1322	4.40
HA 1339	4.40
HA 1339A	4.40
HA 1342A	4.40
HA 1452	3.40
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LA 1201	2.50
LA 1221	2.80
LA 1364	4.40
LA 3300	3.00
LA 3301	3.00
LA 4030P	3.40
LA 4031P	3.00
LA 4032P	3.40
LA 4051P	3.70
LA 4400	3.70
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M 5115PR	4.90
M 51513L	4.90
M 5152L	2.50
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M 5320 DP	2.25
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M 54730 P	8.80
M 53393	7.60
STK 011	7.60
STK 014	9.50
STK 015	6.60
STK 016B	8.50
STK 022	11.00
STK 032	14.00
STK 435	8.50
STK 437	9.80
STK 439	11.00
STK 502	8.80
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TA 7027M	3.70
TA 7045M	3.00
TA 7054P	2.50
TA 7055P	3.00
TA 7060P	1.60
TA 7061AP	1.90
TA 7062P	1.90
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TA 7066P	2.00
TA 7074P	4.90
TA 7075P	4.90
TA 7076P	4.90
TA 7089P	3.00
TA 7092P	4.90
TA 7102	5.80
TA 7106P	4.90
TA 7108P	1.90
TA 7109P	3.40
TA 7120P	1.90
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TA 7122AP	1.90
TA 7124P	1.60
TA 7129P	1.90
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TA 7146P	4.20
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TA 7159P	2.50
TA 7200P	4.60
TA 7201P	4.60
TA 7203P	3.70
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TA 7310P	3.95
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TA 8005P	5.80
TA 78012M	6.60
TA 78012P	5.80
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UPC 555H	2.25
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UPC 577H	2.25
UPC 592HZ	1.60
UPC 1001H	4.90
UPC 1008C	7.00
UPC 1016C	3.00
UPC 1020H	3.70
UPC 1025	3.40
UPC 1026C	3.70
UPC 1032	2.25
UPC 1156	3.70
UPC 1152H	3.40
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PLL 02A	8.80
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IS 953	.25
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IS 1209	.45
IS 1211	.45
IS 1555	.25
IS 1588	.25
IS 1885	.25
IS 2076	.25
IS 2093	.45
IS 2473	.25
IN 34	.25
IN 60	.25
10D1	.40
10D10	.60
VD6B	.40
VD6C	.40
WZ-050	.45
WZ-052	.45
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news of the industry

PTS Electronics has relocated its Syracuse Servicenter in a new and larger facility at 315 North Geddes Street. Melvin F. Burns will continue as general manager.

Frigidaire has introduced an electric range with solid-state controls, and 25 refrigerator models with microprocessor-controlled automatic ice makers. *Retailing Home Furnishings* reports that the refrigerators require 20% less electrical power.

Magnavox has halted production of dedicated-chip video games. According to *Electronic News*, the company will be marketing only a high-end programmable unit by year's end.

Alps Electric, a component manufacturer, plans to produce a color home video camera which could retail for less than $833. *Electronic News* quotes an Alps spokesman as saying that the color camera will have a single vidicon tube and a built-in power supply.

By June of 1977, 18% of the U.S. households owned CB radio equipment, according to an FCC market-research study of personal radio services. The study estimated that the CB market might grow by 40%, if there are no major changes in the marketing situation.

The FCC received almost five million CB radio-license applications last year, making 1977 one of the busiest years for CB licenses.

Canadian consumers have been warned that the sale of new 23-channel CB radios is illegal in Canada as well as in the United States. The Department of Communications in Ottawa, Canada has alerted Canadians that some of the CB equipment banned in the U.S. might be offered for sale there.

Transcutaneous electronic nerve stimulators (TENS) may benefit millions of Americans suffering from pain. *Electronics* magazine reports that about 40 companies are manufacturing the devices which are attached to the skin and emit signals which relieve pain. It is not known why the pain is relieved, for the devices are merely pulse generators, with variable pulse widths, amplitude levels, and repetition rates that can be adjusted by the patient.

Zenith plans to replace any of the "safety" capacitors that have not yet been removed from 500,000 color TVs. According to *Retailing Home Furnishings*, if the capacitor has not already been replaced, Zenith will pay for the capacitor and the labor.

Zenith disclosed during a recent national distributors meeting that the company has decided to produce TV receivers for K-Mart, according to an item in *Retailing Home Furnishings*.

Color TV sales to dealers increased by 11.4% in February of 1978, compared with the same month of 1977, according to the EIA.

continued on page 6

For More Details Circle (8) on Reply Card

continued from page 4

Sony has announced a prototype color video camera which uses a charged-coupled device (CCD) to replace the camera tube, The price in late 1979 is expected to be between $450 and $850.

The U.S. Coast Guard has selected CB radio channel 9 as the official channel it will monitor with marine radio guards at its search-and-rescue stations throughout the United States. This will provide an alternative means of alerting the Coast Guard to boaters in distress.

Merrill Lynch Government Securities Company is using General Electric large-screen TV projectors to display up-to-the-minute summaries of all issues traded at the New York City office. Nine 5-foot, 4-inch by 4-inch screens, located at one end of the trading room, display the details of 432 issues formerly shown on conventional wall boards in the old trading room.

Matsushita has introduced in Japan a phono player that broadcasts stereo music over an internal FM transmitter. The Japanese price is $137. Any number of receivers can listen to the one transmitter within about 15 feet for noise-free stereo, or about 90 feet for monaural.

RCA has introduced four 13-inch color TV receivers, listing from $299 to $329. At the same time, the 15-inch models have been discontinued. This follows the trend for installation of small-screen color receivers in many areas of homes. Jack Sauter, vice president of marketing, has been seen with a lapel button saying, "first is better the second time around." There is speculation that the button relates to the Trendex fourth-quarter figures showing RCA with a 0.1% lead over Zenith—the first time RCA has been ahead of Zenith since 1972.

The new Magna-Vision TV projection television system not only shows a color picture on a 6-foot screen, but also has at the rear a separate 5-inch B&W monitor screen. The two pictures can come from separate channels, so the viewer can watch the projected program of his choice while occasionally observing sports or other special events on the small screen, reports *Retailing Home Furnishings.*

General Electric reported more than one billion dollars in profit from 1977 sales of about $17.5 billion, a new record.

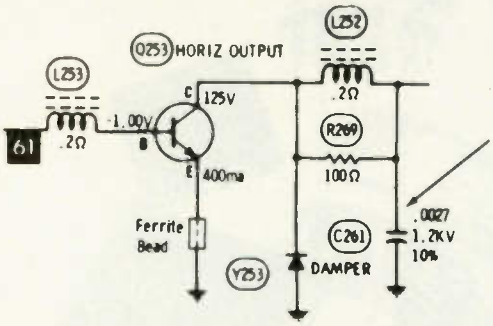
NARDA (National Appliance and Radio-Electronic Dealers Association) has passed a resolution asking distributors and suppliers to show full information about dealers costs on their price sheets, reports *Retailing Home Furnishings*. Jules Steinburg, NARDA executive vice president, is quoted as saying that his members don't know what a competitor is paying for the same merchandise, thus creating unfair competition.

Hitachi recently unveiled a new videotape recorder, model VT 4000. The unit contains 15% fewer discrete components than current VTRs on the market. It will sell in Japan for about $983.

Sound but no raster
General Electric UA (Photofact 1353-2)

Because of the lack of a raster, I started to look for a defect in the horizontal-sweep circuit. Resistors R264 and R265 showed signs of having been overloaded. According to my ohmmeter, R264 was open and R265 had changed resistance.

The horizontal oscillator, yoke, and flyblack appeared to be okay, but the horizontal-output transistor (Q253) was shorted. I disconnected C261 (.0027) and gave it a quickie test by watching for the bounce of the ohmmeter pointer. It charged normally.



I installed two new resistors, and replaced the output transistor, then applied the power. There was no rustle of high voltage and no raster. With the power off, I checked the output transistor again, and found it was shorted.

When I rechecked all of the sweep components, I found that C261 was open. This time, after I had soldered-in a new capacitor, the raster and picture came on with the power. Evidently, the capacitor was intermittent.

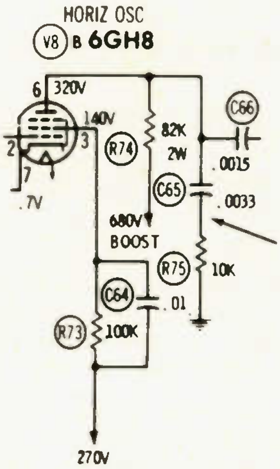
John Kelly
Sardis, Mississippi

Editor's Note: Capacitors of the .0027 to .0082 values that are wired from collector-to-emitter of horizontal-output transistors determine the peak voltage developed by ringing during the retrace time. Therefore, the capacitance value is very critical. Smaller values increase the pulses at the transistor and the amount of high voltage, while larger values reduce the high voltage. If the capacitor opens, the output transistor is destroyed immediately. **Use only the correct value.**

Unstable horizontal
Zenith 14B38/Z B&W (Photofact 1156-3)

When the TV receiver was switched on and a raster first appeared, a parasitic oscillation in the horizontal sweep would produce an unstable "hour-glass" pattern on the screen.

By careful adjustments of the AGC and the horizontal-hold controls, I could obtain a picture. However, when the TV was turned on next time the parasitic and critical operation returned.



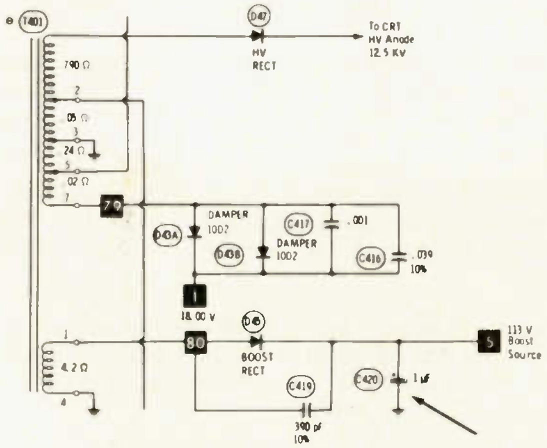
After much time spent in testing individual components of the horizontal-oscillator circuit, I found leakage in C65 and noticed that the case was cracked. Installation of a new .0033 capacitor cured the instability.

Charlie Jackson
Buckner, Illinois

Raster without video
Panasonic B&W T125-A, T126-A
(Photofact 1434-2)

The Panasonic monochrome TV set had a bright raster, but no picture. During tests of the video amplifiers, I found low voltage at the collector of the video-output transistor (TR15).

At first, I guessed that the transistor was shorted, but additional tests showed low voltage from the +113-volt supply. The D45 diode which furnishes the +113-volt boost source checked okay, but **the filter capacitor C420** (1 microfarad) **was open**.



A new capacitor brought back the picture.

Although this repair was not too difficult, the same defective part can cause other symptoms that are harder to diagnose. A partically-open C420 can cause a blurred picture or weak contrast.

The 1 microfarad size is not always easy to locate. If you use a larger size, be sure to keep it away from the high-voltage transformer.

Mark Smith, CET
Excelsior, Minnesota

reader's exchange

Needed: UHF switch number 2000 646-187 for an Arvin television, model 66K18. *James E. Boston, Boston TV Service, 2505 Moorman, Cincinnati, Ohio 45206.*

For Sale: Sencore SM152 TV alignment generator; Lectrotech V7 Vectorscope and color generator; B&K-Precision 1076 Analyst; B&K 1440 scope and probes; Sencore FS134 field-strength meter; Sprague TO-6 Tel-Ohmike; B&K 970 transistor radio Analyst; Sencore TF166 transistor tester; and B&K 750 test-equipment calibrator. All in operating condition. No reasonable offer refused. *Roland R. Bowers, 1108 Seminole Drive, Ft. Pierce, Florida 33450.*

Needed: A copy of *Amateur Radio* (magazine), June 1973 issue, good condition. *Albert Pecaites, 4048 West 161st, Cleveland, Ohio 44135.*

Needed: Instruction and service manuals for model 740-B General Radio capacitance-test bridge. Will buy, or copy and return. *C. R. Iseminger, 1425 Lawndale, Havertown, Pennsylvania 19083.*

Needed: Manual for Dumont model 403 scope. Will buy, or copy and return. *Roger Merrow, 429 Sawyer, South Portland, Maine 04106.*

For Sale: Turner M+2/U CB mike, $5. Excellent condition, with manual and practically new. *John E. Grable, Sunshine Electronics, 353 55th Street, Brooklyn, New York 11220.*

Needed: Schematic and operating instructions for Soundscriber answering machine model DX, or current address of Soundscriber. *Richard Collins, MR. TV, 12 Miller Drive, Hopewell Junction, New York 12533.*

Needed: Stereo tape transport KN-4000 and preamplifier KP-70 for Allied Radio Knight kit. Also, construction manual, schematic, and source of parts for the tape deck. *R. Vellines, Jr., 1228 East Ridge Road, Gary, Indiana 46409.*

For Sale: Sencore DVM-38 digital voltmeter with HV probe, $260; Sencore TC-38 "Hybrider" tube and transistor checker, $150; and Sencore YF-33 yoke and flyback tester with HV probe, $150. Excellent condition, with manuals, practically new and hardly used. *John E. Grable, Sunshine Electronics, 353 55th Street, Brooklyn, New York 11220.*

Needed: Schematic for an Amphenol 860 Color Commander generator. Will buy, or copy and return. *Friendly TV Service, P.O. Box 662, Hot Springs, Virginia 24445.*

Needed: Service data for Bell Industries series 2000 Carillon. *Paul R. Bennett, 129 Lakeside Village, Hobe Sound, Florida 33455.*

Needed: A battery-operated field-strength meter. Make offer. *Lew Wollaston, 1504 Bigh Horn, Alliance, Nebraska 69301.*

Needed: New General Instrument tuner (model TT-155) for a Philco TV; and a used Leader model LCG color/bar generator. *Paul Capito, 637 West 21st, Erie, Pennsylvania 16502.*

For Sale: RCA 3-inch scope, $50; Conar MDL 250 5-inch scope, $75; TWS-6 frequency counter, $50; and Sencore CR143 CRT tester/rejuvenator, $75. All like new, with manuals and probes. *D. Miller, Box 6113, Hilton Head, South Carolina 29928.*

For Sale: Shure M44E magnetic cartridge with elliptical stylus N44E (including extra N44E stylus). Never used, in original package, $15. *Jack Burgess, Box 124, West Blocton, Alabama 35184.*

Needed: Tektronics 211 or 221 mini scope; send price and condition. *Al's Radio and TV, 9 Leonard Road, Hyannis, Massachusetts 02601.*

For Sale: Gonset Comm II 2-meter transceiver, 115/12-volt power, with manuals and miscellaneous parts, $100; B&K-Precision model 700 mutual-conductance tube tester with manual, $100; and Aries AR611 frequency counter, $75. *Allan V. Eisenhaur, 9 Leonard Road, Hyannis, Massachusetts 02601.*

For Sale: HP175A 50-MHz scope with delayed sweep; 1-mV dual-trace plug-in; 4-trace plug-in; with manuals and probes, recently calibrated, $550. *Steve Goulart, 102 South Street, Lynn, Massachusetts 01905.*

For Sale: Five good copies of 1922-23 *Radio News* magazine (August and November of 1922, and November and December of 1923), about 200 pages each, $25 for all five. *Wilbur C. Elmore, 44 Drury Lane, Lebanon, Missouri 65536.*

Needed: Schematic and/or manual for Solar capacitor analyzer, model CF. Will pay, or copy and return. *Joe Berman, P.O. Box 2678, Grand Rapids, Michigan 49501.*

Needed: Volume/switch control (part RA169) for Symphonic miniature TV model TPS-5050. *Don Bryant, 1527 West State Road, Lot 134, Belding, Michigan 48804.*

Needed: Manuals for Hickok RF generator model 19XD; and AEI RF generator model A200. Will buy, or copy and return. *M. J. DeCormier, 11 McCombs, Clinton, Michigan 49236.*

Needed: Schematic and alignment data for a Galaxy V transceiver. Will pay for a copy. *Wendell R. Weeks, 216 30th Avenue, NW, Moultrie, Georgia 31768.*

For Sale: New RCA cathode ray tube, JAN+CNU 5FP7A, $5, plus shipping. *Albert Pecaites, 4048 West 161, Cleveland, Ohio 44135.*

For Sale: Nikoltronix CB analyzer (model GN-1357), $250. *Carl D. McClelland, 244 Linden, Jackson, Tennessee 38301.*

continued on page 14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GENERAL ELECTRIC

reader's exchange

continued from page 12

Needed: Service manual for Telefunken "Hymnus." Have schematic, need wiring diagrams, parts lists, chassis photos, etc. Will buy, or copy and return. Also, need source of spare parts in United States. *George H. Thayer, RD 1, Box 481, Stone Ridge, New York 12484.*

Needed: A function-switch assembly for Olympic stereo model T8300. Will accept just the switch assembly, or the switch assembly and the board together. *Charles N. Brandon, 5030 Northington Drive, Houston, Texas 77039.*

For Sale: A complete set of Rider's manuals 1 thru 23—including index I thru XXIII. Also, four extra volumes, 7, 8, 9, and 10. Write for prices. *Gilley TV, 1302-1st Street, Brookings, South Dakota 57006.*

For Sale: Complete television course including color, four volumes for $12. Will send COD. *Bernard Grupe, 3012 Highland Drive, Cary, Illinois 60013.*

Needed: Tube chart for an I-171B Army-model tube tester made by Simpson during the 1940s. *R. C. Carter, Caltronics Service Company, 16412 Del Mar Lane, Huntington Beach, California 92649.*

Needed: Picture tube for symphonic 5050 number C6407, used or rebuilt for school. *Milton Brown, Rochambeau School, 228 Fisher, White Plains, New York 10606.*

Needed: Photofact TSM131 for a Welton 8-track stereo tape player AM-FM/MPX radio, model 2001. Will buy, or copy and return. *James A. Nourse, 37 Lancaster Terrace, Hampton, Virginia 23666.*

For Sale: Heathkit sweep-marker generator with cables and manual, $125. *R. L. Hallett, Electronic and Appliance Repair, 65 Somerset, Pittsfield, Maine 04967.*

Needed: TC-615 and 610 adapters for B&K-Precision model 550 tube tester and/or schematic for each. Will buy, or copy and return. *David W. Brower, 236 Welsh, Camden, South Carolina 29020.*

For Sale: Miller 90651 grid-dip meter, $75. *Robert B. Monteith, 307 Sunset Boulevard, Melbourne Beach, Florida 32951.*

Needed: Power transformer part number 107264 and 549-6539 for model KG-2000 Knight scope from Allied Radio. *Darrel Richards, 16D Bell Circle, Silver Bay, Minnesota 55614.*

For Sale: PF Reporter from January 1954 to December 1968, and **Electronic Servicing** from January 1969 to January 1978, a total of 288 issues; make an offer. *Lester Binkley, 328 West Dinehart, Elkhart, Indiana 46514.*

Needed: Information about monthly meetings of independent TV techs or electronic-organ techs in the Silver Spring, Maryland area (for the purpose of exchanging experiences about electronic-servicing troubles). *George Olsen, 13519 Westwind Drive, Silver Spring, Maryland 20904; 384-1861.*

Needed: Schematic for an old Decca record player model DP-304. *Robert J. Kralis, 295 Avenue A, Rochester, New York 14621.*

For Sale: RCA color test jig type 10J03 including: high-voltage meter, 10 adapters, Sylvania 19WGP22 CRT, Telematic TA-3000 transverter with 12 convergence and yoke adapters, $335; RCA WR-99A signal generator including all cables, service manual, and WG-295 Video Multimarker, $290; RCA WR-514A TV Sweep Chanalyst including all cables, service manual, and 17 alignment probes, $450; Sencore BE-156 DC bias supply, $25; RCA triggered scope, including service manual and probes, $225; and Leader LTC-905 transistor curve tracer, $110. *William Shevtchuk, One Lois Avenue, Clifton, New Jersey 07014.*

Needed: Schematic or service manual for model XL-1 Unimetrics TV camera, or address of Unimetrics. *Kim Roscher, E-303 Randolph Apartments, Salem, West Virginia 26426.*

For Sale: Radioactive-material handling course in loose leaf with RCA geiger counter, less batteries, as is, $9 plus postage. *E. Smith, 3A, 8636 West Grand, River Grove, Illinois 60171.*

For Sale: More than 500 integrated circuits, a good overall assortment for only $100 postpaid. *William W. Hyatt, 473 DeSoto Drive, Miami Springs, Florida 33166.*

For Sale: Heath IM-22 audio analyzer, $25; Heath IM-22 distortion meter, $30; Lafayette TE-24 crystal-calibrated marker generator (130 KHz - 300 MHz), $20; Mercury 1000 mutual-conductance tube tester, $15; Heath ID-22 electronic switch (for any scope), $15; Sencore SM152 sweep-and-marker generator (complete with cables, instruction book and 12-inch recording), $60; Sencore TL166 automatic transistor analyzer, $55; and B&K-Precision 1076 television Analyst, $75. *Al Hawkes, US 302, Highland Lake Corner, Westbrook, Maine 04092.*

For Sale: Antique radios, console and table models. Also, have some battery radios. *SFC Hobbyists Service, P.O. Box 576, Wishek, North Dakota 58895.*

Needed: Tube tester for old type tubes, such as four-prong. Reasonably priced, as I am retired. *Elmer Mosley, 720 Poplar, Kenova, West Virginia 25530.*

Needed: Schematic and parts list for a Supreme Audolyzer model 688. *Alex Ralston, P.O. Box 366, Unity Saskatchewan, Canada SOK 4L0.*

For Sale: Old magazines, old service manuals, and old tubes. *Arthur Draut, 900 Stanley, Middletown, Ohio 45042.*

continued on page 16

reader's exchange

continued from page 15

For Sale: I'm going out of the CB business, so must sell all CB antennas and accessories. Antenna Specialists and G.C. complete line at 25% below cost, or trade for equipment. Write for description and prices. *Art Glauner, 108 Carey, Deerfield, Michigan 49238.*

For Sale: Test equipment manuals for many popular brands (RCA, Sencore, Hickok, B&K-Precision, etc.). Send SASE with your needs. *Ron Jordan, 5277 Larchwood Drive, San Jose, California 95118.*

Needed: Operating manual for Solar condenser checker model CF1-60, or an explanation of how to use it. *J. E. Humphrey, 1006 East 28th, Los Angeles, California 90011.*

For Sale: B&K-Precision model 415 sweep/marker generator, used twice, perfect condition, with operating manual and probes, $300; and Sencore FE27 Big Henry field-effect multimeter, perfect condition, with manual and probes, $75. *George Welovick, 215 Tottenhaur Road, Lynbrook, New York 11563.*

Needed: Back issues of **Electronic Servicing**, reasonable. Also, a scope, audio generator, etc. Send description and prices. *Murray C. Johnson, Box 272, Oxbow, Saskatchewan, Canada, S0C 2B0.*

For Sale: Knight KG-2100 laboratory scope, hardly used, $120. *Ron Tsubota, Route 2, Box 442, Ontario, Oregon 97914.*

Needed: Flyback transformer part 334S002A1 for a B&W Broadmoor TV model 2712-WA; can be new or good used. *Miller Radio Service, 2469 Crystal Lane, York, Pennsylvania 17402.*

For Sale: McGraw-Hill course in continuing education for electronics engineers and CREI course in management, $9 plus postage. *E. Smith, 8636 Grand, River Grove, Illinois 60171.*

Needed: New roll chart for Mercury Electronics model 300 combination tube and CRT tester. *Thomas H. Jones, 50½ McKinley Avenue, Endicott, New York 13760.*

Needed: Schematic for Airline record player model number GEN-6012A, will copy and return; schematic for Stereomatic 9900 8-track tape player, serial number 9079148, will copy and return; schematic or owner's manual for Electronic Measurements Corporation (EMC) RF-AF-crystal marker/TV bar generator model 700, will copy and return; schematic or owner's manual and tube data book for EICO tube tester, model 625. *John Brouzakis, TV and Radio Repair, RD2, Box 602B, Charleroi, Pennsylvania 15022.*

For Sale: Hickok model 610A universal TV/FM alignment generator; Sylvania model 132 7-inch scope; and Simpson model 479 FM/TV signal generator. Instruction book included with each. Also, old radio schematics and Rider's manuals, all in good condition. *Frank Michuda, Box 532, Braceville, Illinois 60407.*

continued on page 18

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SONY

For More Details Circle (14) on Reply Card

reader's exchange

continued from page 16

Needed: Function switch from Olympic subchassis CL28719, part number SW29217, found in Sams set number 647, folder number 3. Will gladly buy new or good used switch. *Ron Pettett, 404 Cedar Street NW, Demotte, Indiana 46301.*

For Sale: Tubes at wholesale price of $300 with caddy, $175. Excellent condition, with manuals, practically new and hardly used. *John E. Grable, Sunshine Electronics, 353 55th Street, Brooklyn, New York 11220.*

Needed: Schematic for Linear Systems KWM-2 mobile power supply for model "Century 400." Will copy and return, if necessary. *Robert B. Monteith, 307 Sunset Boulevard, Melbourne Beach, Florida 32951.*

Needed: RCA RF generator model WR50B, and Metrotec FEW-1 stereo frequency equalizer. *Frank B. Longenecker, 6 Cranberry Road, Buzzards Bay, Massachusetts 02532.*

Needed: Schematic for RCA VoltOhmyst WV-98A. Will buy, or copy and return. Also, need transformer for Graflex strobe light (500 VAC to charge a 1960 μF capacitor to 450 volts). *Elmer L. Mosley, 720 Poplar, Kenova, West Virginia 25530.*

Needed: Bearcat IV and III CBs for parts only, any condition, send offer. Also, Sony micro TVs and assemblies for parts. *Allan V. Eisenhaur, 9 Leonard Road, Hyannis, Massachusetts 02601.*

Needed: Portable digital multimeter with auto polarity; also, used CB test equipment. *Donald Young, 1037 South Park Drive, Brookfield, Ohio 44403.*

For Sale: Heath model IMD-202-2 digital multimeter, comparable to new Heath IM-1210, assembled and calibrated, 1-meg input, leads and manuals included, $40 plus shipping; EICO model 567 multimeter, 50,000 ohms-per-volt, manual and leads included, $12 plus shipping; and RCA VTVM with leads, old but in good working condition, $10 plus shipping. *Donald Young, 1037 South Park Drive, Brookfield, Ohio 44403.*

For Sale: Heathkit scope application course EF-2, $8; Heathkit IG52 TV alignment generator, $25; Heathkit ID-22 dual-trace scope-adapter, $15; Knight Kit KG685 color/pattern generator, $25. All in good-to-excellent shape, complete, and recently checked out, priced plus postage. *Frank B. Longenecker, 6 Cranberry Road, Buzzards Bay, Massachusetts 02532.*

For Sale or Trade: RCA TM6C video monitor with WP15A power supply, operational, with manuals; and Heathkit IG-57A marker/sweep generator complete with manuals, $150. *Allan V. Eisenhaur, 9 Leonard Road, Hyannis, Massachusetts 02601.*

Needed: Battery charger relay, Sony part number 1-515-218-00, for Sony model HV-5000. State price. *Clyde Perry, 119 East Donelly, Malvern, Arkansas 72104.* □

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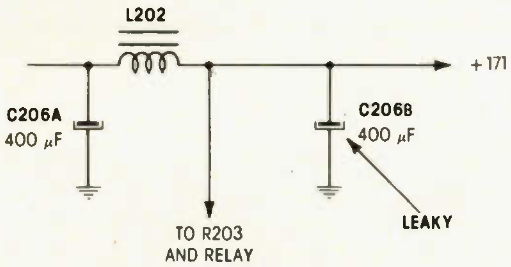
ET1956

symcure

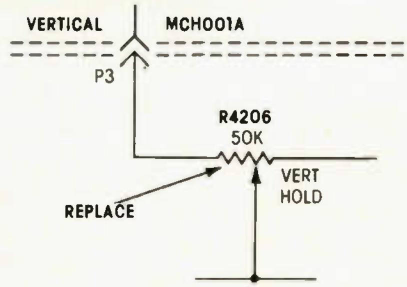
Symptoms and cures compiled from field reports of recurring troubles

Chassis—RCA CTC74
PHOTOFACT—1695-2



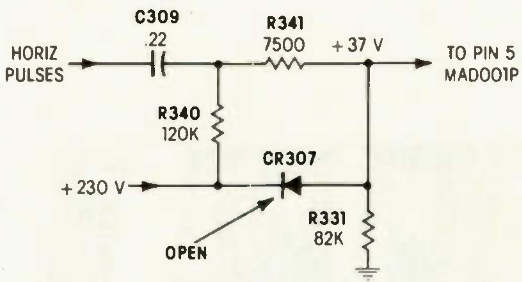
Symptom—At high brightness, power relay chatters and the contacts open, stopping the picture
Cure—Check filter C206B, and replace if leaky

Chassis—RCA CTC74
PHOTOFACT—1588-1



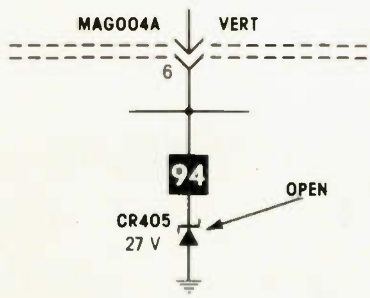
Symptom—Intermittent height or vertical locking
Cure—Check the vertical-hold control, and replace it if it has a loose rivet at a terminal

Chassis—RCA CTC76
PHOTOFACT—1519-2



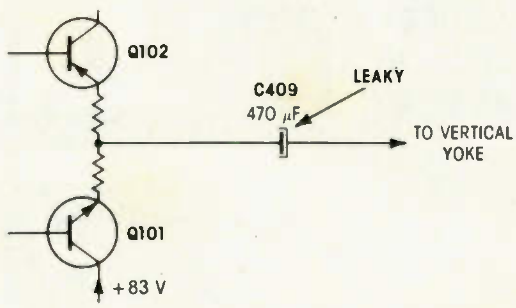
Symptom—Excessive brightness with retrace lines
Cure—Check CR307, and replace if open; or check for an open circuit around terminal D

Chassis—RCA CTC72
PHOTOFACT—1439-2



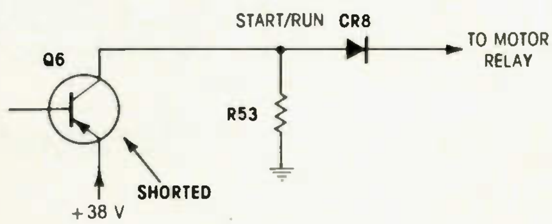
Symptom—Brightness variations cause video pulling at the top
Cure—Check zener diode CR405, and replace if open. Also, check all resistors connected to the zener

Chassis—RCA CTC71AB
PHOTOFACT—1439-2



Symptom—Foldover near the center of the vertical sweep
Cure—Check vertical coupler C409, and replace if leaky or shorted

Chassis—RCA CTC81H non-remote
PHOTOFACT—1615-2



Symptom—Channel motor runs continuously
Cure—Check Q6 start-run transistor, and replace it if shorted

PART 1

Servicing Betamax Videotape Recorders

By Harry Kybett

Adjusting and repairing cassette-type videotape recorders can be interesting and profitable. However, you need service literature, special test equipment, and a detailed knowledge of the circuits and typical troubles. This series begins by explaining the fundamentals and problems of video recording.

A Bright Future For Videocassette Recorders

Home videocassette recorders (HVCRs) now are being sold in large quantities, and sales are expected to climb rapidly for the next few years. You need to learn how to service them NOW, before the first one reaches your shop.

Although a few principles of audiotape recorders and the video/chroma circuits of TV receivers are used in the design of videotape recorders, the machines are quite different, both mechanically and electronically from these other products. Therefore, you must study the circuits and how to adjust or repair them. The suggestions in this series should make it easy for you to begin.

The SONY Betamax

Specifically, these articles are about SONY Betamax HVCRs (Figure 1), although the basic principles of all brands of video recorders are the same.

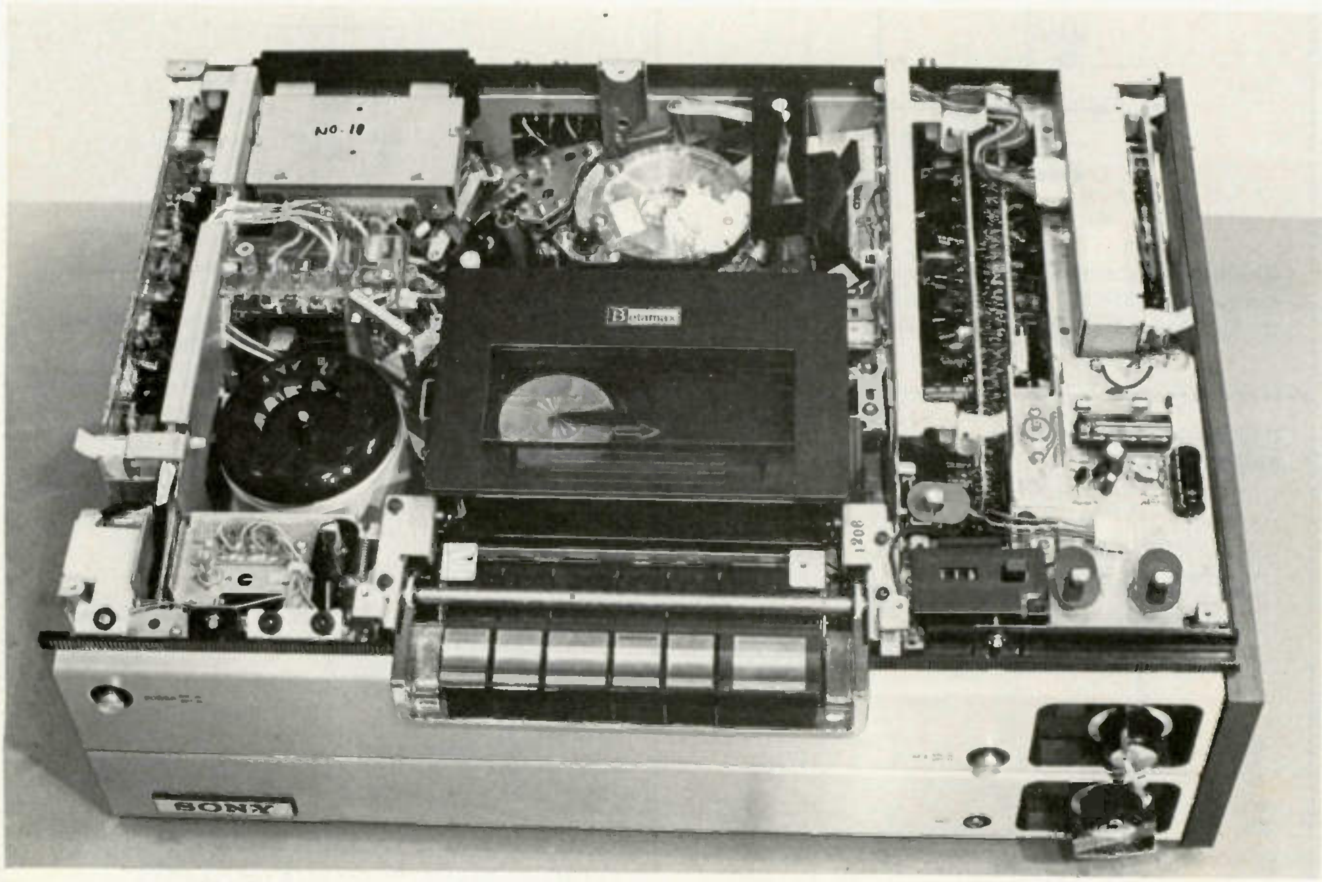


Figure 1 This SONY Betamax is typical of modern high performance Home Videocassette Recorders (HVCRs) that operate without tape threading. It records sound and picture from an external video camera or from internal TV tuners. Any tapes of the same format may be played. For viewing, the RF output is connected to any conventional TV receiver.

There are several "families" of HVCRs, and none of the cassettes are interchangeable. Most of these manufacturers build machines to be sold under several brand names.

In this first article, we include the basics of video recording, the helical format, and the general mechanics of small cassette machines.

In most cases, theoretical information will be followed immediately by a discussion of actual circuits and methods.

Head Gap And Tape Speed Versus Bandwidth

Probably all technicians and hi-fi enthusiasts have heard that faster tape speeds provide better frequency response. Do you know why this is true? We will explain it in a general way.

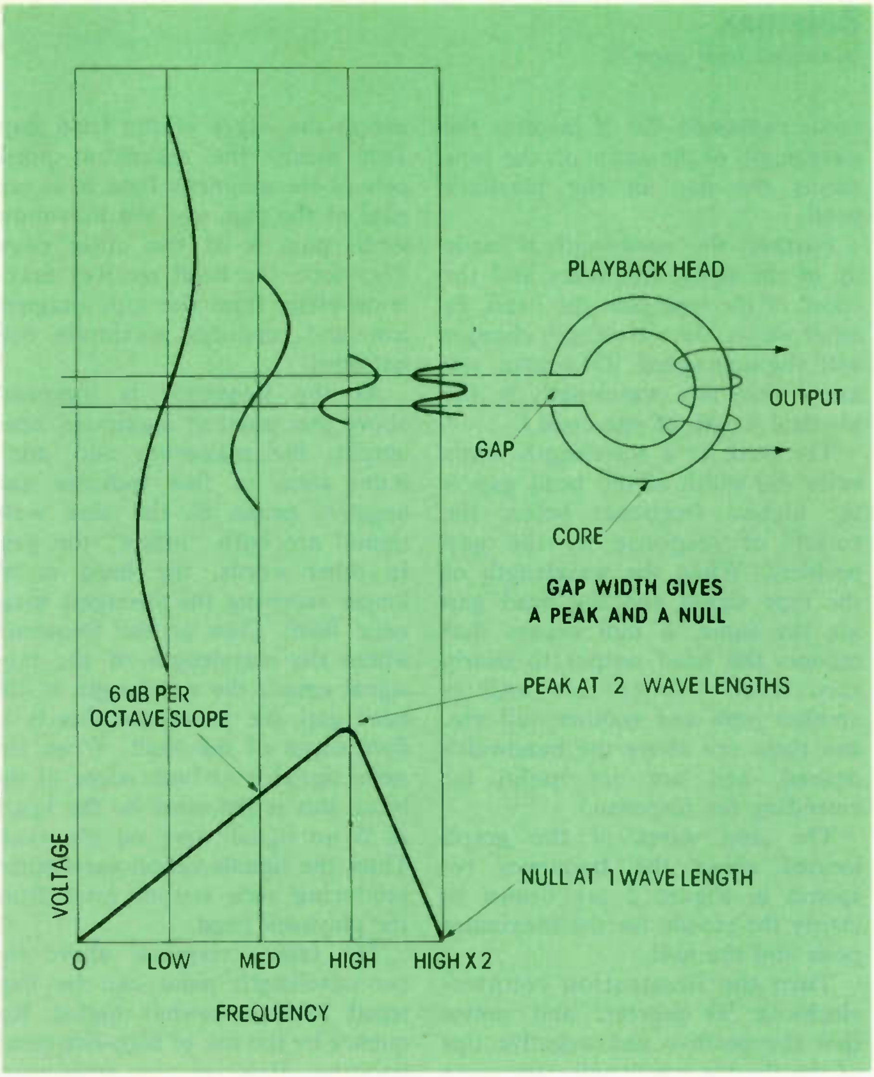


Figure 2 Two main characteristics limit the frequency response of any magnetic tape system, including both video and audio recorders. The rolloff at low frequencies is caused by the playback head, which varies in impedance over the entire band. The high-frequency rolloff above the "2 wavelengths" point is a function of the head gap versus the wavelength of the signal on the tape.

Tape response is not flat

Unless considerable frequency equalization is used, no tape recording and playback system has "flat" frequency response. Systems without any equalization have attenuation of the low frequencies during playback, plus loss of extreme high frequencies during both recording and playback.

Low-frequency problems

All magnetic systems operate mainly from current. This is true of electromagnets, TV deflection yokes, inductances in general, and tape heads. Also, all inductors (including magnetic tape heads) have a higher impedance at higher frequencies. This is the reason tape systems have a falling low-frequency response.

Imagine that an audio recording head is supplied with the same AC signal voltage for all frequencies. During playback the frequency response would be nearly flat. But there is an intolerable problem. If the magnetic recording head is driven with sufficient high-frequency voltage to keep the level above the noise and hum, the lower frequencies would overdrive both the tape and the head into saturation, generating extreme distortion. (Recording bias is ignored here.)

The solution is to supply the recording head with a "constant" current, so the magnetism on the tape is equal at all frequencies. This brings another problem (but one less severe than the extreme distortion) of falling low-frequency response in the playback head. It, too, has lower impedance at lower frequencies.

Audio recorders flatten the frequency response by boosting the low frequencies during *playback*.

High-frequency problems

On the playback frequency-response graph of Figure 2, the peak at the double wavelength is not, strictly speaking, a peak at all. Instead it is a maximum point between two separate falling responses.

The curve below the point is the 6 dB per octave decrease of output signal caused by the decreasing inductance of the playback head. Without the gap problem, the response curve would continue to infinity (theoretically) at the same 6 dB per octave rise of response. That characteristic accounts for the decreasing response at low frequencies.

The other problem is not quite so

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easily explained, for it involves the wavelength of the audio on the tape versus the gap in the playback head.

Further, the wavelength is made up of the signal frequency and the speed of the tape past the head. In other words, the wavelength changes with the tape speed. (Of course, you know that any wavelength is the physical length of one cycle.)

The peak at a wavelength that's twice the width of the head gap is the highest frequency before the rolloff of response by the gap problem. When the wavelength of the tape signal and the head gap are the same, a null occurs that reduces the head output to nearly zero level. (Above this null is another peak and another null, etc. But these are above the bandwidth desired, and are not useful for extending the response.)

The sine waves of the graph located above the frequency response in Figure 2 are drawn to clarify the reason for the maximum peak and the null.

Turn the illustration counterclockwise 90 degrees, and notice that the positive and negative tips of the double-wavelength sine wave are at the *edges* of the head gap. This means the maximum north pole of the magnetic field is at one edge of the gap, and the maximum south pole is at the other edge. Therefore, the head receives maximum effect from the tape magnetism, and produces maximum output level.

As the frequency is increased above that point of maximum head output, the maximum and minimum areas of flux (positive and negative peaks of the sine wave signal) are both "inside" the gap. In other words, the head is no longer receiving the strongest magnetic field. Then at the frequency where the wavelength of the tape signal *equals* the wavelength of the head gap, the maximum flux is at *both* edges of the head. When the *same* signal is at both edges of the head, this is the same (to the head) as if *no* signal were on the tape. Thus, the signals cancel each other, producing zero output level from the playback head.

The falling response above the two-wavelength point can be flattened to a somewhat higher frequency by the use of high-frequency boosting. However, no amount of boosting can extend the flat response completely to the one-wavelength null. Therefore, **the null frequency must be above the desired bandwidth.**

We mentioned before that the recorded wavelength is not an unchangeable number, but it varies with the tape speed. Keep in mind that wavelength increases as the frequency decreases. In other words, lower frequencies have longer wavelengths.

Recording at a faster tape speed stretches each cycle of the audio signal so it occupies a wider *physical* area of the tape. The cycles are wider, and this is a real increase of wavelength. Remember that the exact wavelength is not important. Instead, the vital comparison is the tape wavelength versus the head-gap wavelength.

Narrowing the head gap has the **same relative effect** on response as does an increase of wavelength on the tape. Look at it this way, the object is to prevent any *more* than a half-cycle of the signal from being "inside" the head gap at any time (more than a half-cycle causes partial cancellation), so narrowing the gap is equivalent to having a higher tape speed (longer wavelength).

Therefore, better high-frequency response can be obtained by increasing the tape-to-head speed *or* by narrowing the gap of the playback head. **And, it's even more effective to do both.**

Other effects, such as eddy currents in the heads and tape limitations, also limit the top frequencies that can be recorded and played.

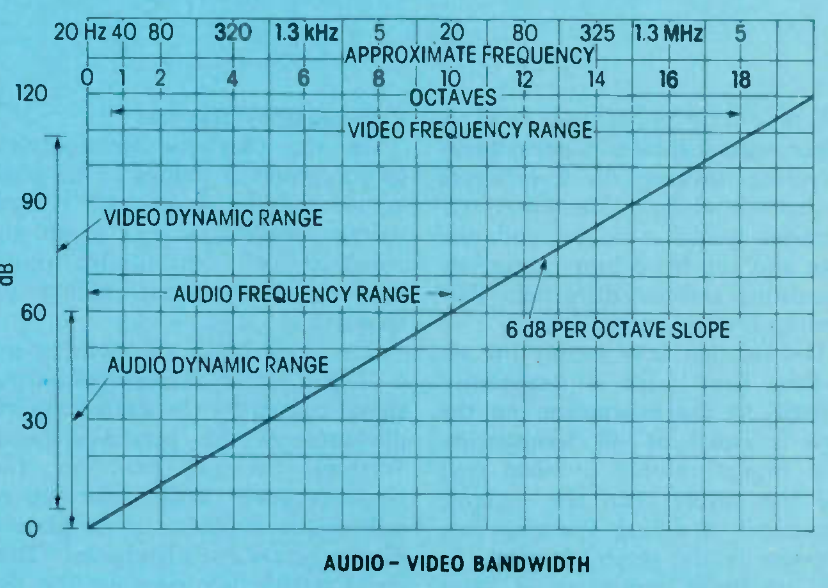

Figure 3 This graph compares the bandwidth in octaves of audio versus video, along with the amount of frequency equalization necessary to flatten the frequency response that rises at a 6 dB-per-octave rate.

Audio Techniques To Record Video?

The frequency response of an audiotape system can be made flat by compensation, increasing the tape speed, and narrowing the head gap. So, it seems likely that a further increase of these three methods would enable the recording and playing of video frequencies. But there are more large problems.

A bandwidth/equalization problem is illustrated by Figure 3. The

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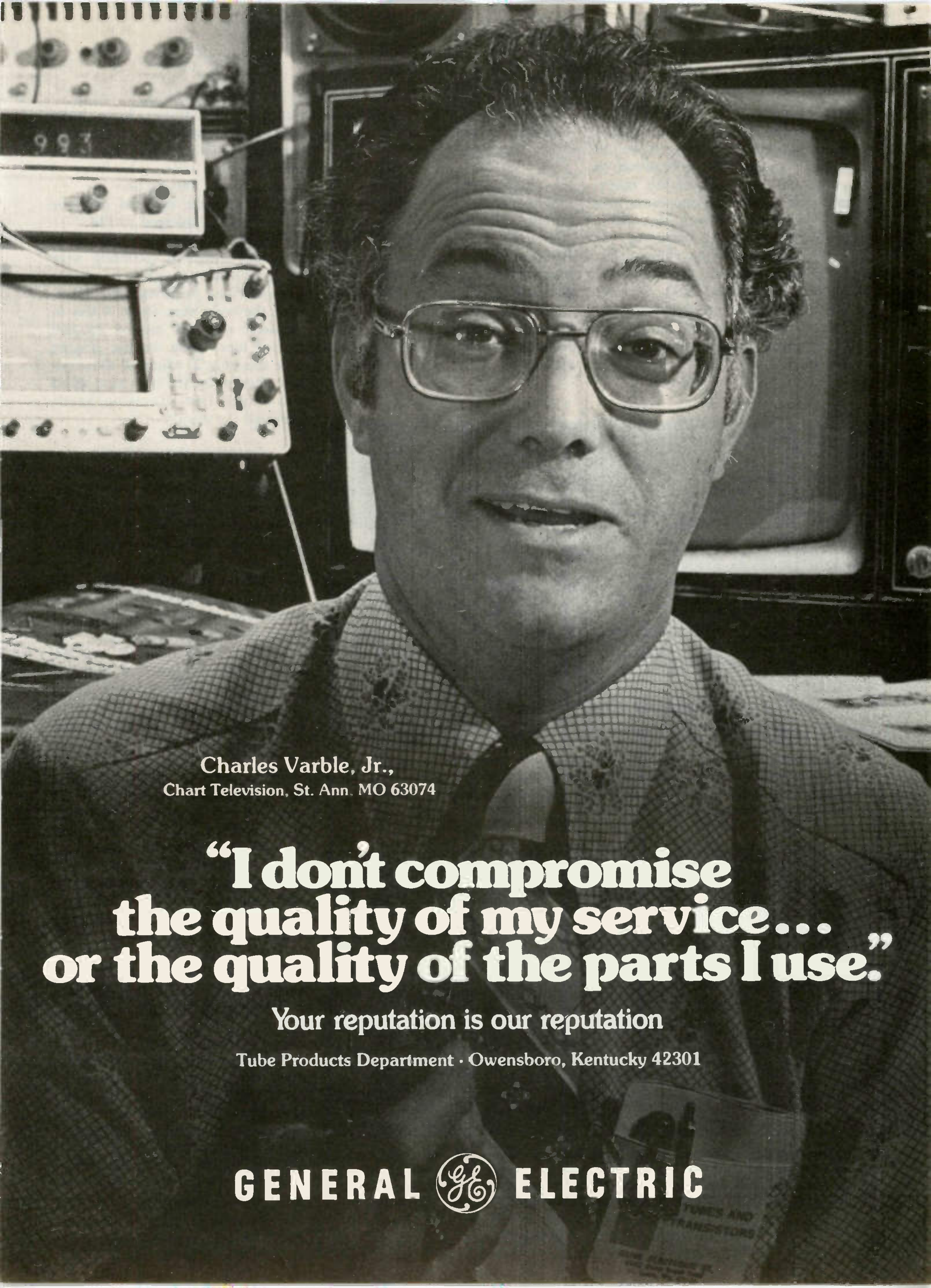

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audio bandwidth of 20 Hz to 20,000 Hz is about 10 octaves (an octave is double or half frequency). About 60 dB of compensation is required to obtain flat response over this range, and that's about the maximum that can be used without impossible problems of noise and overload.

By comparison, the video bandwidth from 30 Hz to 4 MHz covers almost 18 octaves, and requires about 100 dB of compensation to achieve flat response. Of course, that much equalization is not practical.

No, an extension of audiotape-recording principles can't provide satisfactory video recording.

Bandwidth Solutions

Solutions of two problems (the extreme video equalization, and the difficulty of obtaining minimum distortion and noise) seem to have been solved together by **translating the video signal into an FM signal.**

For example, having the video frequency modulate a carrier so it deviates between 2 MHz and 5 MHz gives a 3 MHz bandwidth, but the 18 octaves have been reduced to slightly more than 2 octaves. Equalization to make the response flat over only 2 or 3 octaves is very easy to do.

A later article explains how the video signal is changed to FM.

Several experimental high-speed machines with FM recording were built. These did give adequate monochrome performance. However, the reels were about 4 feet in diameter and held around 250,000 feet of tape. Even so, the playing time was only 20 minutes! Obviously a solution for the high tape speed was imperative. Rotating heads provided the answer.

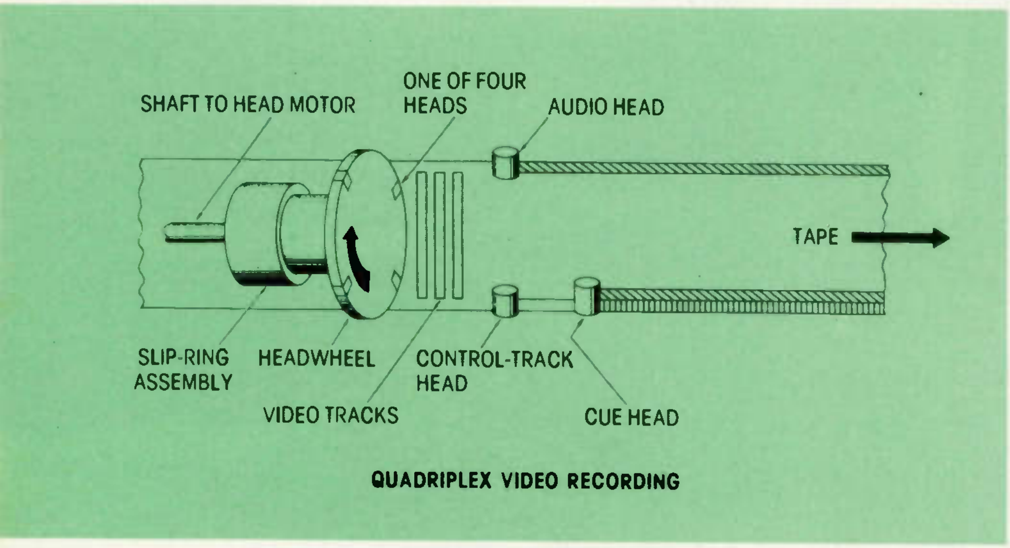

Figure 4 For years, the standard video recorder in TV stations was the "quad" type with four heads that made tracks across the tape to increase the writing speed. Helical machines now can provide equal picture quality, and the battle for first place has begun.

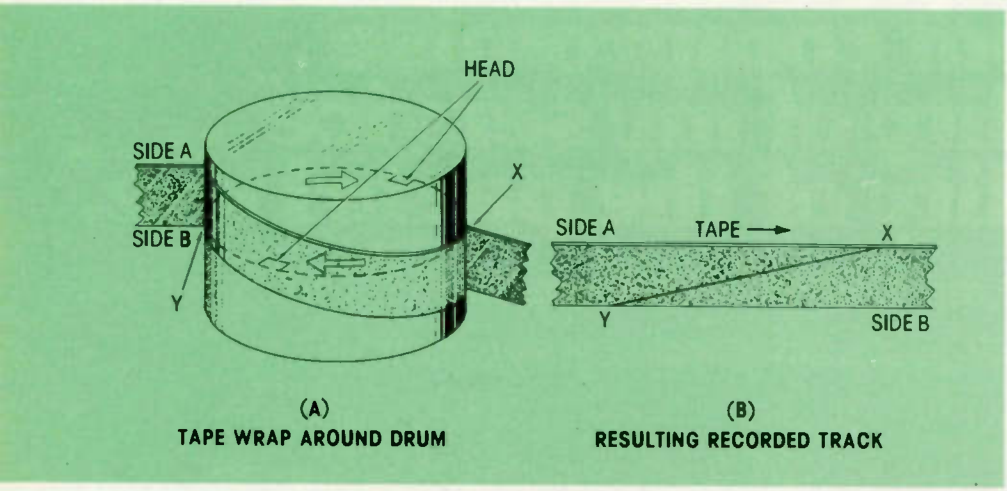

Figure 5 Helical machines can be built with only one head and a full wrap of tape around the drum. However, that presents serious threading problems, so the Betamax uses two active heads and a half-wrap around the drum. Because the tape is slanted (not the heads), the tracks cross the tape at an angle.

Rotating Video Heads

In order to obtain adequate high-frequency response, a high speed between tape and head is necessary. Early models used a fixed head and moved the tape past the head at fast speed. That was the wrong way, for the important thing is the head-to-tape speed (the writing speed) and not necessarily the tape speed through the machine.

A high writing speed can be achieved by the use of rotating heads. Figure 4 shows the arrangement of four heads that rotated in a circle, so each track was almost straight across the width of the tape (at 90° to the movement of the tape). A writing speed of about 1500 inches-per-second (IPS) is obtained with moderate tape speed. With modern head gaps of less than 40 microinches, frequencies up to about 10 MHz can be recorded. A slight overlap is provided, so the next head already is in contact with the tape before the previous one leaves it. Each track contains about 16 to 18 horizontal lines of video.

This method has been the standard for years in TV broadcasting. It is known as the "quad" system.

Helical scanning

Recently another method of scanning with rotating heads has become the standard for home and educational uses. Also, it is challenging the so-called "quad" system in TV broadcasting.

In the helical system the tape is wrapped either halfway or com-

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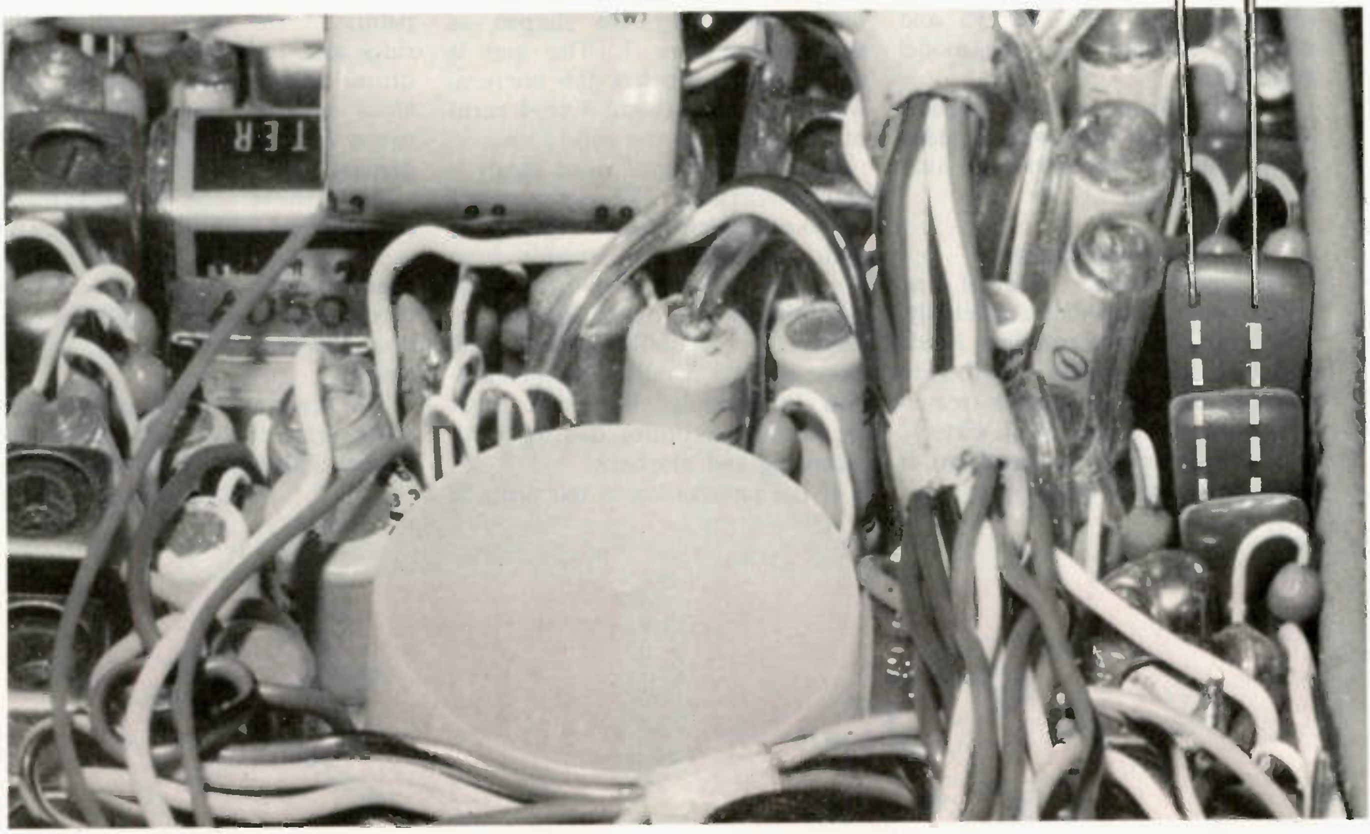

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pletely around a larger head drum. It enters at one level and exits at another in a spiral or helix-type path (the origin of the word helical), while the head rotates against the inside of the tape wrap with a motion that's parallel with the recorder base plate (Figure 5). Therefore, the heads write long slanted tracks (at least they are slanted when the tape is straightened out), with each track containing a complete TV field of 262.5 lines. If two heads are used, there is a slight overlap, and head switching is done during the vertical-retrace interval.

With helical machines, the writing speed is between 100 IPS and 400 IPS, depending on the model and brand.

Because Betamax is a helical (slant track) machine with 2 video heads, we will concentrate on that type of head drum.

The Head Drum

The most critical area of any HVCR is the head-drum assembly. This contains the rotating heads and the tape guides. Both are delicate, and they should be treated with respect and care at all times.

In the Betamax, the head drum is in three general parts (Figure 6). At the bottom is a nonmoving part which has the tape guides and the "PG" coils, another nonmoving upper part furnishes part of the tape-support surface, while in between is the rotating plate. This rotating plate holds the 2 video heads and the "PG" vanes or magnets. ("PG" stands for pulse generator, which refers to the pulse produced in the "PG" coils when the magnets pass over them. These also are called "head tach pulses," and they are used in the servo circuits to control the speed of the head rotation.)

Each of the two video heads is made from a single crystal of ferrite, and they are shaped as shown in Figure 7. The gap is about 28 microinches (0.6 microns) wide, and only about 3 or 4 turns of wire make up the coil.

The positioning of these heads is extremely critical. They are mounted an exact height above the plate, and with an exact protrusion from the plate. When the heads scan the tape, they do not merely contact the surface, but actually penetrate the oxide by 1 to 3 mils. This penetration is necessary for good high-frequency response during both recording and playback.

If the penetration is too deep, it will cause excessive wear of the head and the tape. Too little penetration produces weak and noisy pictures. In the Betamax, the penetration is set during manufacture, and it does not require field adjustments.

The gaps of both heads must be exactly 180° apart. This head "dihedral" is not set during manufacturing, so a slight adjustment is required when the heads are changed (this will be described later).

The recording tape must be guided around the head drum very accurately. This is done by the guides at the entrance and exit points of the drum, and by the ridge around the lower part of the drum. These areas must be kept clean of dirt, dust, oil, or iron oxide, and the parts must never be damaged or handled roughly.

Also, these tape-guiding parts never should be adjusted, otherwise tape interchange is lost. Interchange is the ability to record a tape on one machine and later play it on another without any loss of quality.

The heads and the head disc are quite expensive, and must be treated with care at all times. The

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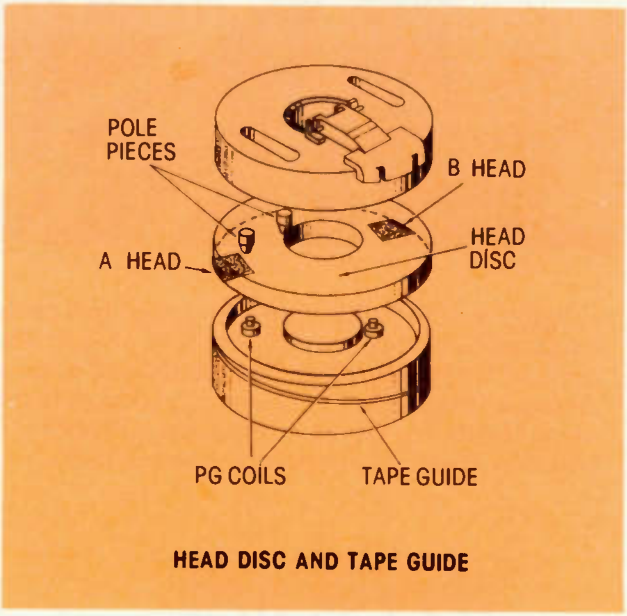

Figure 6 The Betamax drum is in three major parts. Only the center section (with the two heads) moves. The bottom and top sections determine the path of the tape around the drum.

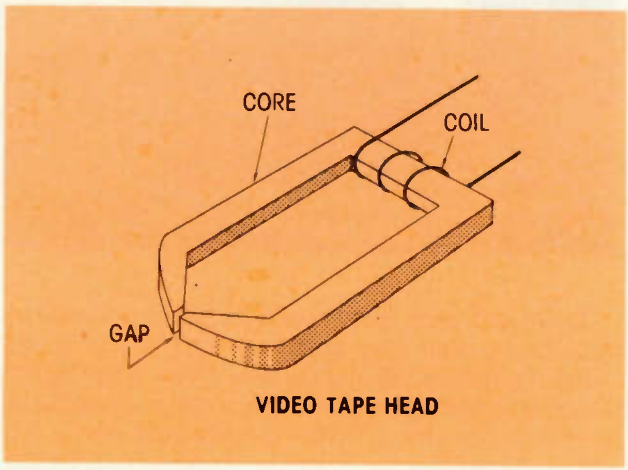

Figure 7 Videotape heads are made with only one gap, and the coil has just a few turns.

Betamax

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ferrite core is brittle and could break easily from excessive force.

Format

As the heads rotate, they record narrow slanted tracks across the tape. During playback, the heads must "scan" the same precise tape area to recover the tiny signal.

To make this process accurate, the tracks are laid down in an orderly manner (Figure 8). The width of the heads determines the width of the recorded tracks. The capstan pulls the tape along its path around the head drum at a speed which allows a space between the tracks. This space is called a "guard band" and it usually has the same width as the tracks. The tape guides maintain the angle of the tracks across the tape, and the tape-travel speed is adjusted during playback so the heads retrace precisely the tracks made during recording. The slant tracks have another advantage besides providing a longer path for each video field: the tilt minimizes crosstalk from the audio and control tracks.

The video signal is applied to the tape in a definite way, with the vertical interval recorded near the end of each track, and the other video placed before it along the remainder of the track.

When the machine is recording, the video/FM signal is fed continually to *both* heads, thus it is not necessary to switch between heads. In the playback mode, the switch from one head to the other is performed during the short time just before the vertical interval when both heads are in contact with the tape.

These specifications collectively make up the "format" of a HVCR:
- length and width of each video track;
- the tape speed and the writing speed;
- diameter of the head drum and the shape of the groove;
- the number of heads used, and the wrap around the head drum;
- the frequency of the FM carrier, and the amount of deviation.

Therefore, tapes made on a HVCR of one format will not play properly on a HVCR of another format. Interchange of tapes is possible *only* between machines of the identical format.

For example, Betamax, VHS, and Quasar all have different formats, so tapes from one will not play on either of the others. In fact, to make sure you don't try to play them, the cassettes are made with different sizes and shapes.

Mechanics Of The Tape Decks

Figure 9 shows the locations of the important mechanical components in a Betamax. The major differences, when compared to an audio recorder, are the head drum and the automatic threading mechanism that pulls the tape out of the cassette.

Inside the cassette, the tape is

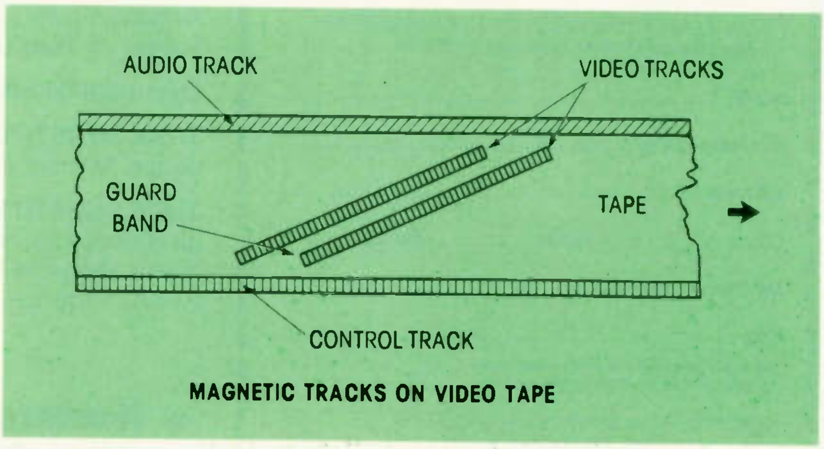

Figure 8 In addition to the slanted tracks with blank sections (guard bands) in between, an audio track is recorded along one edge and a control track is placed along the other edge of the tape. These angles and positions minimize any crosstalk between the tracks.

wound on two reels. A protective flap is pushed up to expose a short length of tape, when the cassette is inserted and lowered over the two reel tables. The tape settles over the pull-out pin on the threading ring, and a microswitch begins the threading operation. The threading ring is driven clockwise by a small DC motor, until it is in the fully-threaded position. At that time, another microswitch opens to remove power to the DC motor. Also on the ring are tape guides and a capstan pressure roller. A solenoid now pulls the pressure roller closed against the tape, and the tape moves along its path around the head drum.

An arrangement of belts and idler wheels (powered by the main AC motor) drives the tape reels. The idlers and pulleys are moved into position by mechanical levers that are operated by the main function keys on the front panel.

Metal foil is used to attach the tape to the reels. This is pulled out at the end of the tape, and it activates two end-of-tape sensors which stop the machine automatically. These sensors, along with the tape-slack sensor and a sensing circuit for head rotation, provide protection for both the tape and the deck. Any major malfunction should force the machine into the "stop" mode automatically.

Tape tension is controlled by an arm that has a tape guide on its end. The tape passes around this guide and thus regulates the tension-braking band that's around the supply reel. If tape tension is too low, the head contact with the tape will be too loose, causing noisy recordings and playbacks with excessive "dropouts." Too much tension stretches the tape, increases the timing errors of the signal, and causes excessive wear of the head. As you can appreciate, proper head tension is very important for any type of videotape recorder. In a later article, we will describe how it is adjusted in the Betamax.

Other Functions

Audio signals are recorded on a narrow track along one edge of the tape, by conventional methods (no slant track here). At the opposite edge is recorded a control track, which is used to control the rotation speed of the heads and the tape speed during playback. Operation of the control track will be discussed along with the servos.

The main erase head covers the full width of the tape. It erases the video tracks, the audio track, and the control track.

Several circuits are used in the system-control section of the deck. For the most part, these switch the correct automatic mechanisms or protective devices in and out, and control the threading and unthreading of the tape.

The TV tuner is a separate section mounted at the end of the

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main deck. It has a VHF and a UHF tuner, a power supply, and an IF and demodulator board which provides station video and sound signals to the main deck. These functions are the same as those in a TV receiver, so they will not be explained in detail.

The RF modulator is in a small enclosed box. It is a miniature TV transmitter, which can be switched to operate either on channel 3 or on channel 4. It receives video and audio from the tape deck and has an RF output that goes to the antenna terminals of a conventional TV receiver. This way, the recorded program can be viewed without the necessity of a special monitor. The RF modulator is classed as an "unserviceable" device to comply with FCC regulations about radiating circuits. It can be replaced easily, if it ever goes bad.

Troubleshooting And Servicing

Each article of this series will end with advice about servicing and troubleshooting.

With HVCR machines, there are two main symptoms that usually alert the customer to a need for service. First is the symptom of a complete lack of picture and sound. The second is something wrong with the picture, such as no color, snow, or bending.

Of course, such general symptoms might have several possible causes. Therefore, a logical procedure must be used. For example, a problem of no picture (when a known-good tape is played) might indicate a broken cable, a defective video-output transistor, or other video defect. On the other hand, there might be two unrelated troubles, such as a blown fuse and a broken belt that drives the head drum or capstan.

Most troubles can be localized by following the excellent step-by-step procedure in the Betamax service manual, or by going through one of the alignment procedures. For example, when a stable picture can't be obtained during playback, a check of the servo alignment and the tape tension often will show where the fault lies.

Where possible, common faults will be listed with the most-likely cause. Thus, the typical defects that produce a lack of video output will be found with the coverage of video recording and playback, the servos, and the mechanical system.

Equipment

Very little extra equipment is required to service Betamax machines. A dual-trace scope having at least a 10-MHz bandwidth, and a frequency counter are the major items. The most-useful small item is the Sony SL-0001 alignment tool. This tool has a screwdriver blade at one end and a shaped non-inductive bit at the other end for adjusting coils.

An alignment tape is necessary before you attempt to service any HVCR. In fact, you MUST have one. An alignment tape is needed for each format, and they can be obtained from the manufacturer. These tapes are expensive, and should be treated with care.

Next Month

Details of luminance (black-and-white) recording, including methods of minimizing crosstalk between the video tracks, will be discussed next month. □

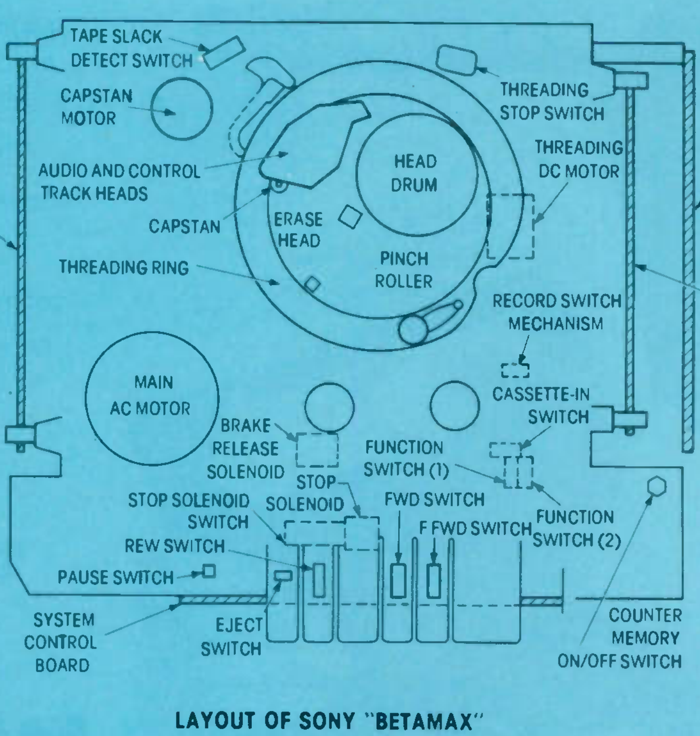

Figure 9 This mechanical layout of the SONY Betamax is explained in the text.

All Electronics Crossword

by Frank R. Egner

This one shouldn't be too hard if you remember your basics.

ACROSS

1 Alternating current
2 EMF unit
7 Opposltion
9 Translstor gain
11 Electron charge
14 Integrated circuit
16 Metal frame
17 Color setup
18 Capacitance unit
19 Mlcro-micro
22 Light emitting diode
23 XL or XC
24 Electronic voltmeter
27 Transistor part
29 Loglc gate
30 Current indicator
31 Red plus blue
34 No continuity
35 Logic gate
37 Output impedance
38 Opposition to change
39 Red plus green
40 33-1/3 RPM record

DOWN

1 Logic gate
2 EMF measurement
3 Magnetic coupler
4 Single sideband
5 Plug-in mounting
6 Tube capacitance (prefix)
8 Give off electrons
10 Filter coil
12 Semiconductor
13 Volume units (P1)
15 Blue plus green
20 Hourly charge
21 Selective circuit
22 Troubleshooting step
25 Four element tube
26 Non-directional
28 Meter scales
32 Amplifier rating
33 Frequency attenuator
36 A dielectric

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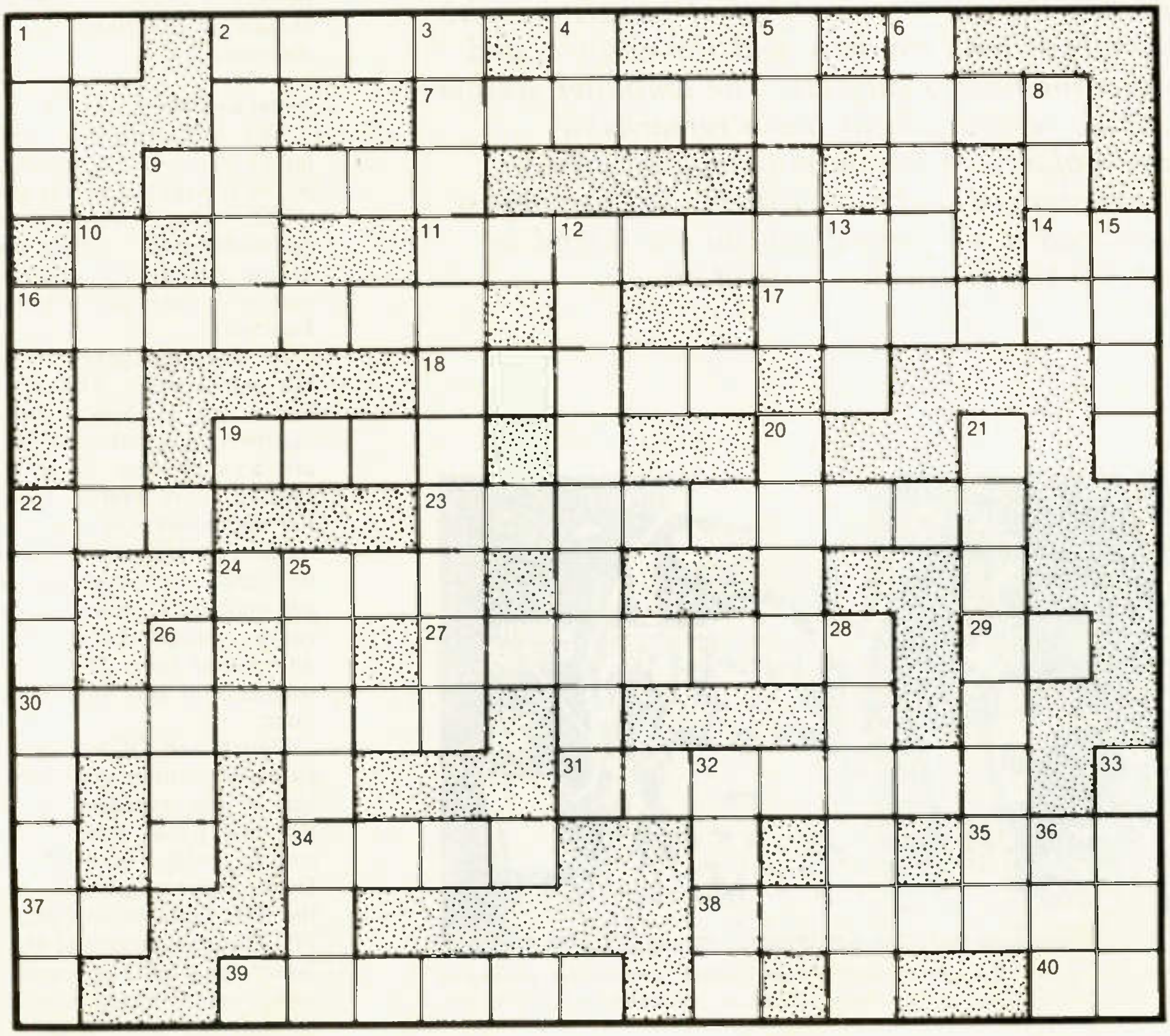

Servicing Sylvania Color TV, Part 3

By Gill Grieshaber, CET

In addition to detailed explanations of the Sylvania E44 vertical-sweep system, other practical information is included about how to predict the output waveform of transistors with signals at both the base and the emitter, and other interesting subjects. The amplifier section of this vertical circuit has a remarkable resemblance to the output stage of some transistorized audio amplifiers. So, we suggest you read it all, even if you do not intend to service this particular vertical circuit.

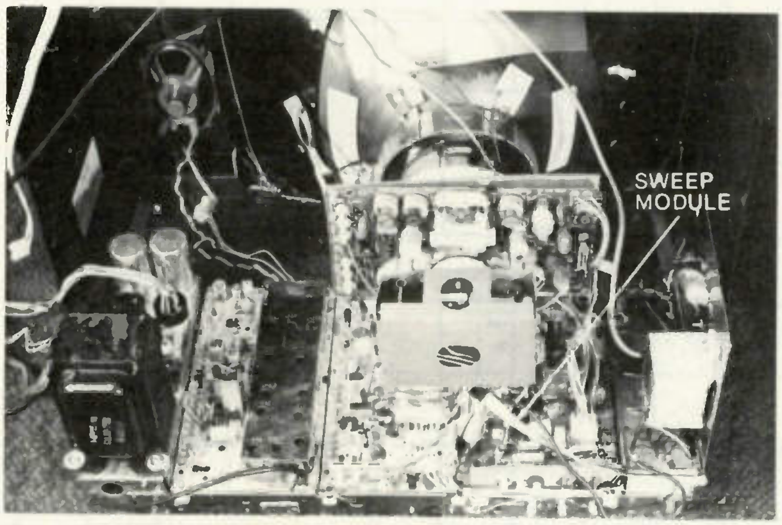

Figure 1 All of the vertical-sweep components (except the yoke and top/bottom pincushion parts) are located on the sweep module of the E44 Sylvania.

No conventional vertical oscillator is used in the E44 Sylvania chassis. Instead, an IC digital-countdown system produces both horizontal and sweep frequencies, as described last month.

Essentially, this vertical-deflection system amplifies the signal from the countdown IC, shapes and linearizes the signal, provides for height adjustments, and furnishes power amplification to drive the yoke.

That brief recap of the circuit functions omits some unusual waveforms and well-engineered circuits, which are interesting subjects for detailed analysis.

Stage-By-Stage Operation

Locations of the principal vertical-sweep components are shown in Figure 1 and Figure 2, so you can become acquainted with this new chassis as the circuit operation is discussed.

Buffer amplifier

The Negative-going vertical-rate pulses from pin 7 of the countdown IC300 are applied to the **emitter** of Q302, which functions as a "grounded-base" buffer amplifier, having a noninverted output at the collector (see the schematic of Figure 3).

No signal is applied to the base, but one is there. This is unusual, but it has a logical basis. The negative-going pulses at the emitter are forward bias for Q302, thus causing base/emitter conduction. For the duration of each pulse, this conduction is similar to a low-value resistance connected between base and emitter. Therefore, some of the emitter pulses also appear at the unbypassed base. The amplitude is smaller, but the waveshape is the same.

Signals and DC voltages at both base and emitter contribute to the bias of any transistor. In this case, the base pulses subtract from the emitter pulses to reduce the effective input amplitude. Therefore, the B/E signal is less than 2 volts PP. The phenomena of the emitter input signal also appearing at the unbypassed base is unique to bipolar transistors. It can't happen

Sylvania

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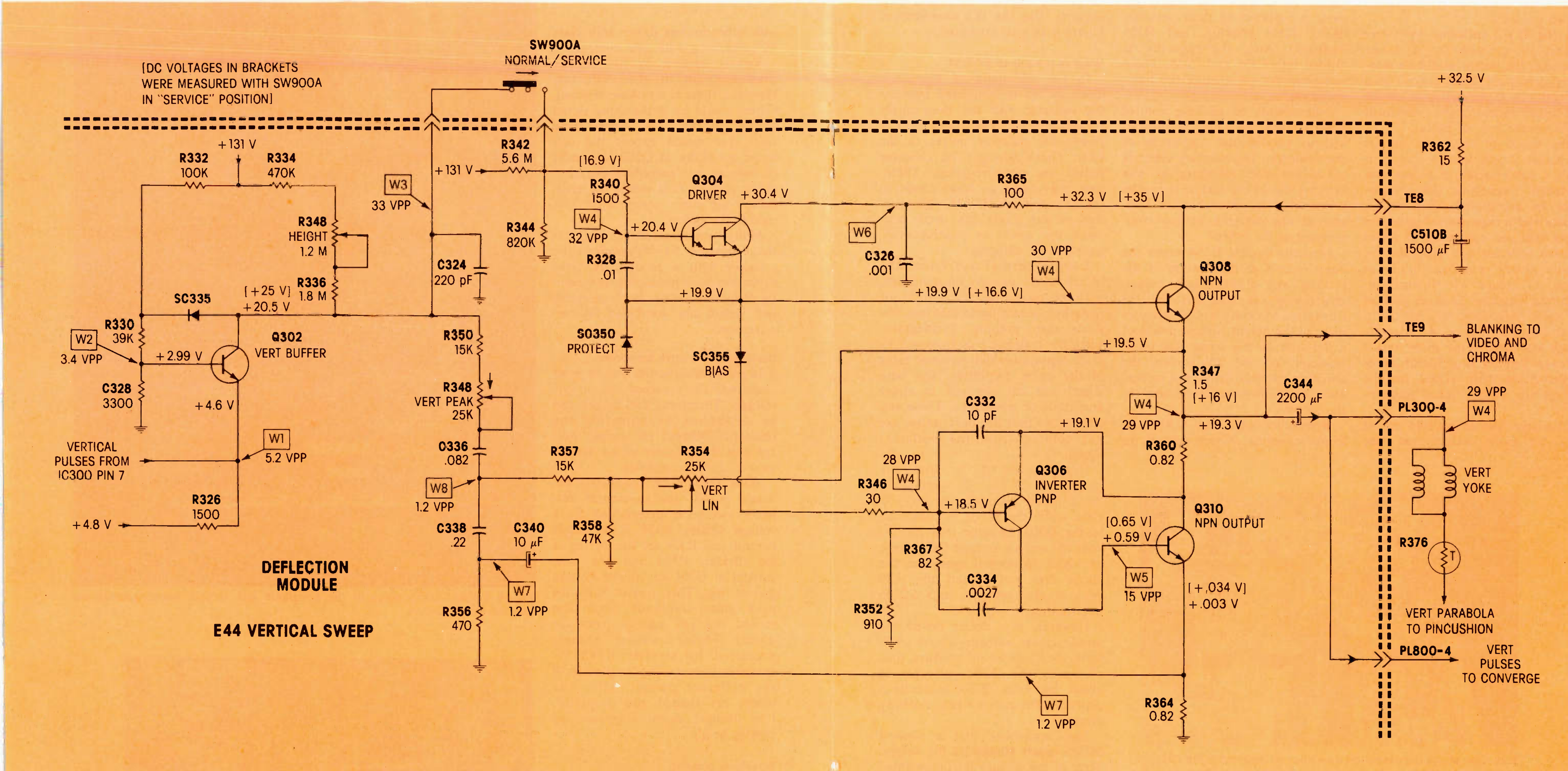

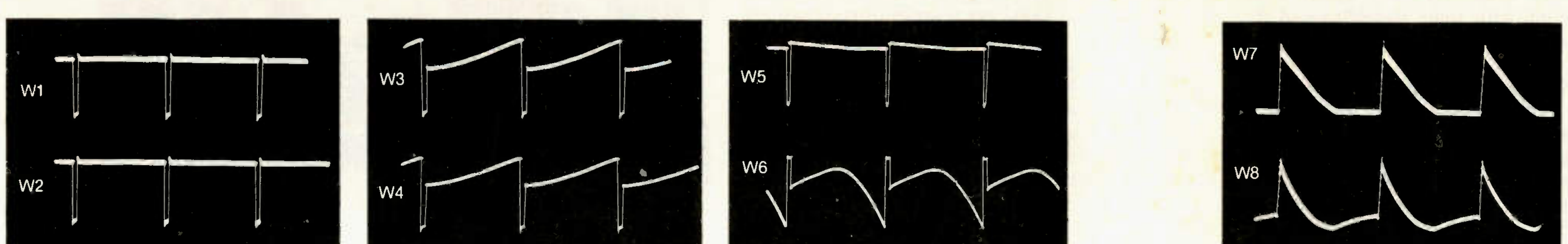

Figure 3 (above) This is the schematic of the entire vertical-sweep system. There is no conventional oscillator, so most defects that give poor height or linearity will not change the locking. The vertical-output transistors are wired in a "totem-pole" configuration, which resembles many audio-output circuits. Several waveforms are marked "W4" because they were nearly identical. The peak-to-peak values are listed with each one, and the waveforms are shown in Figure 4.

Figure 4 (at left) These are the waveforms for Figure 3. The vertical lines have been touched up to make the waveforms more clear.

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form at the Q302 collector must be shaped properly.

If the Q302 collector were bypassed to ground by a large capacitor, the pulses would be integrated (low-pass filter action) into sawteeth. Or if the collector circuit had linear resistors, the waveform would consist only of pulses.

The signal to drive the output transistors should have a waveform that's a combination of pulses and sawteeth. Therefore, **the components to accomplish this are a resistor and a capacitor of optimum values that are connected in series between collector and ground.** The resistor allows some amplitude of pulses to escape the integration, while the capacitor changes part of the pulse amplitude into sawteeth, as shown in Figure 4. Similar wiring was used in the plate circuit of some horizontal-oscillator tubes to shape the drive signal for the grid of the output tube. Remember?

Of course, the actual E44 circuit is a bit more complicated (see Figure 3), because the single resistor is replaced by three resistors (R350, R348 peaking, and R356 feedback). Also, the capacitor is divided into C336 and C338. These variations do not change the basic operation.

Adjustments of peaking control R348 change the pulse amplitude, without varying the amplitude of the sawteeth. The primary effect is to adjust the linearity at the extreme top of the raster. It can be misadjusted to cause bottom foldover at one extreme, or top compression at the other.

Linearity control R354 varies the linearity only at the bottom of the picture, and R348 height adjustments vary the size but not the linearity. Maximum CW adjustment of the height control produces a flat spot on the scope waveform. However, on the TV screen, the scanning extends below the screen, and the foldover can't be seen in the picture.

Remember that the Q302 collector waveform is very critical for obtaining good vertical-sweep linearity. Use the W3 waveform of Figure 4 as your standard.

What is the job of SC335?

In the schematic of Figure 3, diode SC335 is connected between the collector and the base-supply voltage of Q302. You might think it passes the collector pulses to the base. That's wrong. The collector pulses are negative-going. Therefore, they can't go from anode to cathode through SC335. (Conduction of any diode can occur only when the anode is positive compared to the cathode.)

During normal operation, the SC335 diode can be disconnected, without changing the height or linearity. According to this test, the diode does nothing. Incidentally, when the collector was bypassed by a .22 capacitor which removed most of the pulse amplitude, the base signal was not changed in either amplitude or waveshape. These two tests prove that the base pulses are not coming from the collector signal.

Next, we'll try to find the purpose of SC335. DC voltage at the cathode measures about +39 volts, while the anode is connected to the Q302 collector that has 33 volts PP and an average DC voltage of +20.5. In normal operation, the anode does not exceed the +39 volts at the cathode, and SC335 does nothing.

However, if a defect raised the anode peak voltage above +40 volts, the diode would conduct, thus clamping the Q302 collector to about +40 volts. SC335 evidently is a protective component, nothing more.

But, remember that **a shorted SC335 nearly eliminates the height.** Most of the picture is concentrated in a horizontal band about 1-inch high, with some widely-spaced dim scanning lines above.

Why are R342 and R344 included?

Elimination of the height during adjustments of the gray-scale tracking is accomplished by SW900A, which merely opens the path between the collector of Q302 and the base of driver transistor Q304.

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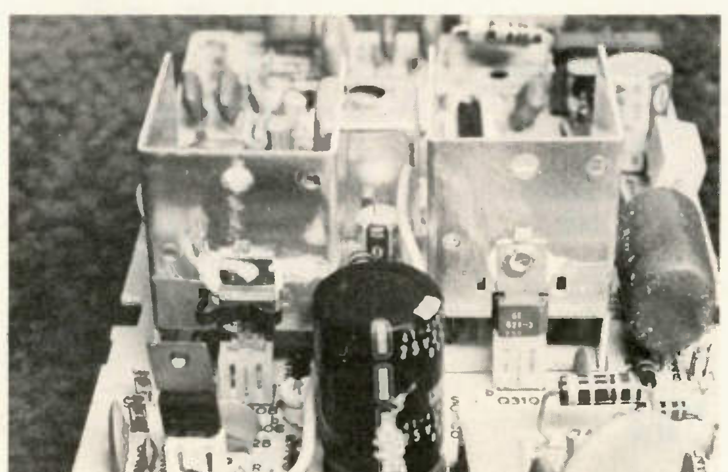

This view of the deflection module after removal from the chassis shows many of the vertical components. The power transistor at the lower left is Q304, the driver. Both output transistors are mounted on large aluminum heat sinks. Q308 is at the left, and Q310 is at the right. The transistors plug into sockets, and the heat sinks come out with the transistors. Just squeeze the two top front edges of the heat sink towards each other, tilt up the front part of the heat sink (to release the catches) and the heat sink with transistor easily lifts out. Evidently, these outputs come from different sources, for one was mounted by a screw, and the other of a different shape was mounted by a metal spring. The heat sinks are connected to the collectors, making fine test points. The black part at the lower center is the output capacitor C344. All of the solid-state components of the vertical circuit are mounted in sockets for easier servicing.

with tubes (unless driven into class "C" operation with grid current).

Signals applied to the emitter produce gain at the collector. However, there is no phase reversal. (There would be if the same signal entered at the base.) From these facts, you would expect the collector waveform of Q302 to consist of nothing but amplified negative-going pulses. This would be true, except for some components that modify the pulses.

Many vertical circuits integrate these pulses by bypassing the collector with a moderately large capacitor, and producing sawteeth. In the E44 circuit, both sawteeth and pulses are combined in one waveform.

Developing the drive waveform

In pulse circuits, the output peak amplitude can't exceed the supply voltage. Therefore, the height can be controlled by adjusting the resistance between the supply voltage and the collector of an oscillator or a buffer amplifier.

When Q302 is not conducting between pulses, the maximum collector voltage is determined by a voltage divider. R334, R348 height control, and R336 are the top leg of the divider. R344 and the base current of Q304 act as the bottom divider leg. This means that the peak pulse amplitude never can exceed the DC voltage from the divider. Higher collector voltages produced by smaller R348 resistances increase the amplitude of the collector pulses. After the pulses are shaped and amplified, this stronger signal increases the picture height.

Waveform shaping

Between ground and the collector of Q302 are a series of resistors and capacitors. These parts have two primary functions. Negative feedback signals from two points of the output stage are brought to the ends of C338, where they improve the linearity (this will be explained later in more detail). However, the other function of this network is even more important. The wave-

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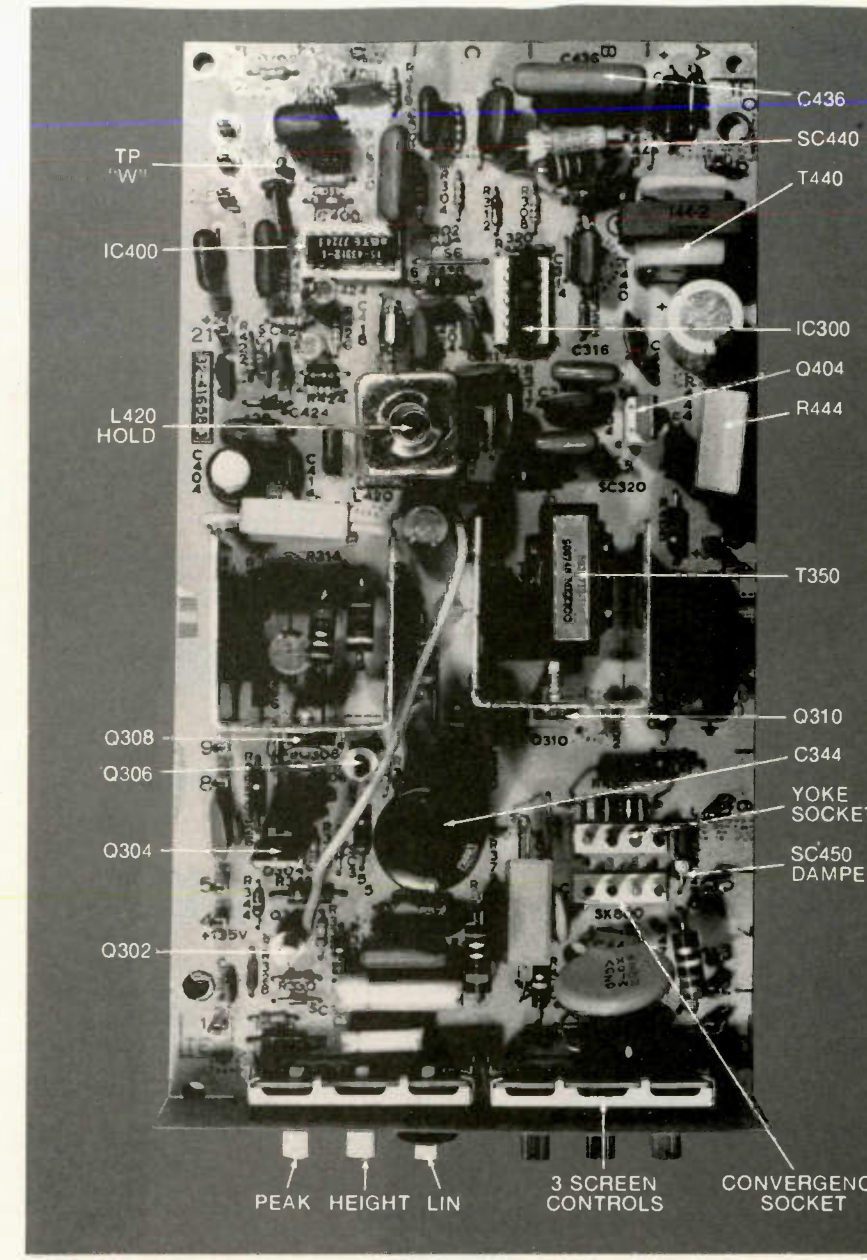
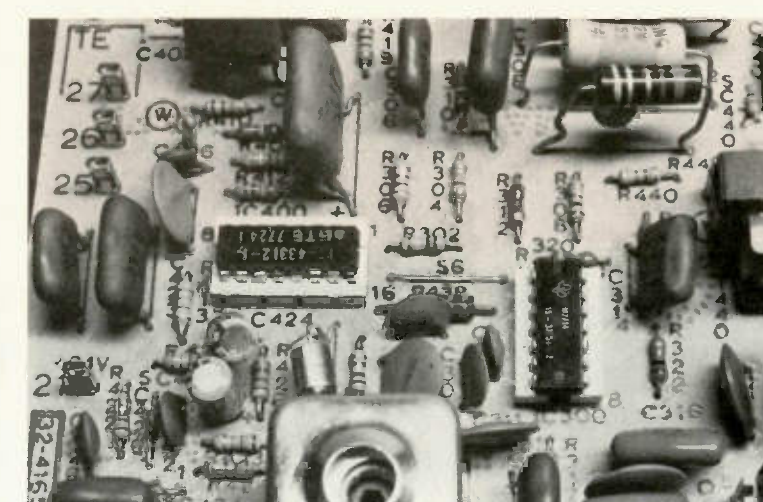
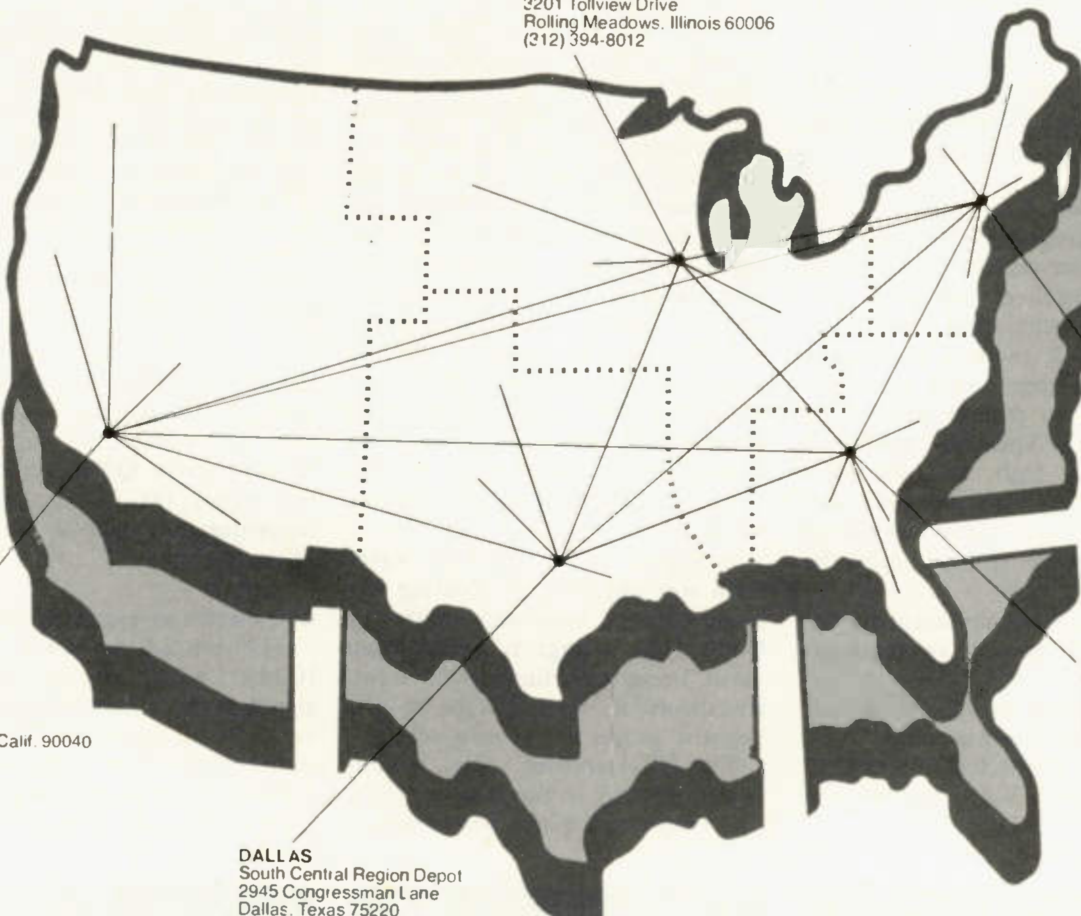


Figure 2 Major components of the horizontal and vertical sweep circuits are pointed out by arrows.



The IC at the right is IC300, which provides both the horizontal and vertical frequencies.

Seven years ago we split the country today we've got it all together



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Without R342 and R344, about +35 volts would be dropped from collector to emitter of output transistor Q308. The R342 and R344 voltage divider provides about +17 volts DC (there is no AC signal then) to the base of Q304. Essentially the same voltage is passed on to the Q308 base, and indirectly it provides Q310 with about the normal amount of bias and C/E voltage.

In Figure 3, the DC voltages shown in parenthesis are the ones measured when SW900A was open, in the "service" position.

Driver operation

Driver transistor Q304 appears to be a medium-power plastic type with an attached collector-connected heat sink. But, the schematic shows it to be a darlington type. That is, the power transistor has an internal emitter follower to drive the base. Therefore, the input impedance is high, and the base current is low. This prevents any distortion of the drive waveform because of excessive loading by the driver base.

Use the correct replacement for Q304. **Don't use a conventional power type.**

Q304 operates as an emitter follower, with the output signal from the emitter connected directly to the base of Q308, one of the outputs.

Of course, emitter followers have approximately the same signal amplitude and waveform at both base and emitter. Figure 3 and Figure 4 show the same W4 waveform for both, at 32 VPP for the base and 30 VPP for the emitter. Also, the W6 collector waveform is shown. It's not important, but is included to show normal operation for this circuit. Most emitter followers have the collector heavily bypassed, so there is no appreciable collector waveform.

Although the input signal in most circuits is applied to either the base or the emitter (not to both), **the input actually is the signal between base and emitter.** This also applies to emitter followers; however, the base has the input signal, and the emitter output is a negative-feedback signal that cancels part of the base signal. This small remaining B/E signal is the true input signal, which is difficult to visualize since it is so much smaller than the separate base and emitter waveforms.

In Figure 5, the 1.1 VPP waveform was obtained by floating the scope between base and emitter of Q304. (The voltage is higher than usual, because darlingtons have two transistors in series.) Tips of the negative pulses are at zero voltage.

The Q304 emitter signal is connected directly to the base of Q308 (the output transistor that supplies the height at the bottom of the TV screen). Also, the signal goes through diode SC355 and a resistor to the base of Q306, which inverts the signal for Q310, the output transistor that deflects the top half of the picture.

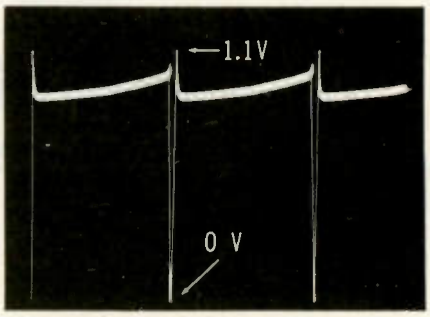

Figure 5 This is the base-to-emitter waveform of Q304, the driver transistor. It is made up of the difference between the base waveform and the emitter waveform. Zero volts is at the bottom tips of the pulses, and the total amplitude is 1.1 VPP. About 0.6 volt of the waveform is below the base conduction point of the darlington transistor, so that much of the negative end of the pulses is not amplified by the transistor.

Complementary-symmetry outputs?

The output coupling capacitor (C344), which feeds the sweep signal to the yoke windings, and the symmetrical appearance of the two output transistors might appear to indicate a complementary-symmetry type of output. This is not true.

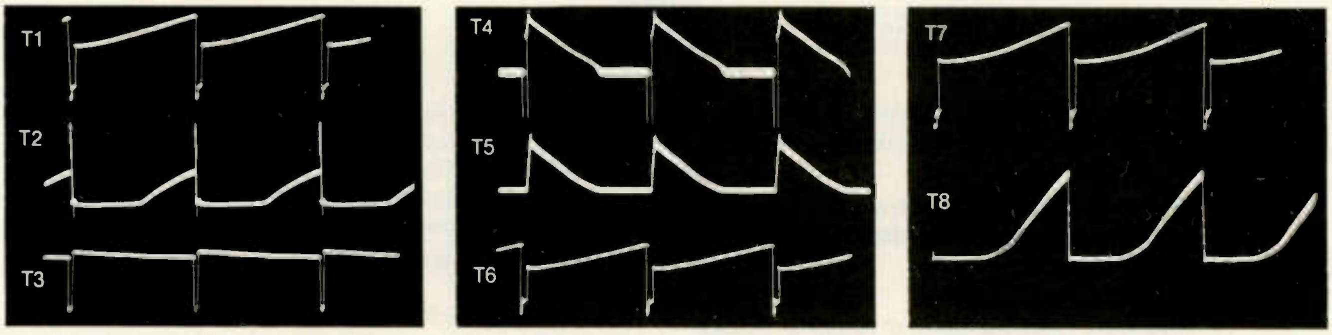

Figure 6 These are waveforms of the Q306/Q310 phase-inverter/amplifier system. Trace 1 is the waveform at the base of Q306. It's the same as W4 in Figure 4, but reduced in amplitude. Trace 2 shows the B/E waveform of Q306. It is made by subtracting the emitter waveform (which comes from the collector of Q310) from the base waveform. Trace 3, the Q306 collector waveform, appears to be a nearly-straight top base line with large pulses. However, when it is expanded vertically by more scope gain, Trace 4 shows the top base line has definite sawteeth. The pulse tips are completely off the bottom of the scope screen. This waveform also is the base signal of Q310. Trace 5 is the current waveform for the emitter current of Q310. It is taken across R364. Trace 6 is the waveform at the collector of Q310. It's similar to W4 of Figure 4. Trace 7 is the waveform at the emitter of Q308 (the base waveform is like that of Trace 1). Trace 8 shows the Q308 emitter current, because the scope was across R347. Trace 5 and Trace 8 show that Q310 and Q308 each draw a sawtooth current for a different half of the cycle.

Notice that both output transistors are NPN polarity types; complementary-symmetry outputs have one PNP and one NPN.

Complementary-symmetry circuits do not have a phase inverter (Q306 in this case) before one output transistor.

These distinctive differences prove the output circuit is a totem-pole and not a complementary-symmetry type.

Q308 is operated as an emitter follower (deflecting the bottom half of the raster), and the base and emitter waveforms are almost identical. The Q310 half of the output circuit is more complicated.

Drive for NPN Q310

The Q308 base signal also is sent through SC355 and R346 to the base of Q306, which functions as a phase inverter.

Although the circuit has only a few parts, the operation involves complex theory. For example, Q306 is connected in the common-emitter configuration, which gives highest gain. Yet, when we examine the signal requirements for the Q310 base, it's clear that gain is not wanted. Gain would provide the Q310 base with more drive than the Q308 base has.

Another complicating factor in achieving equal power from both output transistors is that Q308 is an emitter follower with a gain of nearly one. By contrast, Q310 has output from its collector, a circuit that usually provides a voltage gain. (When carried beyond the superficial level, circuit analysis is not simple.)

Several factors reduce the gain of the Q306/Q310 system. First, the gain of Q306 is reduced by loading from the very low Q310 input impedance. In turn, the Q310 gain is low because the collector is feeding a low-impedance load (the yoke). However, **the main factor that reduces the gain** (and stabilizes it) **is the negative feedback from the collector of Q310 to the emitter of Q306.**

Before we analyze the Q306/Q310 operation in detail, we need to know what these two transistors are supposed to do in general. **The Q306/Q310 circuit should produce a current gain (power gain) along with unity voltage gain without phase inversion.** Both Q306 and Q310 are connected to invert the signal, so the signals at the input of Q306 and the output of Q310 will have the same phase.

The remainder of the explanation can be learned by a careful analysis of the Figure 6 and Figure 7 sweep waveforms. Many of these waveforms have never been shown before.

The Q306/Q310 system

The base signal for Q306 comes from the Q308 base through diode SC355 and R346, while R352 functions as the lower leg of a voltage divider to reduce the AC and DC signals that are applied to

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the base of Q306.

During measurement and analysis of this circuit, I wondered about the precise function of SC355. In other models, such a diode gives a bias offset to reduce "crossover" or "notch" distortion. To determine the effects of SC355, I shorted across it while watching the TV picture. The top half of the picture moved down slightly, the bottom half moved up a bit, and a light horizontal bar made up of compressed scanning lines appeared at the vertical center of the screen. So, SC355 eliminates "notch" distortion, and is very essential in this circuit.

At the base of Q306, the waveform is approximately the same as those W4 waveforms found at the collector of Q304, Q308 emitter, and the output at C344. Notice that the amplitude is about 28 volts peak-to-peak, which would be very excessive in a conventional amplifier. But, the emitter of Q306 has a negative-feedback signal of nearly 100% coming from the collector of Q310, and this greatly reduces the gain by phase-cancelling part of the input signal.

The waveforms at the base and emitter of Q306 are so nearly identical that you probably could not see the difference, even using a dual-trace scope. That's why we showed only one waveform at trace #1 in Figure 6.

But there *is* a slight difference, for **the emitter waveform is subtracted from the base waveform to produce the true input of Q306** (Figure 6, trace #2). The same waveform was obtained by subtracting the base and emitter waveforms inside a dual-trace scope, and by connecting one scope channel between base and emitter.

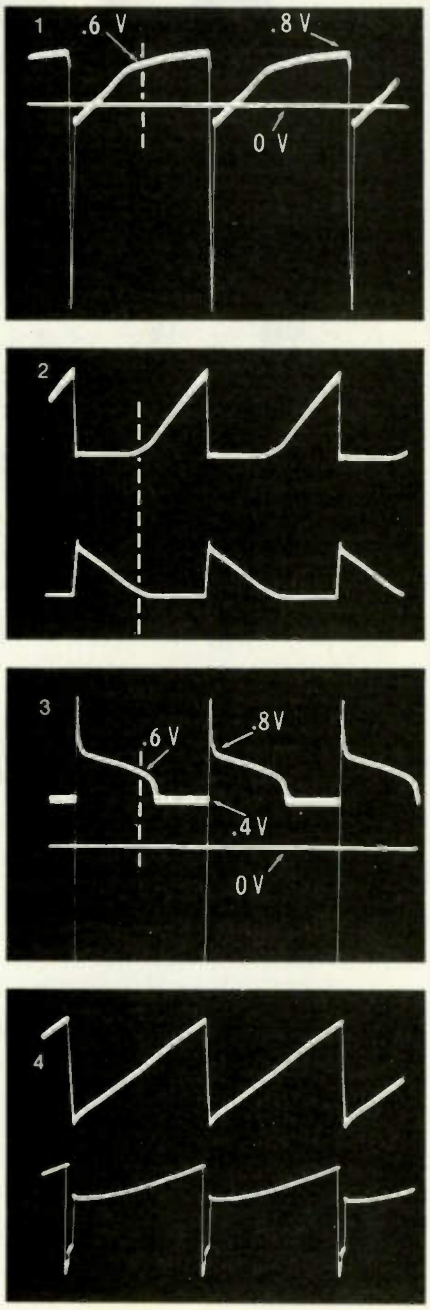
Trace #3 is the Q306 output at the collector, which is connected to the base of Q310. The waveform seems to be mostly negative pulses, but we'll soon find out that the base of Q310 ignores any negative voltage or any positive voltage below the cutoff-bias point.

To show the true waveform from the viewpoint of the Q310 base, I increased the scope gain, obtaining the trace #4 waveform. The negative pulses could be seen faintly, extending far below the bottom of the scope screen.

When you remember that Q310 is a NPN type, it's clear that Q310 should draw maximum current at the beginning of the vertical sweep (top of the TV screen, and the left half of each cycle on the scope screen). That's exactly what occurs, as proved by trace #5 taken across R364. Since R364 is between Q310 emitter and ground, the voltage waveform across it truthfully shows the waveform of the transistor current.

Trace #6 shows the waveform at the collector of Q310, while the waveform at the Q308 emitter is shown by trace #7. These two waveforms are very similar, but each is tilted a different direction by the individual transistor currents. Both waveforms are combined at the junction of R347, R360 and C344 to form the vertical-sweep output signal.

Q308 current is shown by trace #8, which was taken across R347. Compare this waveform to trace #5, the Q310 current. The Q310 cur-



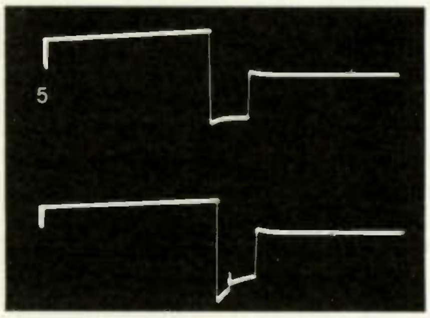


Figure 7 DC scope waveforms with the zero-voltage line are necessary for understanding of these transistor biases and currents. Photo 1 is the Q308 base-to-emitter waveform with zero line. Remember that the transistor draws no current until the forward bias exceeds 0.6 volt. So, the transistor should draw a sawtooth current during the second half of the cycle. The top trace of Photo 2 (emitter current of Q308) proves the previous prediction. Photo 3 shows the Q310 base-to-emitter waveform with zero-voltage line. Since it will draw no current except when the forward bias is +0.6 volt or more, we predict Q310 will draw a sawtooth current for the first half of the cycle. The emitter-current waveform (Photo 2 lower) follows the prediction. These waveforms prove that any parts of the B/E waveform falling below 0.6 volt (for a silicon transistor) do not appear in the output signal. Photo 4 shows the sawtooth of yoke current, and the lower trace is the normal output waveform at C344. Photo 5 shows yoke ringing. The top trace is a widened negative pulse at the output when the yoke is replaced by a resistor (to eliminate any yoke ringing). The bottom trace is the normal tip of the negative pulse at the output signal when the yoke is in operation. The waveform does not change enough to be a good symptom of an open yoke.

rent produces height for the top half of the picture, and the Q308 current contributes height for the bottom half.

But did you notice that both transistor emitter currents were positive-going? That seems wrong, because yoke current must swing alternately between negative current and positive current, with zero current in between. Here's the explanation: The increased Q308 current charges C344 to a higher voltage, while increased Q310 current discharges C344 to a lower voltage. The yoke is operated from the charging current at the output of C344.

Linearity Adjustments

Both the peak control and the linearity control affect the linearity of the vertical sweep, while the height control does not vary the linearity to any noticeable degree.

The linearity control adjusts the amount of negative feedback brought to the peaking circuit from the output signal. Exactly how this operates is not clear.

Amplitude of the negative-pulse portion of the waveform at the collector of Q302 is determined by the peaking control. This affects spacing of the scanning lines mainly at the top of the picture. However, when the pulse amplitude is excessive, the bias of some subsequent transistors is upset, thus compressing the bottom of the sweep.

Proper operation of all three controls produces good linearity.

Questions?

Has the previous discussion answered all of your questions about the vertical sweep of the E44 Sylvania? Well, I thought I understood it all until I remembered some doubts about the pulses in the sweep output waveform. From a detailed analysis of tube-powered vertical sweep in **Electronic Servicing** (October 1971), I remembered that the pulses in the vertical-output signal did no work. Only the sawteeth contribute to the height. In the older TVs, the pulses were formed by ringing of the yoke and output transformer. Some solid-state vertical-sweep circuits clip off part of the pulses to protect the transistors.

Since the relative ratio of pulse to sawtooth in the Sylvania E44 circuit was almost identical at the Q302 collector and at the output of the yoke, it seemed the circuit merely amplified the input waveform.

However, if that was true, the huge negative-going pulses at the base of Q310 should have appeared as amplified positive-going pulses at the collector. When these were added to the Q308 emitter signal, the positive pulses should have cancelled the negative ones coming from Q308, or even overpowered them leaving the output waveform with positive pulses. Evidently the operation is different from conventional linear amplification.

Below cutoff bias

We have hinted before that any parts of input waveforms which are below the forward bias needed to barely begin C/E conduction are not amplified, and do not appear in the output signal. Before we can know which parts of the input signal will be amplified and which will be ignored, **we must know what parts of the input signal are forward bias and which are cutoff bias.**

Correct answers were provided by using a dual-trace scope to show the true zero-voltage line in several important waveforms (see Figure 7). Some of these waveforms were shown before, but without the zero line.

Q308 input signal and base current

Photo 1 in Figure 7 is the Q308 input waveform between base and emitter, with zero voltage shown by the horizontal line through the waveform.

A transistor must have base current to produce collector current. Also, no waveform can appear in the output without being formed by a variation of the C/E current. Therefore, if the pulses in the output come from Q308, the current waveform of Q308 *must* have pulses.

We can know where collector current *should* flow during each cycle by knowing where the base

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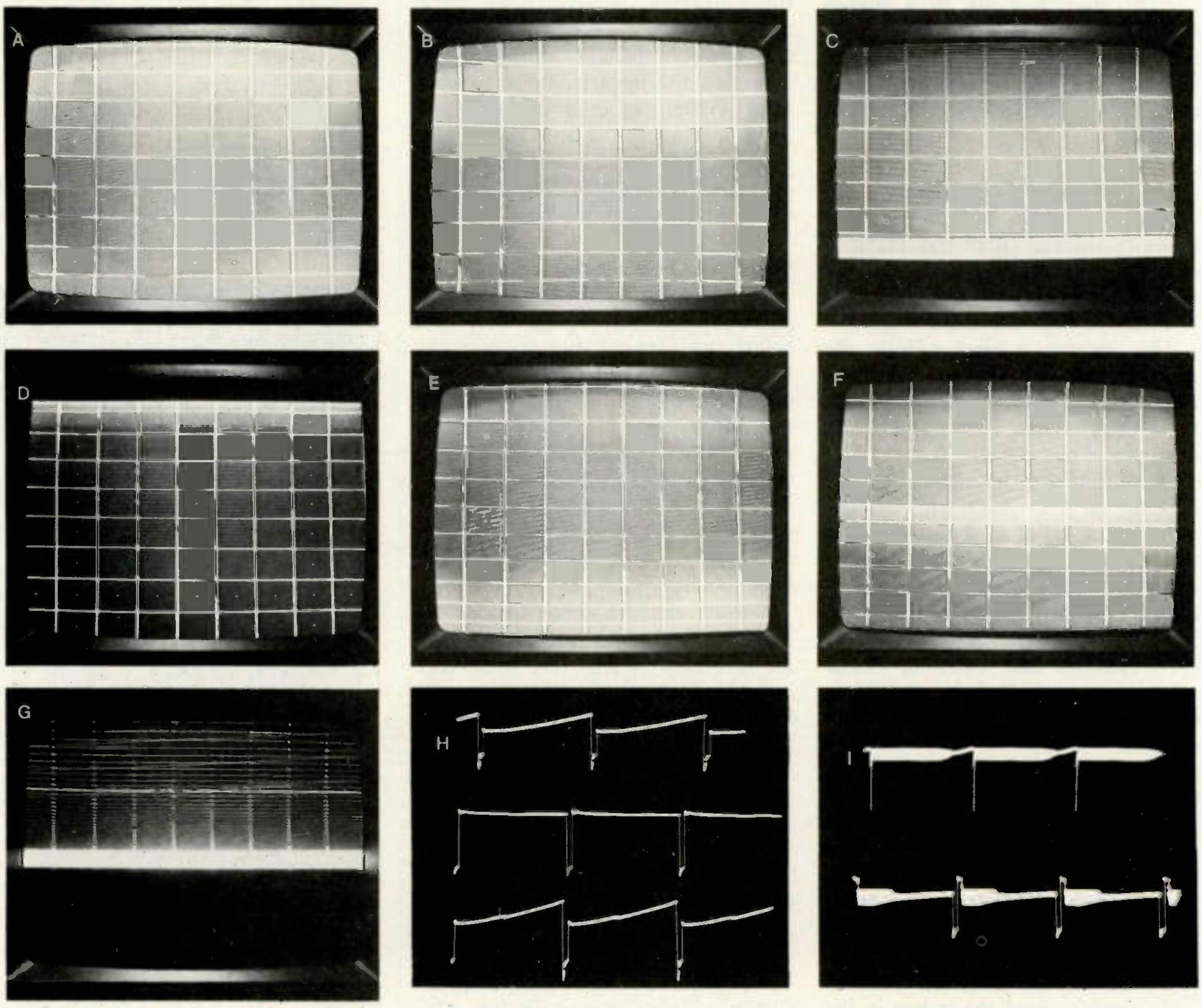
draws current. Right away without any accurate measurements, we know that the 3-VPP negative-going pulses are cutoff bias, and so will not affect the current nor the output waveform.

The steep slope of the distorted sawtooth shape is the beginning of a linear sawtooth waveform. However, it does not remain linear, because at a certain positive forward-bias voltage, the base current begins to flow. For the remainder of the cycle, the added load of the increasing base current compresses the steep sawtooth into a gradual slope.

In other words, the steep slope shows where the forward bias of the input signal is not sufficient to cause base current, and the gradual slope shows where the base is drawing current. Of course, higher base voltages produce higher base current (and higher C/E current).

The rounded shoulder between the two slopes marks the point where base current first begins to flow. The scope showed the voltage at that point was +0.6 volt (obviously, it was a silicon type). From this voltage, the input signal voltage rises slowly to almost +0.8 volt just before vertical retrace.

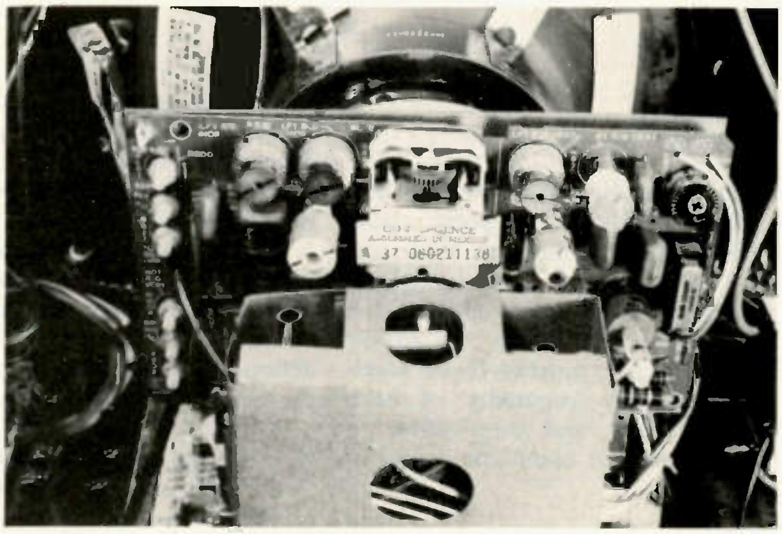
If our interpretation is correct, Q308 should have zero collector



These pictures from the Sylvania picture tube and the scope screen show the visual effects of several parts defects. (A) This crosshatch pattern is normal, for comparison. (B) Lack of height near the center of the raster prove the top/bottom pincushion correction has been eliminated. (C) Spreading at the top and foldover at the bottom result when the peaking control is turned fully clockwise. (D) Turning the peaking control to the CCW end compresses the top. (E) A CCW adjustment of the linearity control compresses the bottom and spreads the top scanning lines. (F) Foldover at the center is the symptom of a shorted SC355 diode. (G) When diode SC335 is shorted, there are wide-spaced scanning lines at the top and a small deflection near the center. (H) The top scope waveform is the normal output waveform at C344, for comparison; the trace at the center is the flattened waveform when SC335 diode is shorted; and at the bottom, the tiny notch near the center of each cycle is caused by a shorted SC355 diode. (I) These 2 waveforms are so distorted that they can't be recognized as the sweep output. The top trace is caused by an open Q310, while an open Q308 gives the bottom trace at the output.

current until the midpoint of the cycle. Then the C/E current should increase steadily to a maximum at the end of the cycle just preceding retrace.

The top trace of photo #2 in Figure 7 proves the prophesy is right. Connecting the scope across R347 (the Q308 emitter resistor) gives a voltage waveform that corresponds to the current waveform. Notice the absence of any spike or pulses. **The pulses in the normal output waveform to the yoke certainly did not come from Q308.**



Components of the top/bottom pincushion circuit are clustered near the right-top corner of the convergence board (that's mounted on the neck of the picture tube).

Q310 input signal and current

If the base-to-ground waveform of Q310 is viewed in the conventional way, most of the amplitude is in the negative-going pulses (see waveform W5 in Figure 4), with the sawtooth portion so small that it appears as a minot tilt of the upper base line.

But when the scope is connected between base and emitter of Q310, the scope gain is increased greatly, and a zero line is added (see photo 3 of Figure 7), it is plain that all of the pulse amplitude is negative when compared to the +0.6 volt that's necessary to produce base (and collector) current. Also, the top base line which appeared nearly flat now has a reversed and distorted sawtooth shape between each pair of pulses.

Ignoring for the moment the small positive-going pulses at the beginning of each cycle, we notice that the B/E signal is about +0.8 volt at the start of each cycle (the top of the TV screen), and it drops smoothly down to about +0.6 volt

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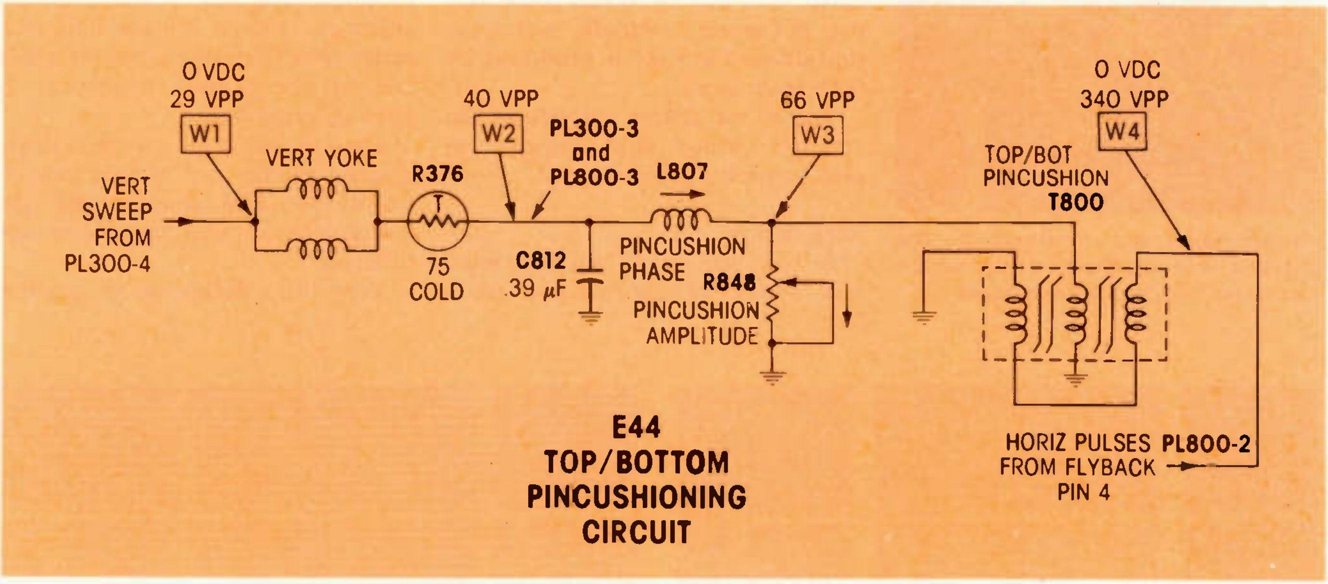
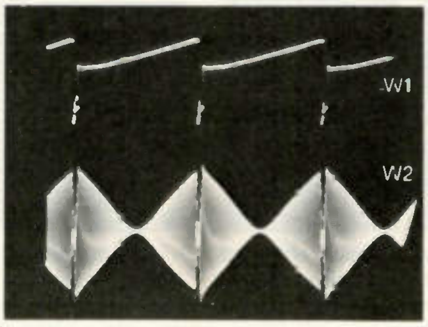
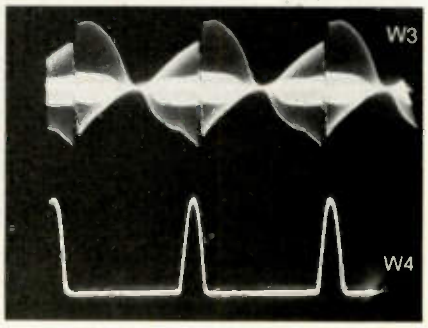


Figure 8 (above) This is the schematic of the top/bottom pincushion-correction circuit. The waveforms are in Figure 9.

Figure 9 (at right) These are the waveforms for the top/bottom pincushion circuit of Figure 8.





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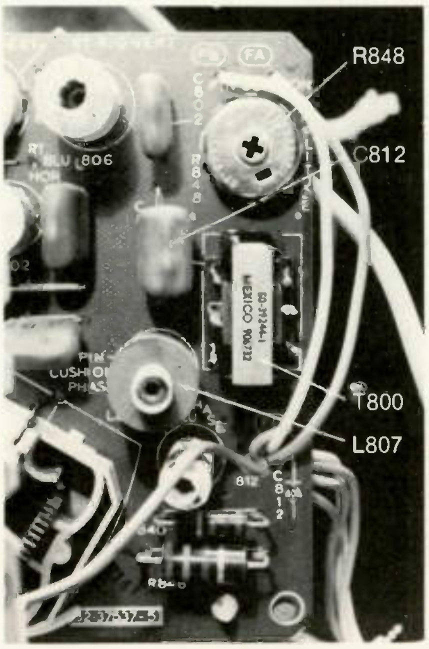
before rounding the shoulder and falling rapidly to a point about +0.4 volt above the base line.

This waveform approximately is an upside-down version of the Q308 B/E signal. Therefore, we expect the Q310 C/E current to be maximum at the beginning of each vertical cycle and drop down to zero current at about the center of each cycle.



Arrows point out locations of the Sylvania E44 top/bottom pincushion circuit on the convergence board.

The bottom trace of photo #2 in Figure 7 proves the theory is true. This is the waveform of the Q310 C/E current taken from the emitter resistor, R364.

The waveforms of Figure 7 show that **each output transistor conducts for half of the time** (class "B" operation), with Q310 providing deflection at the top and Q308 at the bottom of the TV screen.

Where do the output pulses originate?

We skipped over the moderate-amplitude positive pulses in the Q310 input waveform of photo 3. The tips of these pulses apply about +1.2 volts to the Q310 base, driving the transistor in total saturation.

Look again at the current waveforms of photo 2. The Q308 current (top trace) shows no significant pulses at either top or bottom, while the Q310 current (lower trace) has a small positive-going pulse at the top of each sawtooth. After inversion by Q310, these pulses are stretched into large negative-going pulses. The pulses are supplied by Q310 and not by Q308. However, the deflection sawtooth waveform that drives the yoke is produced by both transistors.

These waveforms illustrate the strange things that happen in direct-coupled pulse circuits.

Yoke ringing

A test was made to determine how much of the output pulse amplitude was coming from yoke ringing. I was surprised to find almost no pulses added to the waveform. In Figure 7 photo 4, the top trace shows the linear vertical yoke current (obtained by connecting the scope in parallel with a small resistor in series with the yoke). Below it is the normal vertical-output waveform.

In photo 5, the top trace shows one expanded output pulse after the yoke was disconnected. Notice the square corners of the pulse. The normal pulse with the yoke connected is shown by the lower trace. Yoke ringing adds only a small extra overshoot to the left side of the tip.

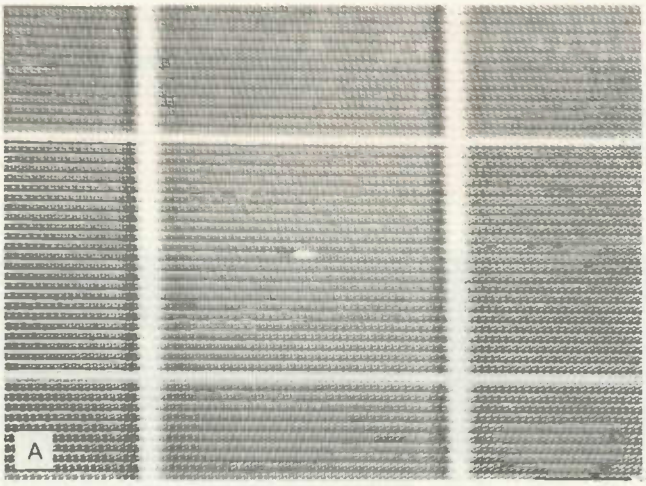
Troubleshooting tip: the output waveform changes very little when the yoke is open. Don't depend on the waveform to indicate an open yoke.

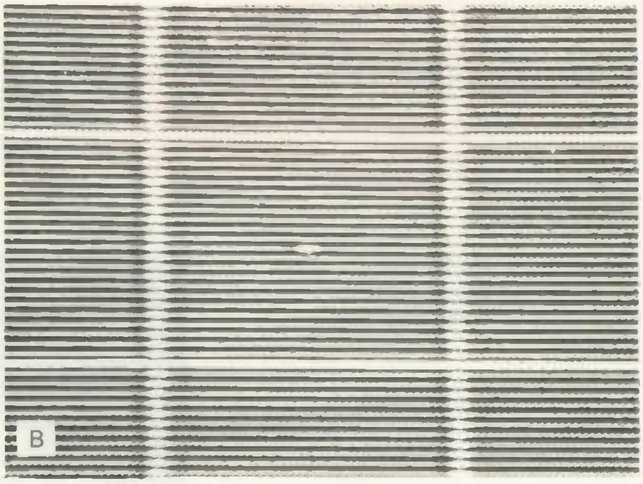
Open output transistors

Complementary-symmetry output stages (not this one) that have both a positive and a negative supply (and do not need an output-coupling capacitor) still can deflect either the top or bottom half of a raster with fair linearity when either one of the output transistors is open or removed.

That is not true of the single positive voltage and output capacitor of the E44 chassis, and the symptoms of open transistors are different.

Very little deflection is possible





Sylvania TV receivers with the count-down circuit are said to have perfect Interlace (which is not true of many sets). By using the interlace option of the American Technology ATC10 generator, we found the interlace to be good. Photo A is a closeup of the crosshatch pattern with interlace, and Photo B is the same pattern with the interlace turned off.

with either one of the output transistors removed or open.

Top-And-Bottom Pincushioning

Figure 8 is the schematic of the E44 top/bottom pincushion-correction circuit. Vertical-sweep current from the cold end of the yoke upsets the balance of the T800 pincushion transformer. When unbalanced, the transformer permits the horizontal pulses to enter the center winding of T800. These horizontal pulses are filtered by L807 and C812 into parabolic shapes which are added in series with the vertical yoke to increase the height near the center of the horizontal scanning lines. L807 can be adjusted to change the phase or tilt of the correction, and R848 adjusts the amount of correction.

The center winding of T800 does double duty. The yoke current passes through it to trigger the release of horizontal energy, and the filtered horizontal signal is applied to the same vertical current that passes through the center winding.

Figure 9 shows waveforms of the pincushion-correction circuit.

Comments

Troubleshooting the Sylvania E44 vertical-sweep system has both similarities and differences when compared to analyzing other solid-state vertical circuits. That's why we have taken so much trouble to tell you how it operates and what to expect.

One important and unique difference is that defects which do not affect the IC300 count-down circuit don't change the vertical frequency. Multivibrators, for example, often change frequency radically when the height or linearity is changed by either adjustment or parts defects. But, the Sylvania count-down circuit maintains the proper frequency, making diagnosis easier in cases of insufficient height or poor linearity.

Next Month

Some general details of the IF circuit will be discussed next month, along with a detailed description of the AGC operation and the AFT circuit. □

CARTOON CORNER

"It's been smoking more
and we've been enjoying it less."

"I've got the best TV repairman in town,
and that's not just my opinion
—it's his."

"Yeah, that's right;
but we don't say *what* day!"

Sam Wilson's Technical Notebook

By J.A. "Sam" Wilson, CET

No One Fixes Magnets

Electronic systems have many magnets and electromagnets. Therefore, the study of magnetism is appropriate for technicians. Deflection yokes, for example, work by electromagnetic attraction.

Seldom do the schools spend much time studying magnetic phenomena, so consider this as a postgraduate course.

I'm certain to receive some letters saying that technicians really don't need to know anything about magnetism, because no one can repair magnets. Well, doctors can't "fix" a human liver either, but they still study about them in medical school.

What Do You Know About Magnetism?

Here is a short quiz to determine how much (or how little) you know about magnetic principles. Answers are given at the end of this article. Mark "true" or "false" after these statements:

(1) Ferromagnetic materials are *attracted* to a strong magnet, but some other materials are *repelled* by a strong magnet.

(2) It is possible for a gas (such as hydrogen) to have magnetic properties.

(3) A magnetic bubble is a pocket of air in a magnet.

(4) A magnetic amplifier is used to increase the strength of a magnetic field.

(5) According to history, the first known practical use for magnetism was in the year of 2637 B.C.

Why Are There No Wooden Magnets?

Have you ever wondered why a piece of wood can't be magnetized? A kindergarten teacher probably would explain that the wood isn't a magnetic material. That redundant answer is just a stall to keep you from bugging her until you can read this article.

The reason some materials can be magnetized and others can't is because of **the spin of electrons,** as shown in Figure 1.

As each electron moves around the nucleus, it also spins on its axis. This electron spin produces a magnetic field, and the direction of the field is determined by the direction of the spin.

In most materials, the spins and the resulting magnetic fields are *compensated*. In other words, there

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Sam Wilson's monthly "Technical Notebook" will present a variety of subjects and ideas. Sam has strong opinions, and possibly some will provoke conversation and controversy. The ideas and opinions of this column are not necessarily those of the editor or other employees of Electronic Servicing.

Your letters are welcome, so long as you give us permission to quote from them. Address all letters to:

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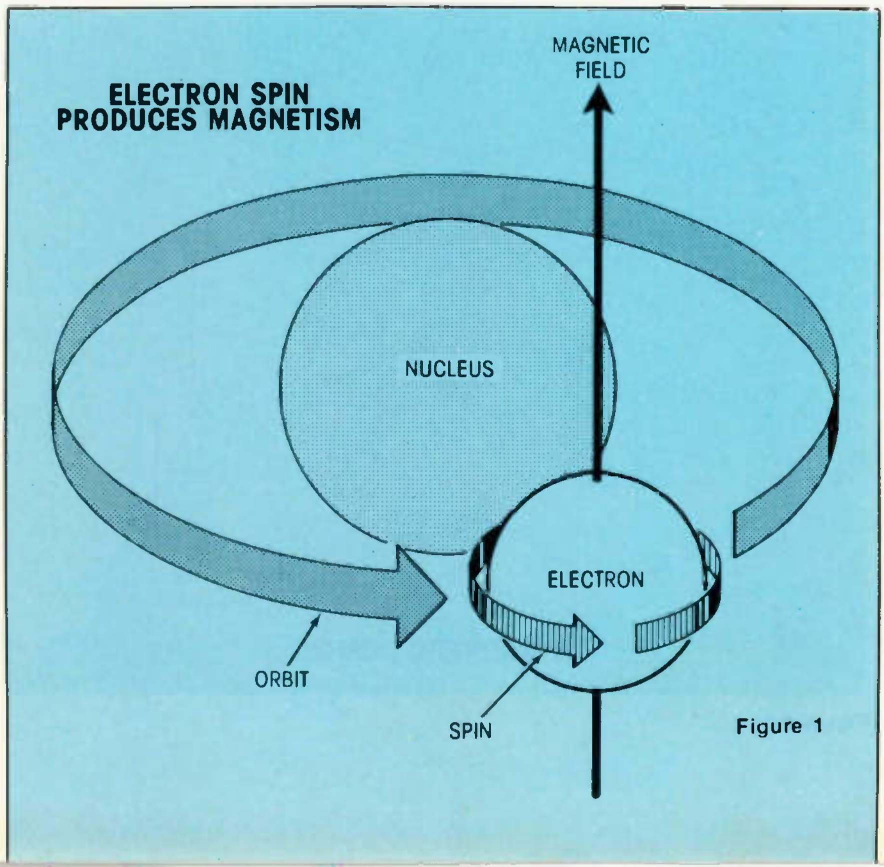

Figure 1

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are as many electron spins in clockwise direction as there are spins in counterclockwise direction. So, the magnetic fields cancel, leaving no net external magnetic field.

A few materials (such as iron, nickel, and cobalt) have spins that do not cancel completely. Some uncompensated spins produce a resultant magnetic field. Incidentally, to make the material magnetic, the uncompensated spins must be in an inner orbit. Therefore, each molecule of iron behaves as a tiny magnet.

Every particle in an atom is believed to have a spin and a resultant magnetic field, but the *electron* spin produces the magnetic effect in iron and other ferromagnetic materials. Some magnetic devices have been designed to use proton spins. We'll discuss those at a later time.

By itself, the uncompensated electron spin can't account for the total magnetic properties of ferromagnetic materials. The crystalline structure of the iron also is an important factor. The atoms (or molecules) in the crystal have uncompensated spins that tend to lock their magnetic fields into a single pattern called a "domain."

Let me phrase that another way. A single molecule or atom in a magnetic material acts as a very tiny magnet. When that atom is in a crystal, its field adds to the fields of other atoms in the crystal. These combined fields produce a strong localized field. That's what makes up a domain.

Figure 2 illustrates how the electron magnetic fields of an unmagnetized material have no resultant field. Uncompensated spins produce tiny magnetic fields which are represented by arrows. When the arrows point in random directions, there is no net field.

In the domain of Figure 3, all magnetic fluxes of each atom combine with the magnetic flux of the other atoms to produce a net north/south field for the domain. About 1,000,000,000,000,000 atoms are in a domain (count them, if you doubt!), and each domain has a volume of 0.000000001 centimeters.

Although the domain size is very small, you can see them under a microscope. In unmagnetized iron, each little domain and its associated field is pointed in a different direction at random.

Now, when the iron is magnetized, each domain turns around and lines up with the others to produce a net magnetic field for the iron.

The relationship between a magnetized and an unmagnetized piece of material usually is illustrated as shown in Figure 4. Each tiny magnet represents a domain. Unmagnetized material has the domains in a random pattern, while magnetized material has all of the domains aligned in the same direction to produce a net magnetic field. There are a great number of

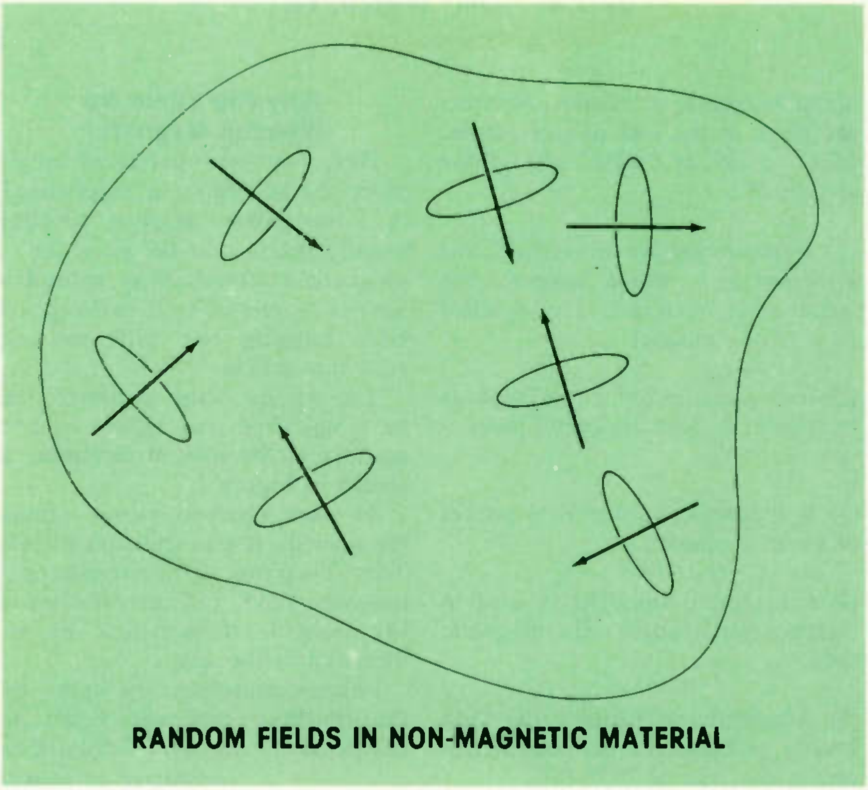

Figure 2

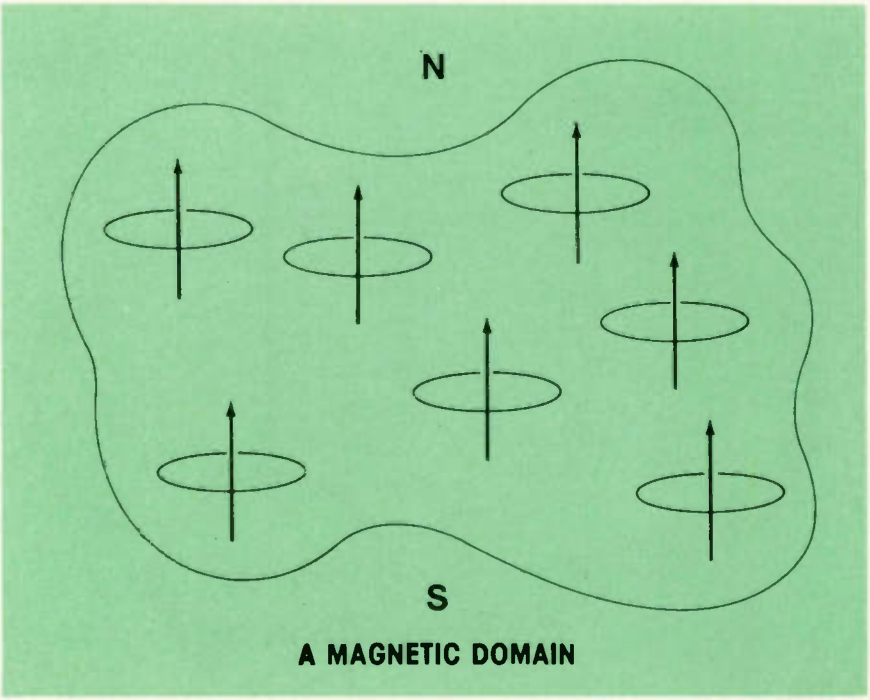

Figure 3

domains in each piece of iron. **Remember, the illustration is only a model.**

Proof Of Domains

The following simple experiment demonstrates the existence of domains. When a magnetic field is near a magnetic material, the material becomes magnetized. Stronger magnetic fields produce stronger magnetism. Figure 5 shows a characteristic curve of magnetizing force versus magnetism.

Although this curve appears to be smooth, it actually is made up of small steps. If you expand the curve by increasing the gain of a scope, you can see these steps. Or, as shown in Figure 5, a curve having sufficient fine detail could be magnified by a reading glass. (Sometimes, this is called the "Barkhausen Experiment.")

These small steps represent domains turning into alignment as the magnetizing force is increased.

In fact, by using the experimental setup of Figure 6, you can *hear* the domains turning into position.

Why "Johnny" Can't Understand Magnetics

Two serious problems for teaching or understanding magnetics are multiple measurement systems, and an unfortunate tendency to compare the similarities of magnetics and electronics.

Too many standards

Progress in any technical field is dependent upon the ability to make measurements. Unfortunately, there are a number of different systems of measuring magnetics. Any attempt to learn about magnetics by mastering *all* of these systems probably would flounder on the excessive math necessary for converting from one system to another.

A better way is to specialize in only one system. Then you can use a conversion, if you ever need to work with another system. Throughout this series, we will use only MKS units.

Forget Ohm's law

I believe it is more confusing than helpful to teach magnetics by making direct comparisons with electrical circuits. The differences outweigh the similarities.

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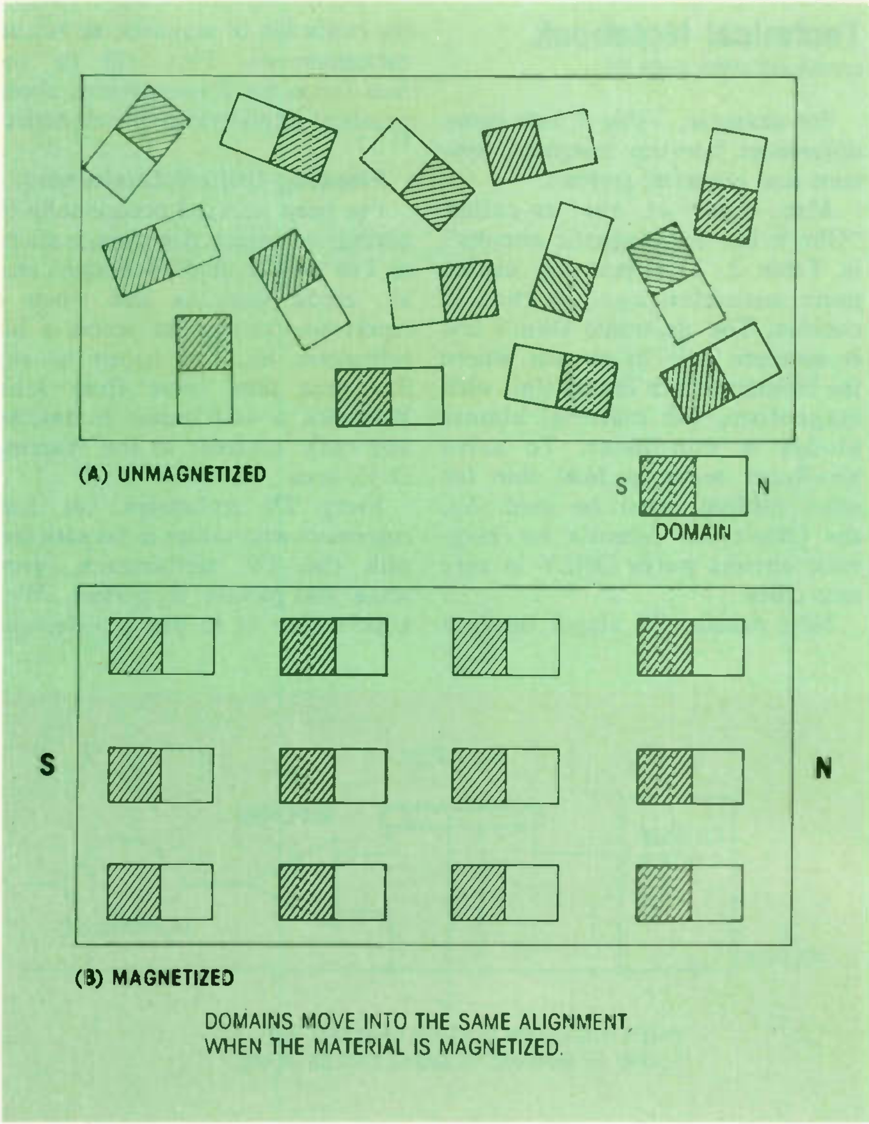

Figure 4

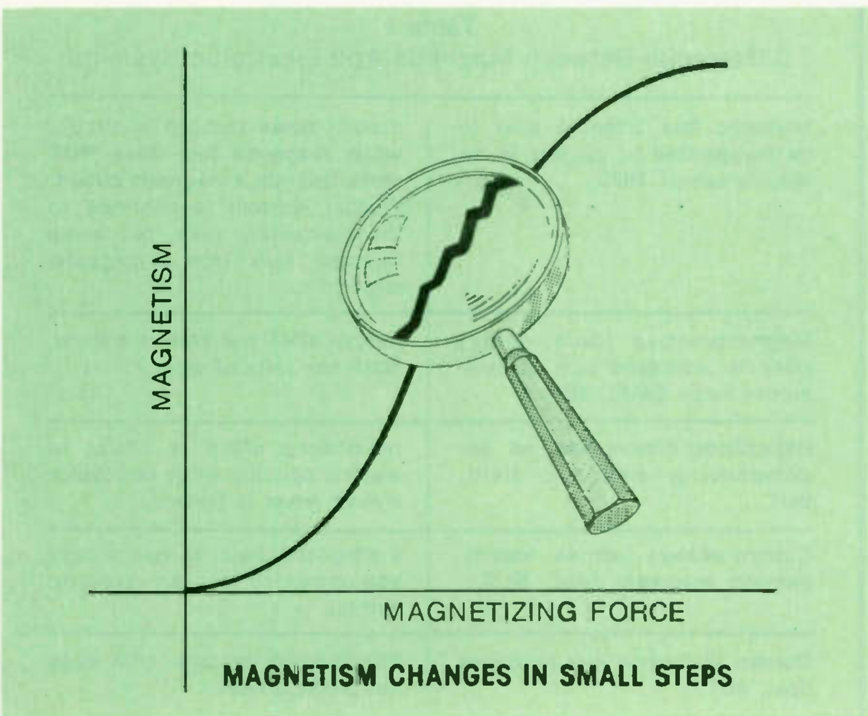

Figure 5

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For example, Table 1 lists some *differences* between magnetic systems and electrical systems.

Also, look at the so-called "Ohm's law for magnetic circuits" in Table 2. This equation causes more misunderstandings than it clarifies. The electronic Ohm's law is accurate only in circuits where the resistances are linear. But, with magnetism, the material almost always is non-linear. To solve non-linear math, a load line (or other method) must be used. So, the Ohm's law formula for magnetic circuits works ONLY in very rare cases.

Next month, I'll attack head-on the confusion of magnetic units and measurements. This will be the foundation for future articles about practical applications of magnetics.

Pleasing Critical Customers

I've been accused occasionally of having an overactive imagination, so I'm always glad to blame...er... ah, credit someone else when I report something that seems a bit ridiculous. So, I'm happy to say this next idea came from John Witkoski, a well-known technician and radio amateur in the Warren, Ohio, area.

Every TV technician has had customers who refuse to be satisfied with the TV performance, even when the picture is perfect. Witkoski's idea is to use a videotape recorder as a psychological gimmick.

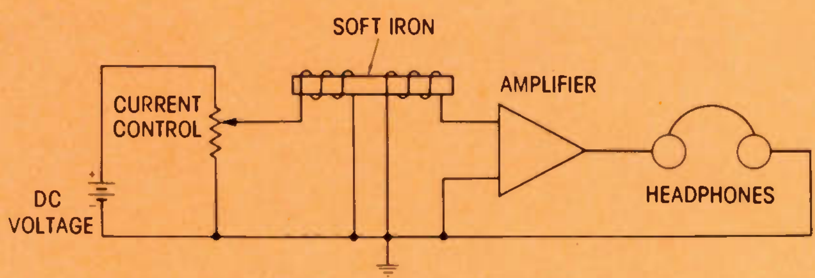
The first step is to make a videotape recording of someone washing a dirty window (perhaps your shop window), as shown in Figure 7.

When a customer is impossible to please, tell him/her that you will have the *inside* of the picture tube cleaned to improve the picture. Play the tape in a VTR connected to the TV and allow the customer to watch a realistic view of a tiny man washing the TV screen.

If you have a color camera, show cleaning of each color separately. You might even have the technician picture-cleaner pick up "dirty" electrons (rubber balls) and place them in a container. Perhaps you can think of other variations.

I don't know what you should tell a customer who calls you later to complain that you missed a spot! (Or perhaps, what you should tell the judge at your trial.)

Witkoski passed along this idea, but he doesn't use it himself. You see, he doesn't have *that* kind of customer.



WHEN MAGNETISM IS BEING CHANGED, THE SOUND OF DOMAINS ALIGNING CAN BE HEARD.

Table 1
Differences Between Magnetic And Electronic Systems

Magnetic flux often is said to be comparable to current in an electric circuit, BUT...	current **flows** through a circuit, while **magnetic flux does NOT move through a magnetic circuit.** Further, current is confined to the conducting path, but some flux can "leak" from a magnetic circuit.
Magnetomotive force (MMF) often is compared with electromotive force (EMF), BUT...	neither MMF nor EMF is a force. Both are units of work.
Reluctance always has an accompanying magnetic field, BUT...	resistance often is linear in electric circuits, while reluctance almost never is linear.
Current always has an accompanying magnetic field, BUT...	a magnetic field is not always accompanied by an electric current.
Current through a wire produces heat, BUT...	flux through an iron core does not produce heat.

Low-Voltage Regulated Power Supplies

Once, I nominated RTL and TTL digital logic as the klutzie idea of the month, because of the weird supply voltages. RTL requires 3.6 volts, and TTL needs 5 volts. This presents problems for portable battery-operated circuits. I received some flack about my criticism.

Since then, I have thought about the problem. Mercury cells have a terminal voltage of 1.2 volts each, after the initial discharge time. Three in series would work well for 3.6 volts, and four gives 4.8 volts,

Table 2
Ohm's Law
For Magnetic Circuits

$$\emptyset = \frac{MMF}{R}$$

(where Ø is the flux, MMF is the magnetomotive force that produces the flux, and R is the reluctance, or opposition to the flux)

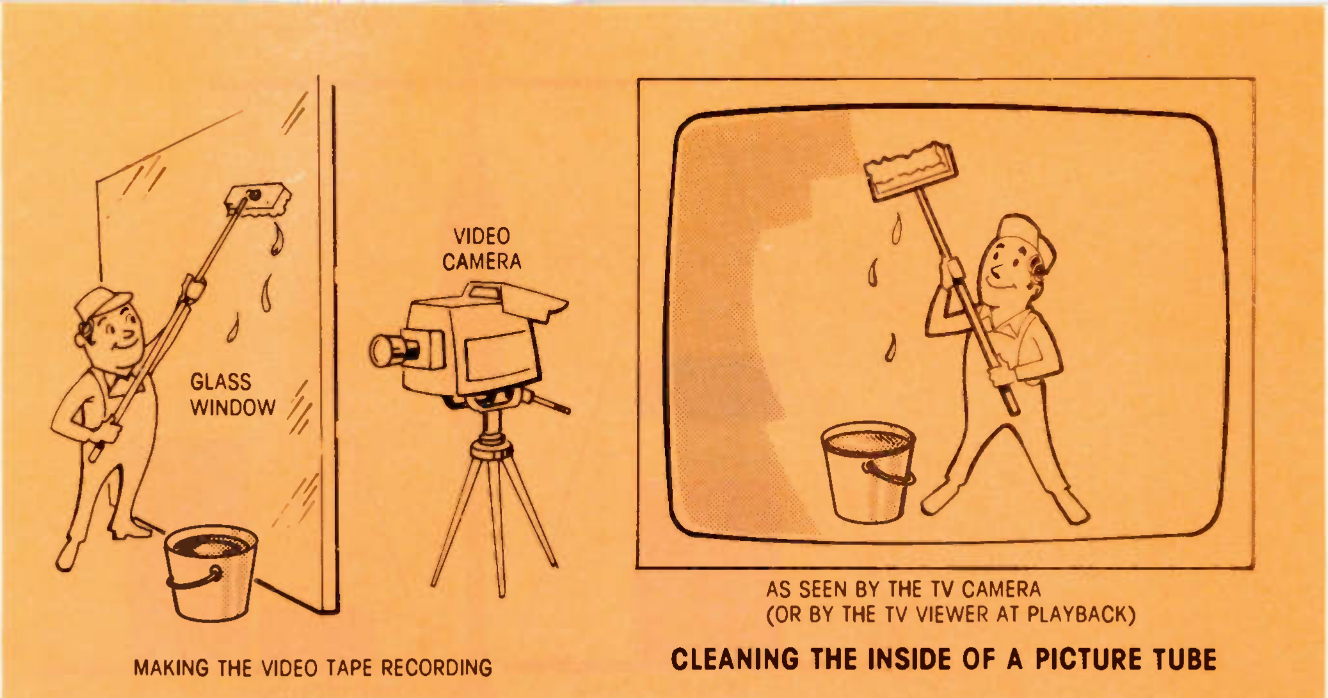


Figure 7A

Figure 7B

which is near enough to make TTL circuits work okay.

Alternately, a higher battery voltage can be reduced and regulated by a simple circuit (see Figure 8). The forward-biased silicon diodes will give about 0.6 volt drop across each. Six diodes should give about 3.6 volts. The variable resistance allows adjustment to offset battery weakening, and it allows some choice of output voltage.

Okay, critics, stop the protest letters.

Sam says:

I need back issues of the original Technical Notebook that was sent to ISCET members. Also, I would appreciate receiving any back issues of *Electronics* or *EED*.

Answers To The Magnetics Quiz

(1) **True.** All materials can be categoried as: *ferromagnetic* (materials that are attracted to a strong magnetic field); *paramagnetic* (materials that have virtually no magnetic properties); or *diamagnetic* (materials such as hydrogen, copper, and silver which are repelled by a strong magnetic field).

(2) **True.** In the answer for #1, I listed hydrogen as diamagnetic. Other gases have magnetic properties. In fact, a sensitive measuring instrument (called a nuclear procession magnetometer) uses the magnetic properties of a gas to detect changes of magnetic field strength. It has been used in aircraft to locate buried iron-ore deposits.

(3) **False.** A magnetic bubble isn't a bubble at all. It is a tiny cylinder-shaped domain of magnetic intensity. These so-called bubbles are used in computer bubble-memories.

(4) **False.** Magnetic amplifiers are used to control the amount of AC power delivered to a load. They work by controlling the flux of specially-designed transformers.

(5) **True.** The emperor of China (it is said) was chasing a rebel prince in 2637 B.C. He and his gunsels became lost in a heavy fog, and couldn't locate the rebel. The emperor built a crude compass that always pointed south. By using the compass, the emperor and his staff found their way out of the fog and caught the bad guy. This is the first record of a practical magnetic device. □

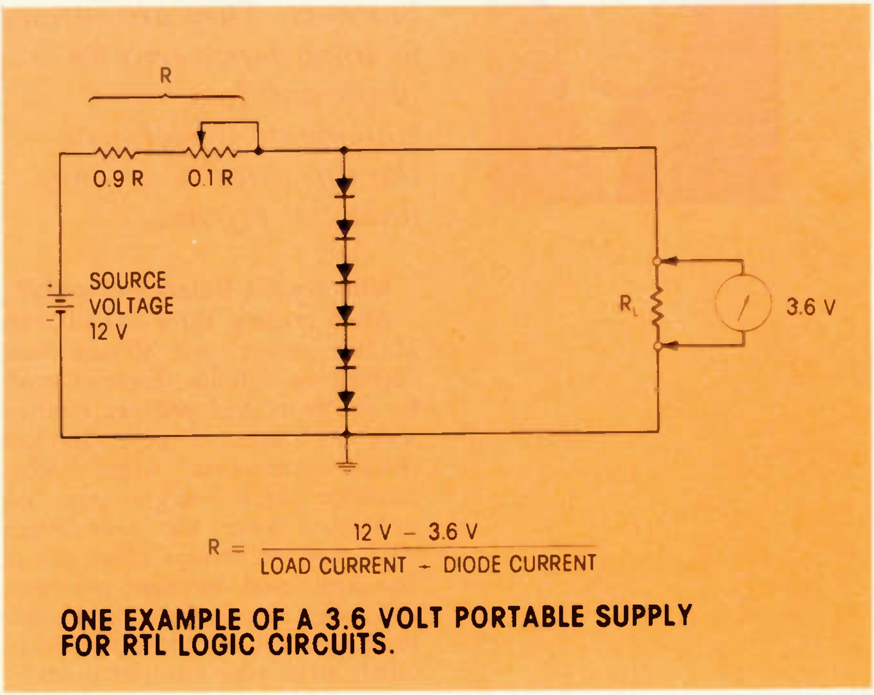
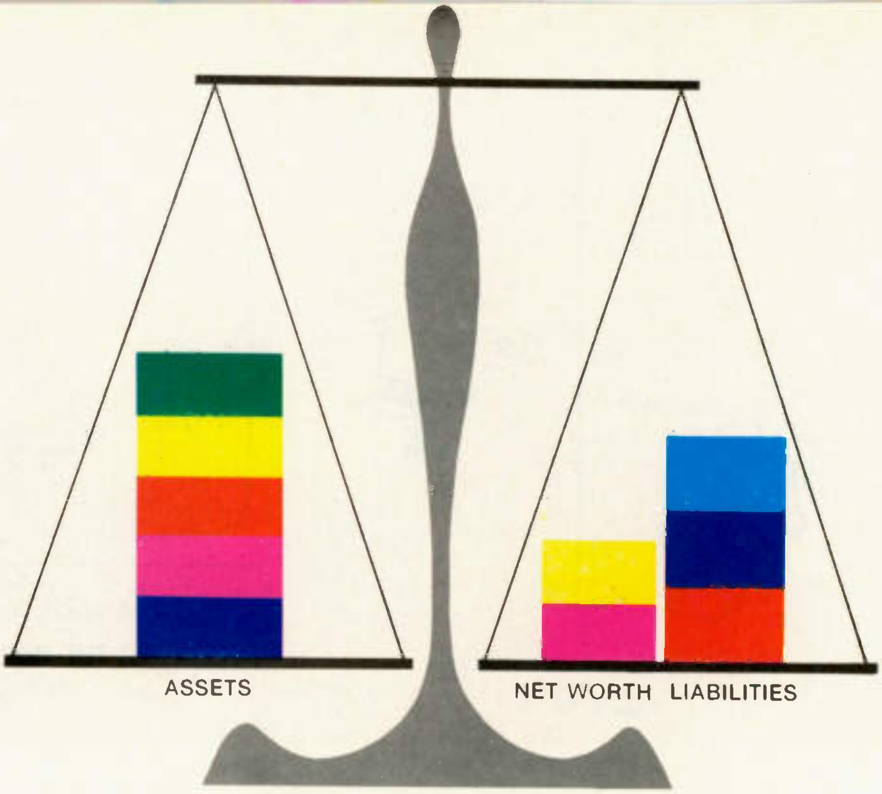


Figure 8



Service Management Seminar, Part 4

By Dick Glass, CET

Balance sheets *are another valuable tool to help you analyze the long-term health of your business. They are second in importance only to profit-and-loss statements, which rate the top priority among financial reports.*

Who Needs Balance Sheets?

After reading three installments of this series, you should have decided on definite financial goals for the year. And you are familiar with the basics of profit-and-loss (P&L) statements. After P&Ls, "balance sheets" might seem superfluous. After all, your P&Ls show that the various ratios are in line with good business practices, and you are making a normal profit. Doesn't this prove that P&Ls satisfy all of your business needs?

No, that's not true. I'll agree that analysis of P&Ls takes priority over the information from balance sheets. It *is* imperative for you first to identify and correct any excessive expenses or inadequate profits from parts sales. Also, repeated losses of net profit eventually will force you into bankruptcy. These are advantages of P&Ls. Even so, balance sheets are almost as important to your business as P&Ls are.

The Complete Picture

A balance sheet supplies a complete financial picture of your business at a given date. You might believe a P&L does that, but it doesn't. Each P&L shows (1) how much money you received; (2) how much you paid out; and (3) how much money remains as net profit after the period of time.

Unfortunately, a P&L can't show these important factors:

- the amount of your net worth;
- whether your assets are growing or decreasing; and
- the total amount of debts you have.

Although a P&L showing a substantial net profit for the period might give you a feeling of security, it's even better when you compare balance sheets for the beginning and ending of the period and learn that your total assets have grown!

An Extreme Example

We'll exaggerate and imagine that you became frustrated with the problems of obtaining parts rapidly. In an attempt to have all needed parts immediately, you bought an entire warehouse of electronic parts at a price of $200,000.

If you normally sell $50,000 worth of parts per year, this would be a four-year supply. Because of the adequate parts inventory, your parts sales and parts profits (as shown on the P&L) *are* increased (perhaps higher profits of $5,000 from extra sales of $10,000).

But, look at the other side of the situation. If you had invested the $200,000 in saving certificates, you could have earned $15,000 per year. That's three times as much as the extra $5,000 earned by increased parts sales!

This is one example of a P&L that gave a false impression by *not* listing inventory size. However, the balance sheet would have spotted it by showing an overbalanced investment in parts.

Another example is when the owner withdraws more money than the business makes in net profit. For short periods, this might not be detrimental. It could be disastrous if the periodic balance sheets were not monitored to check against a *continual* shrinkage of net worth or operating capital.

Ratios

P&Ls have several important ratios that you should be aware of constantly. In the same way, comparisons from balance sheets are equally important. Another valuable tool is to compare certain P&L percentages with figures from the balance sheet.

In summary, you can have P&L ratios, balance-sheet ratios, and combination P&L versus balance-sheet ratios. It's impossible to have a complete financial picture of your business without *both* P&L statements and balance sheets.

In fact, many businesses order both *each month* from their accountants. If you have a small business (perhaps less than six employees) and you are very close to all areas of the business, one balance sheet per year might be enough.

Employee's Personal Balance Sheet

Of course, employees have little interest in the balance sheets of a business. But you and your family have a financial condition, just as businesses do; and, if you try to borrow money from a bank, the banker will need the kind of information listed on balance sheets.

Also, if you ever have ambitions about forming your own business company, you should learn about balance sheets now. Incidentally, the balance sheets of many single proprietorship (one owner) businesses are more like a personal "financial status" statement of the owner than they are of a company.

Example Of A Personal Balance Sheet

Figure 1 is a hypothetical personal balance sheet, which you can compare with business balance sheets to show the similarities between them.

In Figure 1, Dick Smith's net worth is $19,200. Without any major misfortunes during the year, his January 1, 1979, balance sheet should show equity increases in his house, auto, and insurance policy. His stock or savings account might increase in value, or the cash on hand could be higher than before. All of these things increase his net worth.

Notice that the house is shown in the assets column at the *original* price paid for it, but the other asset items are listed at the *current* market value. Of course, the house *could* be listed for the present value (which probably would be higher because of inflation), except for the difficulty of obtaining an appraisal each year. However, a bank would want to know the market value of the house if they were investigating your request for a loan. At such times, a current appraisal is necessary. On the other hand, autos and personal effects should not be listed by the purchase cost because rapid depreciation prevents any resale at

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DICK SMITH
PERSONAL BALANCE SHEET
Jan. 1, 1978

ASSETS		LIABILITIES	
House (cost)	$30,000	House mortgage	$20,000
Auto (worth)	$ 3,000	Auto installments	$ 500
Furniture & personal effects	$ 6,000	Charge accts due	$ 300
Cash	$ 300	Total liabilities	$20,800
Savings Account	$ 200		
Insurance (cash value)	$ 240	Net Worth	$19,200
Stock	$ 260		
Total assets	$40,000	Liabilities plus Net Worth	$40,000

Figure 1 Individuals or families also can have "balance sheets" to prove net worth. Although business balance sheets add more items and include more details, the general layout is similar to this one.

Service Management

continued from page 55

prices near the original cost. Therefore, it is more accurate to estimate the present true value on personal balance sheets.

For business balance sheets, the *original* cost of buildings, vehicles, and other assets is shown, in addition to the amounts of depreciation. This is an advantage because depreciation is a deductible expense which reduces the taxes.

You can see that balance sheets are easy to prepare. There are many variations, but they contain nothing mysterious or difficult. Use Figure 1 and calculate Dick Smith's net worth if he had a $29,000 mortgage, $3,000 owed on an auto, and $8,000 in charge accounts. Answer: His net worth would be zero. People who declare bankruptcy often have a "negative" net worth (they owe more liabilities than they have assets).

Remember this definition: **A balance sheet shows what you owe and what you own at a given date.**

DICK SMITH TV
BALANCE SHEET
January 1, 1978

ASSETS			LIABILITIES & NET WORTH		
CURRENT ASSETS			CURRENT LIABILITIES		
Cash	$2,000		Accts. Payable	$ 4,000	
Accts. rec.	$4,000		Notes payable	$ 2,000	
Parts inventory	$8,000		Taxes payable	$ 1,000	
		$14,000			$ 7,000
			LONG TERM LIABILITIES		
FIXED ASSETS			Note payable	$ 2,000	
Autos-trucks	$5,000				$ 2,000
Furn. & fixtures	$4,000				
Test equipment	$2,000				
		$11,000	TOTAL LIABILITIES		$ 9,000
			EQUITY		
			Original cash investment	$ 2,000	
			Reinvested earnings	$14,000	
			TOTAL NET WORTH		$16,000
TOTAL ASSETS		$25,000	TOTAL LIABILITIES PLUS NET WORTH		$25,000

Figure 2 This is a simple, but complete, balance sheet for a business. It shows **what is owned and what is owed at a specific time.** The total net worth is *added* to the liabilities because net worth is owed to the owner just as the liabilities are owed to outsiders. Assets less liabilities equals net worth. For bookkeeping purposes, the value of all assets should equal (balance) the sum of the liabilities and the net worth.

Confusing Balance Sheets?

Some technicians are confused by

DICK SMITH TV
BALANCE SHEET
January 1, 1978

ASSETS				LIABILITIES & NET WORTH			
CURRENT ASSETS		1-1-78	1-1-77	CURRENT LIABILITIES		1-1-78	1-1-77
Cash on hand		$ 500	$ 900	Accounts Payable		$ 4,000	$ 2,000
Cash in bank		$ 1,500	$ 300	Notes Payable		$ 2,000	$ 0
Accounts receivable:	$ 4,500			Taxes Payable		$ 1,000	$ 200
less res. for bad debts	$ 500	$ 4,000	$ 3,000	Total Current Liabilities		$ 7,000	$ 2,200
Parts inventory		$ 8,000	$ 5,000	LONG TERM LIABILITIES			
Total current assets		$14,000	$ 9,200	Notes Payable		$ 2,000	$ 0
FIXED ASSETS				TOTAL LIABILITIES		$ 9,000	$ 2,200
Vehicles: (original cost)	$10,000						
Less depreciation reserve	$ 5,000			EQUITY			
		$ 5,000	$ 2,000	Capitol stock	$ 2,000		
				Surplus, or retained earnings	$14,300		
Furniture/fixtures cost	$ 8,000						
Less depreciation reserve	$ 4,000						
		$ 4,000	$ 5,000	TOTAL NET WORTH		$16,300	$17,300
Test Equipment at cost	$ 6,000						
Less res. for depreciation	$ 4,000						
		$ 2,000	$ 3,000				
OTHER ASSETS							
Prepaid insurance		$ 300	$ 300				
TOTAL ASSETS		$25,300	$19,500	TOTAL LIABILITIES AND NET WORTH		$25,300	$19,500

Figure 3 When two or more balance sheets are compared it's possible to detect trends and determine if the various "ratios" are becoming better or worse. This illustration contains two balance sheets of consecutive years, thus making comparisons easy.

balance sheets. One reason is that "liabilities plus net worth equals the total assets." You might ask: "Why should I add something desirable (equity or net worth) to something that is bad (liabilities) to equal the value of my total assets?"

Here is the reason: Both liabilities and net worth actually are debts! Of course, it's easy to understand that liabilities are debts, but can net worth be a liability? "Net worth is my nest egg. It's the money or value I have invested over the years in the business. I'm always trying to increase net worth. How can it be a debt?"

Look at it this way: **Net worth is owed by the business to YOU, just as the liabilities are owed to outsiders.** All of the assets are owed either to you or to your creditors.

Business Balance Sheet

Examine the business balance sheet of Figure 2 and you'll notice many similarities to the personal balance sheet analyzed before. The assets are divided into "current" and "fixed" categories, and the liabilities are called "short term" and "long term." Both balance sheets "balance," show the true net worth, and list amount owed in liabilities.

Is Smith's TV "Healthy"?

The P&L of Smith's business shows that it is operating with a profit. But, that's not enough to prove good financial health. There is a standard formula—the ratio of assets to liabilities—called the "current ratio." A two-to-one (or higher) ratio of assets to liabilities is considered to be satisfactory. In Figure 2, the assets were $25,000 and the liabilities were $9,000. This is a 2.7:1 ratio, which is better than satisfactory.

Any accountant, banker, or financial authority would consider Smith's business to be in good condition. Of course, the business is very small, and no one will loan him any large sums of money yet. But, if the business grows and remains in good financial health, the P&Ls and balance sheets will be of value in proving that he has sound knowledge of financial management.

Equity

We stated that equity was any portion of the assets not owed to outside creditors. Equity is the investment of the owner, plus the profits left in the business. (Of course, it might be minus the losses!)

Sometimes equity is called proprietorship, net worth, or capital plus retained earnings. But, whatever the name, it's the value of the business after the liabilities are deducted from the assets.

Long- And Short-Term Liabilities

On business balance sheets, the liabilities are split into two types, to make clear the kinds of debts. Short-term debts (such as distributor bills, truck payments, or small bank loans) are those due to be paid within one year. Mortgage or note payments that are not due for a year or more, are called long-term debts.

Each yearly balance sheet should show an allowance for future income taxes, the ones to be paid on current-year profits.

Current Assets And Fixed Assets

Current assets include cash (on hand and in the bank), accounts receivable, and inventory. It's assumed that these can be converted to cash during the current year.

Fixed assets are those not expected to be converted to cash during the year (or accounting period). These include the business building (if you own or are buying it), test equipment, vehicles, and store fixtures.

A More Realistic Balance Sheet

Although the first two examples were true balance sheets, they were simple. Figure 3 shows one that is more typical of those for your business.

By comparing the current balance sheet with the one of last year, you can spot any changes, and

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whether they were beneficial or not.

Let's assume that these changes of Mr. Smith's business occurred during 1977:

- accounts receivable increased by $1,000 (33⅓%);
- parts inventory increased by $3,000 (60%); and
- he purchased a new truck for $5,000 by using a bank loan.

Analysis

By comparing the two balance sheets (Figure 3), we can prove the following:

(1) Smith TV lost money during 1977 (net worth decreased by $1,000, so the P&L must show the same loss).

(2) The business *appeared* to be more prosperous because of the new truck and the increased parts stock.

(3) Assets increased from $19,500 to $25,300. The current ratio is 2:1, which remains satisfactory. But notice that last year it was 4.2:1.

(4) Smith invested $800 in cash (increased total cash on hand and in the bank), realized $1,000 more in accounts receivable, invested $3,000 more in parts, and spent $5,000 for a new truck. Perhaps his net loss for 1977 was caused by higher interest charges plus larger depreciation expenses. However, a minor benefit of the bigger depreciation expense is to reduce taxes for the year. This is helpful since he extended himself somewhat by going into debt.

(5) If his January 1, 1977, equity of $17,300 had been converted to cash and invested in a savings plan at 7.5% interest, he would have received about $1,300 interest for the year. As it is, he shows a $1,000 loss on the investment.

(6) It's likely that the loss during the year was caused by inadequate prices of both parts and labor. To reverse the downward trend, he must become more profitable. Hopefully, the reduced equity and P&L loss might have been produced by the owner withdrawing a large amount for salary. If true, this would not make the balance sheet appear so discouraging.

Ratios

In the near future, I'll discuss in detail "ratio analysis" for service shops. But, while our minds are absorbed in balance sheets, we'll touch on the subject.

Current ratio

As explained, the current ratio should be at least 2:1. If so, it answers yes to the question: "Does the business have enough current assets to meet the current debts, with a margin of safety to cover possible losses from inventory shortages or poor collections?"

Return on owner's equity

This return should be above the amount you *could* receive in interest, if the total were invested in savings accounts or securities. (Many service shop owners believe a return of 25% or larger is not excessive for money risked in the business. For Dick Smith TV, this would be $4,000 profit for the year of 1977. **Notice that this should NOT be considered as wages for the owner, but strictly as interest on the money he has invested.** He should pay himself an equivalent technician or management *salary* for the services he renders.

Inventory turns

The amount invested in inventory is shown on the balance sheet, and the P&L lists the cost of parts sold for the year. From these you can compute your inventory turns by dividing the cost by the average inventory of parts (calculated by adding the beginning and the ending inventories and dividing by two). If the parts cost of last year was $25,000 and the average inventory was $6,500 ($8,000 + $5,000 X ½), the inventory turns were nearly 4 times.

Now, inventory turns is a difficult area to establish a precise figure that separates good and bad performance. One problem is that smaller shops are unable to perform enough volume of service work to provide more than two or three turns per year. Also, it's difficult to obtain more than a very few inventory turns in shops that do a large percentage of warranty repairs.

However, knowing your inventory turns ratio is useful for providing a figure for judging future improvements.

Questions

We believe that, after you work with P&Ls and balance sheets and obtain some of the benefits, you will enjoy working with them. Consider them as financial diagnostic equipment, just as scopes and digital meters are equipment for electronic diagnosis.

Probably you now have questions about certain bookkeeping procedures; but after you study these articles and ask for advice from your accountant, it's likely you will find the answers. If not, write to me in care of **Electronic Servicing.** Any subjects or questions that bother many of you will be explained in later articles.

Next Month

Methods of setting prices that are fair to both you and your customers will be analyzed and discussed next month. □

Corrections

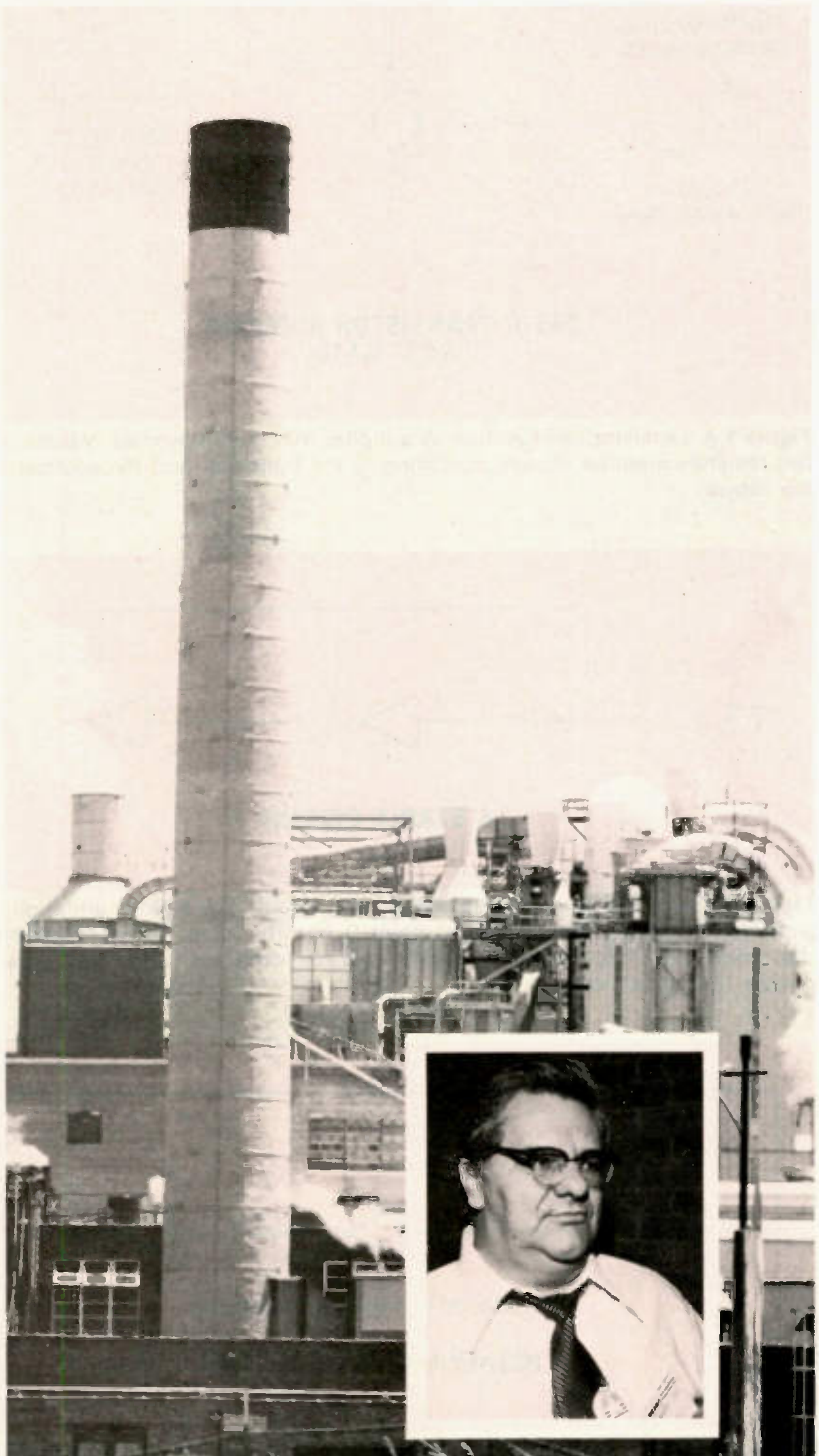
In Figure 1 on page 28 of Service Management Seminar, Part 2 in February **Electronic Servicing**, one shade of blue was omitted from the graph of the "Hours Worked" section. Tech A should be shown as working seven hours and having one hour of non-productive time, while Tech B worked only four hours and "goofed off" for another four hours.

Also, paragraph 3 of column 3 on page 30 of the same article should have read:

Don't base the productivity rating on the number of hours actually worked or the technician's wages. **The first rule is to figure each technician's productivity from the dollars he brings in.**

The Basics of Industrial Electronics, Part 10

By J. A. "Sam" Wilson, CET



The past several articles have explained digital-logic circuits, including basic gates, truth tables, and typical circuits. This month, we will discuss some applications of digital logic.

Clocks

In logic systems, one of the landmarks to look for is the clock-pulse generator. Many systems—especially those with counting circuits—use square waves or pulses to time the operations.

Multivibrators

Sometimes, the required clock pulses are obtained from multivibrators. Digital multivibrators are quite different from the vertical or horizontal multivibrators used in TV receivers. Those multivibrators had two tubes or two transistors, with the output and inputs cross-coupled, so each output fed the other input. The tubes or transistors were required to have gain, to compensate for the losses of the circuit. Digital gates have unity gain, since the input and output amplitudes usually are identical. These facts alone show you that digital multivibrators must be different from those with transistors.

A transistor can operate as an inverter, as shown in Figure 1. A base high produces a low at the collector, and a low at the base causes a high at the collector. When sufficient forward bias is present during the high and zero is applied during the low, the transistor either is saturated or cut off.

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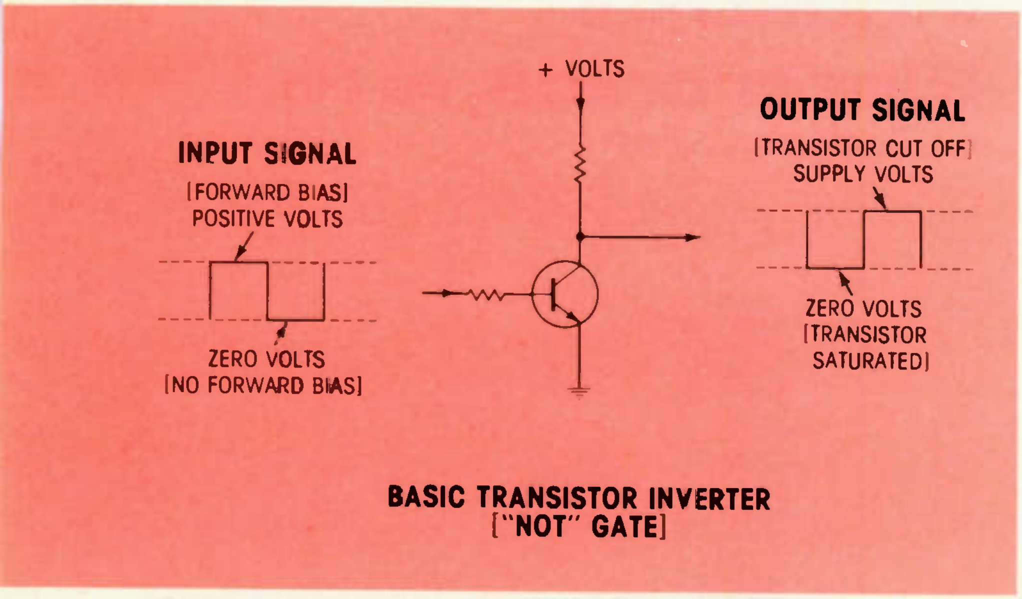

Figure 1 A transistor can function as a digital NOT gate (inverter). Values of the two resistors must be chosen according to the transistor and the application of the circuit.

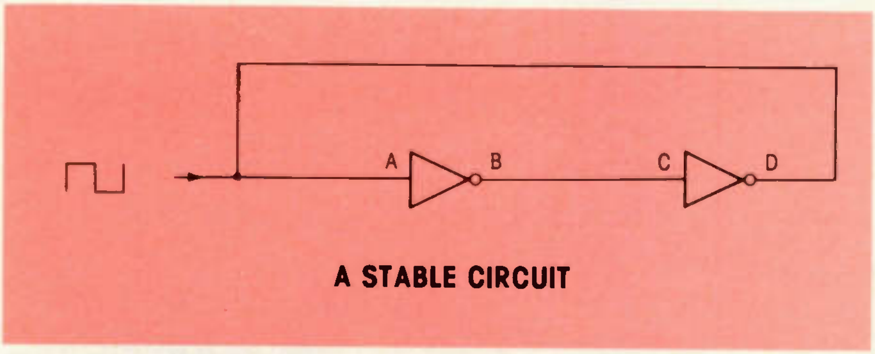

Figure 2 Two NOT gates connected in this circuit are stable, although they accomplish nothing. The output at point D has the same digital waveform as the input at A. So, connecting them together does no harm, and does not change the operation.

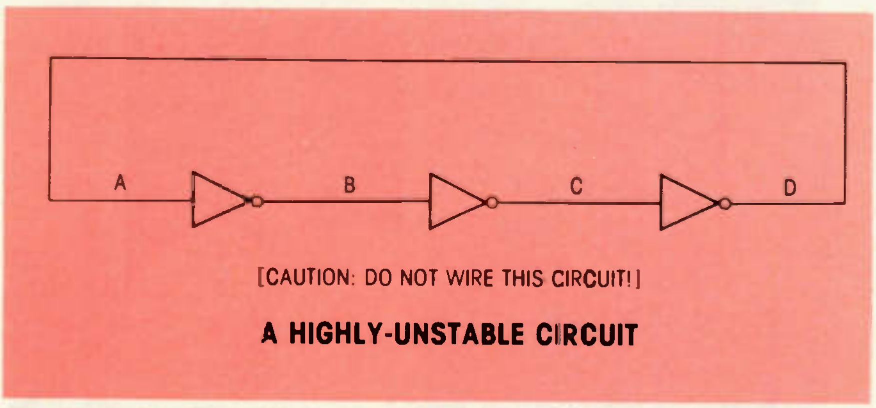

Figure 3 Three NOT gates in cascade become a strong and unstable oscillator because of propagation delays. Refer to the text for details.

This is the characteristic of NOT gates. So, it follows that NOT gates can be wired as a multivibrator.

Stability without oscillation

In Figure 2, two NOT gates are wired with each output feeding the other input. If these gates were transistors and a coupling capacitor is added, the circuit would oscillate. However, with NOT gates, it is stable. A high input at A produces a low at points B and C, and a high at point D, which is connected back to the input. The feedback is redundant, but it can't increase the input any more than the originating high. (Two highs equal one high, in this case.)

At the other extreme, a low at the input point A causes a low at B and C, and a low at D, which is coupled back to A. The signal fed back doesn't do anything, but it doesn't interfere. So, the circuit is stable. (Again, two lows at the input are no different from a single low.)

Three NOTs become an oscillator

When a third NOT gate is added to the circuit (Figure 3), it becomes highly unstable. At first look you might think that the circuit will merely turn itself off. A high at point A becomes a low at B, a high at C, and a low at D. But, D is connected to A, so it seems the low would *cancel* the original input high. However, an important characteristic, not one that shows on a schematic, modifies the situation.

Each gate has a propagation delay. That is, the output changes slightly later than the input.

Suppose a high is introduced to the input at point A. After a short time delay, the output at D becomes low, forcing the input low. The new input low, following the time delay, produces an output high, which after a time delay becomes a low at the output, and so on continuously. **The circuit is an oscillator,** operating at a very high frequency! Of course, an external high is not necessary to trigger the oscillation. At turn on, all three gates have low inputs, and the first one to produce a high output starts the oscillation.

To reduce the frequency enough for clock operation, it is necessary only to lengthen the propagation time delay.

Improved multivibrator clock

In Figure 4, a capacitor has been added in parallel with the second NOT gate. It works in conjunction with the gate resistors to lengthen the time delay. (Actually, it is a time-constant oscillator.)

The LED indicates the state of the output. R1 limits the LED voltage and current.

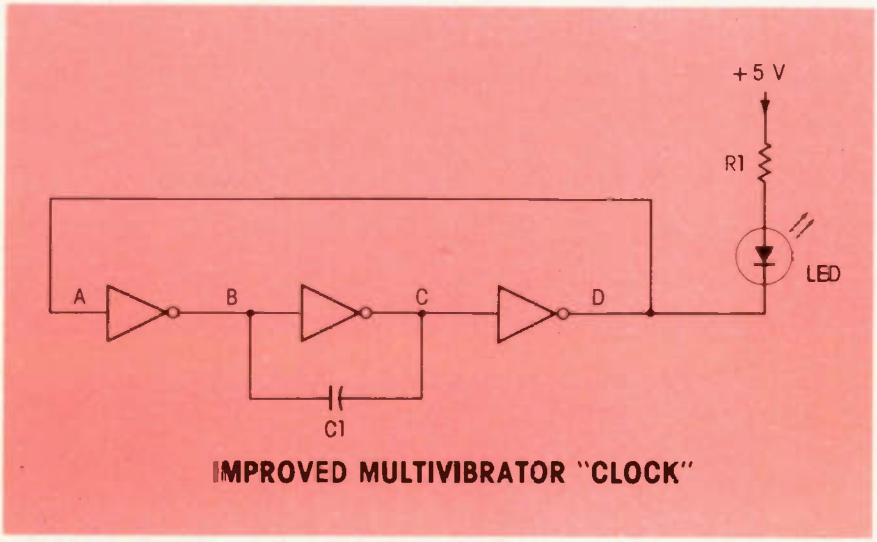

Figure 4 Adding a capacitance in parallel with the second NOT gate lowers the frequency of oscillation. Any reasonable frequency can be obtained by selection of the proper capacitance. The LED indicates an output signal.

Experiment #1

Construct the electronic circuit of Figure 4. The corresponding physical layout using an IC is shown in Figure 5. A large capacitance (300 microfarad) slows down the free-running frequency until the LED can be seen flashing on and off as it indicates the output state. Make sure to connect the cathode of the LED to the output at pin 8.

After observing the slow flashing of the LED, change the capacitance to 1 microfarad, and notice that the LED no longer appears to flash. Of course, the oscillator is operating at a higher frequency, and human eyes see this as a continuous glow.

While the capacitance is 1 microfarad, connect a scope to verify that the waveforms at points C and D are 180° out of phase. Use a dual-trace scope, a single-trace scope with an electronic switch, or obtain a lissajous pattern to determine the phase.

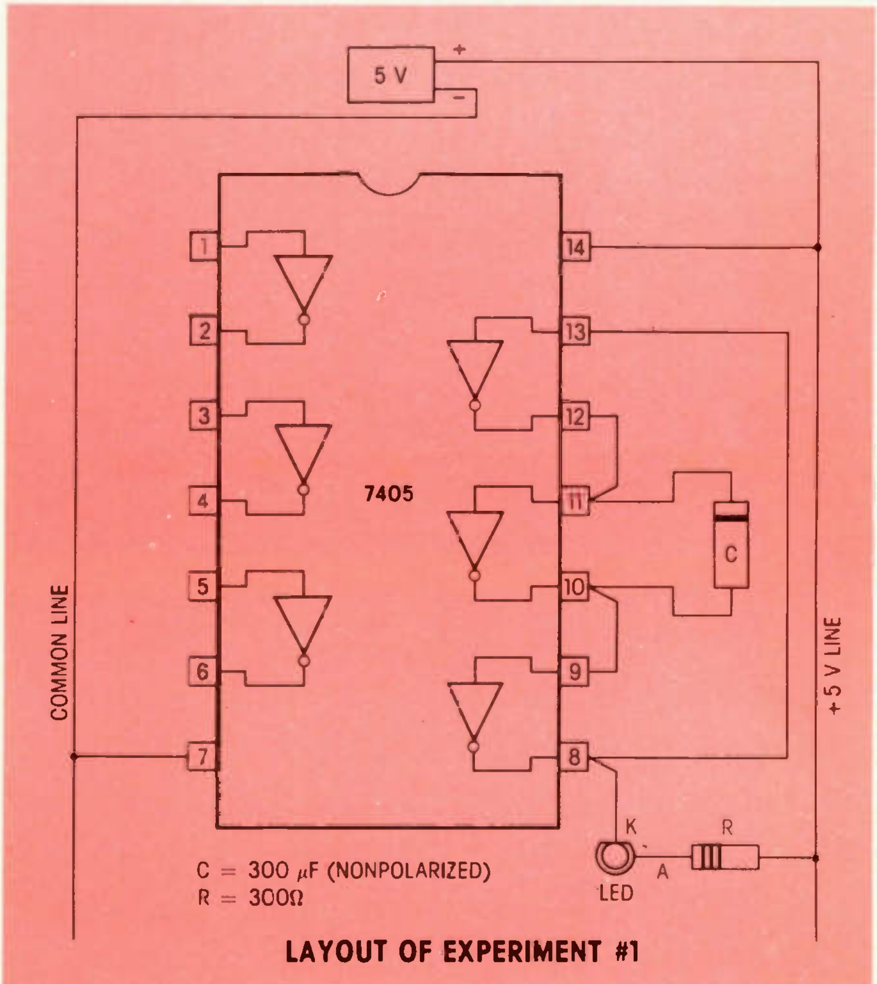

Figure 5 For experiment #1, physically construct the three-NOT-gate circuit of Figure 4 this way.

Troubleshooting Question #1

In the circuit of Figure 4, will the LED be on (lit) when point D is high? Or will it be on when Point D is low? (Answers to the troubleshooting questions are at the end of this article.)

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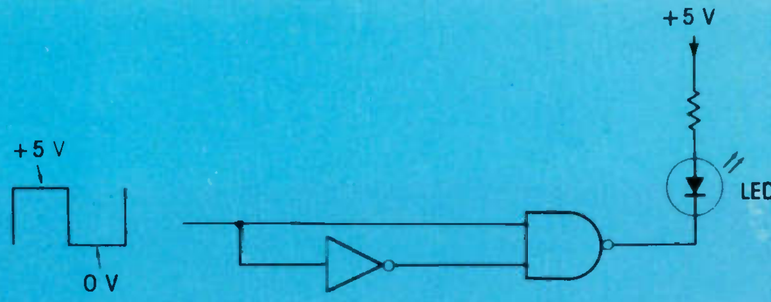
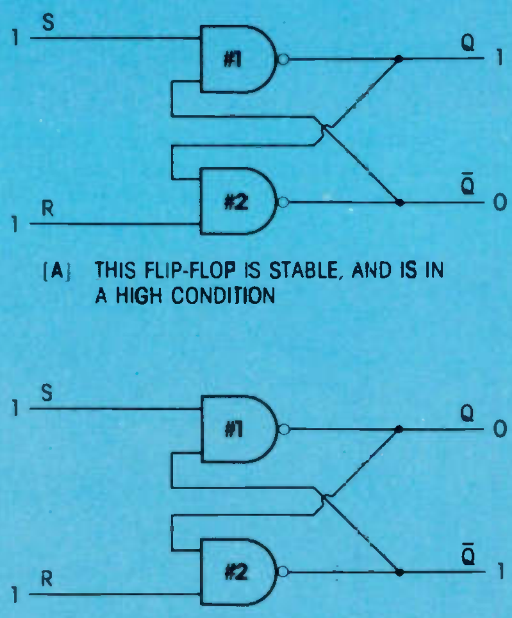


TROUBLESHOOTING QUESTION #2

WHICH STATEMENT IS CORRECT?

( ) THE LED WILL BE ON AT ALL TIMES
( ) THE LED WILL BE OFF AT ALL TIMES
( ) THE LED WILL FLASH ON AND OFF ALTERNATELY

Figure 6



(A) THIS FLIP-FLOP IS STABLE, AND IS IN A HIGH CONDITION

(B) THIS FLIP-FLOP IS STABLE, AND IS IN A LOW CONDITION

THESE ARE ONLY STABLE CONDITIONS POSSIBLE FOR NAND FLIP-FLIPS

Figure 7

Table 1
Flip Flop Possible Conditions

First Condition	The flip flop is in a high condition The flip flop is in a Logic 1 condition The flip flop is on	Q = 1 Q̄ = 0
Second Condition	The flip flop is in a low condition The flip flop is in a Logic 0 condition The flip flop is off	Q = 0 Q̄ = 1

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Troubleshooting Question #2

Figure 6 shows a square-wave clock pulse that's fed to a simple logic circuit. Disregarding the possibility of "glitches" (from propagation delay), should the LED:
(A) be on all of the time?
(B) be off all of the time?
(C) flash on and off periodically?

Cross-Coupled Gates

The next circuit for study has many different names, such as latch; cross-coupled gate; bounceless switch; R-S flip flop; and S-R flip flop.

The input terminals are marked S (for set) and R (for reset), and the output terminals are Q and NOT Q̄ (Q). The output letters don't stand for anything specific, but are commonly used for the outputs of flip flops.

All flip flops have one characteristic in common. There are only *two* possible output states, and only one can occur at a time. These flip-flop conditions are listed along with all of the various descriptions in Table 1.

Figure 7 shows an R-S flip flop made of NAND gates. The two input terminals (S and R) normally are in a logic 1 (high) state. The flip flop condition is changed by switching *either* S or R to logic level 0 momentarily. This circuit can be used only in applications where it is not possible for both inputs to have a logic level 0 at the same time.

Earlier in the series, we suggested that you memorize the truth tables for all of the basic gates. If you did that, you know the only way to obtain a logic level 0 at the output of a NAND gate is to have *both* inputs at logic level 1. Any other combination of inputs gives a logic 1 at the output.

The conditions of Figure 7 are the only two possible stable conditions. When the flip flop is switched from one condition to the other, the change is so rapid that it can be called instantaneous, for most applications.

In the high condition of Figure 7, there is a high from the S terminal to NAND #1, and a low input from the NOT Q terminal. This produces a high at the Q output terminal. NAND #2 has two highs at the

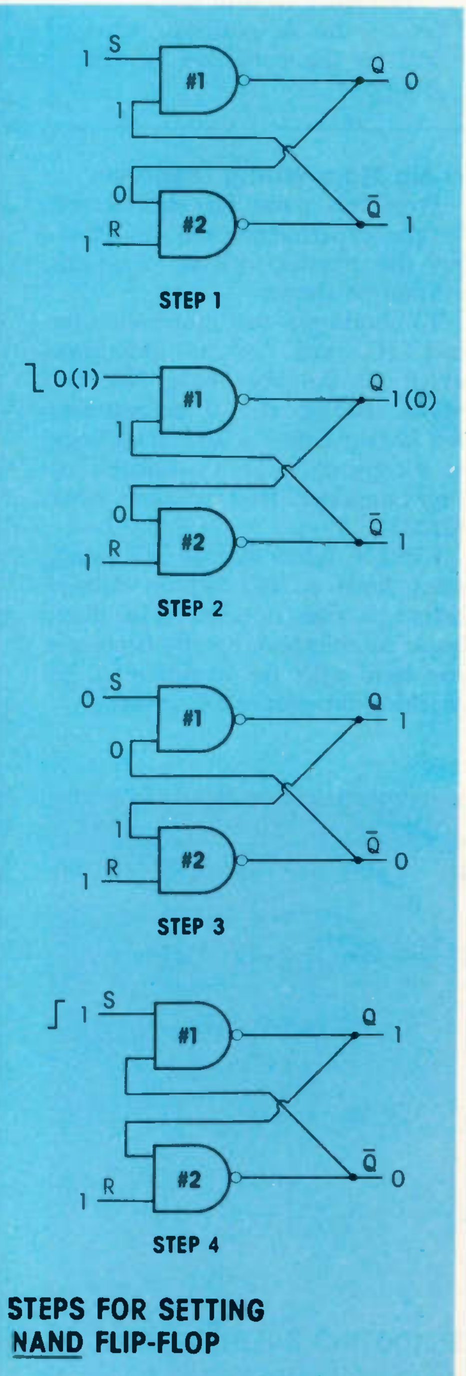

Figure 8 These are the four steps for changing a NAND S-R flip flop from a low condition to a high condition.

inputs. Therefore, the output is a low (logic level 0).

In the low condition of Figure 7, NAND #1 has two highs at the inputs and a logic 0 (low) at the output. NAND #2 has a high and a low at the inputs, so its output is a high.

You always should verify the inputs and outputs of each gate for each of the conditions and changes discussed. That is good practice for solving troubleshooting problems.

Steps for NAND flip flops

Figure 8 shows the four steps for *setting* a NAND flip flop from a low to a high condition. **Step 1 shows the circuit in a stable low condition.** In step 2, a logic 0 is delivered to the set terminal (the old input is shown in parentheses). Since the inputs now are a 1 and a 0, the Q output changes to a level 1. During step 3, the new logic 1 Q output of gate #1 is fed to NAND #2. NAND #2 now has two logic 1's at the inputs, so the output at NOT Q becomes a logic 0. In step 4, the S terminal is returned to level 1. **The flip flop now is in a stable high state.** (In step 4, the Q output did not change because neither the previous low-and-low inputs of NAND #1, nor the new high-and-low inputs can give a low output. Therefore, the high state at Q remains the same when the set input receives the high at step 4.)

Although considerable time is required to follow the step-by-step changes of Figure 8, the total time of the flip flop might be only a few nanoseconds.

Troubleshooting Question #3

Assuming that the NAND flip flop in step 4 of Figure 8 is stable in the high condition, what will happen if a logic 0 is delivered to the S terminal?

The answer to Question 3 is very important. The rules that follow should help you understand some of the counting circuits which will

continued on page 66

Industrial

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be discussed later in this series. They are:

Rule #1 If the NAND flip flop is in a low condition, it can be switched to a high condition by momentarily switching the set terminal to logic 0.

Rule #2 If the NAND flip flop is in a low condition, its output is not affected when a logic 0 is delivered to the reset terminal.

Rule #3 If the NAND flip flop is in a high condition, it can be switched to a low condition by momentarily switching the reset terminal to logic 0.

Rule #4 If the NAND flip flop is in a high condition, the output is not affected when a logic 0 is delivered to the set terminal.

Remember, when a flip flop is high, it is in the set condition. And when the flip flop is low, it is in the reset condition.

One more important factor is made clear by the steps of Figure 8 (particularly step 2). **Switching from one condition to another takes place at the trailing edge of an input pulse.** This is typical of NAND logic systems, such as TTL.

Troubleshooting Question #4

Which flip flops in Figure 9 will change, given the conditions shown?

Troubleshooting Question #5

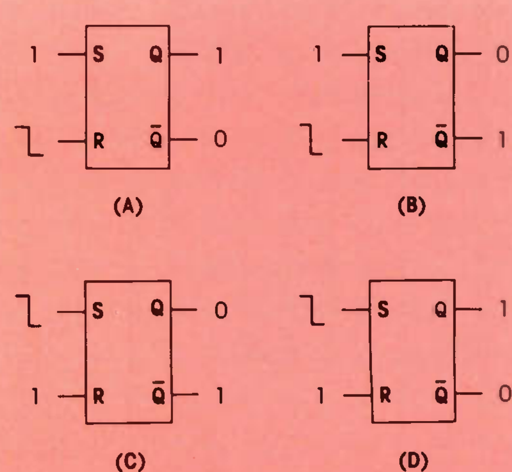
In Figure 10 with the switch set to the A position, what will be the condition of the flip flop?

No More Wiring Diagrams

From this point on, the circuits for the experiments will be given, but the physical wiring diagrams will not be shown.

To obtain pin-out information for each IC, and how to determine which IC numbers have NANDs, NORs, NOTs, etc., I recommend you obtain either a TTL handbook or a copy of "TTL Cookbook" by Don Lancaster (Howard Sams book #21035).

Keep in mind that an IC always must have a DC supply voltage before it can operate. Therefore, begin troubleshooting any problems you have with the experiments by checking for proper DC power.



TROUBLESHOOTING QUESTION #4
WHICH FLIP-FLOP WILL CHANGE, GIVEN THESE CONDITIONS?

Figure 9

Experiment #2

Wire the cross-coupled gates of Figure 8. Begin by connecting both inputs (S and R) to the B+ to provide logic 1 inputs, but don't connect anything to the outputs. Use a logic probe to determine the initial condition of the flip flop.

Next, change the condition of the flip flop by momentarily changing the wire of either the S or R input to common (ground).

Make a list of which connections change the condition of the flip flop, and which connections have no effect.

Experiment #3

Wire the circuit of Figure 10, but before you apply the power, answer these questions:

(1) What condition should the flip flop have when the switch is at position A?

(2) What condition should the flip flop have when the switch is at position B?

Then, apply the power, try both positions, using a logic probe to verify your answers.

Answers For The Troubleshooting Questions

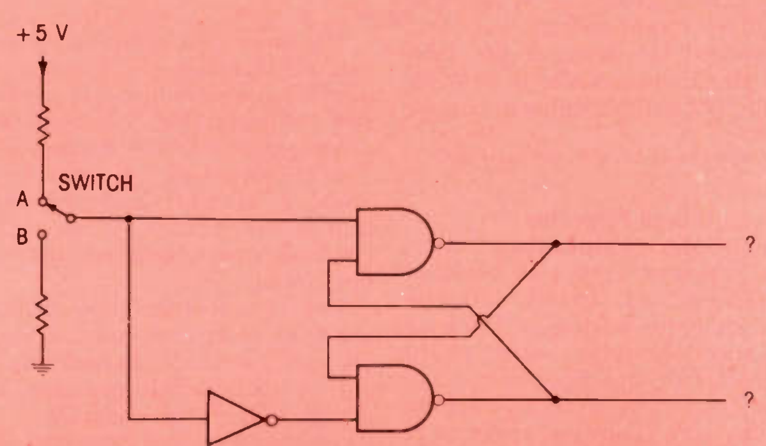
Answer #1 The LED will be on (lighted) when point D is low. (When point D is high, the same voltage appears at each end of the LED.)

Answer #2 The LED will be off at all times. The LED can light only if the NAND output is low. But, that's impossible because the inverter prevents the NAND inputs from ever having the same state.

Answer #3 Nothing will change. The flip flop is in a high condition, so a logic 0 delivered to the S terminal will have no effect. Notice that a logic 0 at the S terminal will supply logic zeros to both inputs of flip flop #1. Since the output is level 0, it will remain there.

Answer #4 Flip flop A will change to a low condition. Flip flop B will not change. Flip flop C will switch to a high condition. Flip flop D will not change.

Answer #5 The flip flop will be in a high condition. □



TROUBLESHOOTING QUESTION #5

WITH THE SWITCH POSITION SHOWN HERE, WHAT WILL BE THE CONDITION OF THE FLIP-FLOP?

Figure 10

Solution to

All Electronics Crossword

Across

1 AC	24 VTVM
2 Volt	27 Emitter
7 Resistance	29 OR
9 Alpha	30 Ammeter
11 Negative	31 Magenta
14 IC	34 Open
16 Chassis	35 NOR
17 Purity	37 ZO
18 Farad	38 Inertia
19 Pico	39 Yellow
22 LED	40 LP
23 Reactance	

DOWN

1 AND	15 Cyan
2 Volts	20 Rate
3 Transformer	21 Resonant
4 SS	22 Localize
5 Strip	25 Tetrode
6 Inter	26 Omni
8 Emit	28 Ranges
10 Choke	32 Gain
12 Germanium	33 Trap
13 VUS	36 Oil

productreport

Crimping Tool

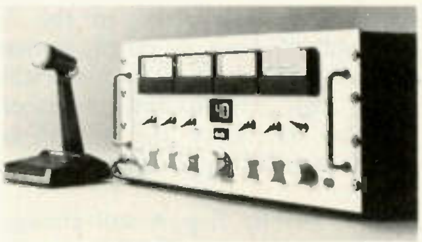
Klein Tools' new crimping tool, model 1006, is designed for crimping non-insulated terminals and connectors ranging from 10 to 22 AWG.

The tool is tapered for use in confined spaces. The plastic-dipped handles are red and black for quick identification of the crimping side of the plier.

For More Details Circle (31) on Reply Card

CB Base Station

M. H. Scott Company has introduced its first CB base station, the DAK Mark IX. The unit uses hybrid circuitry and employs tubes in the modulator and RF-output stages. Both the receiver and transmitter have PLL circuitry.



Meters and controls are arranged in a logical sequence. An oversized digital readout, controlled from a large channel-selector knob, indicates the channel in use.

Four 3-inch illuminated meters provide continuous monitoring of standing-wave ratio; plate current; percentage of modulation; and incoming-signal strength. Also, the plate-current meter can be switched to read RF power output.

Suggested list price of the DAK Mark IX CB transceiver is $349.95, and the DM100 microphone lists for $39.95.

For More Details Circle (32) on Reply Card

Surge Protector

The **DYMA Engineering** "Line-Surge Protector" plugs in between the 120-volt AC outlet and the power cable for equipment (such as solid-state) that is sensitive to damage for AC-line transients.

Two separate actions remove most of the voltage spikes. A varistor-type of surge suppressor shorts out any large voltage transients whose amplitudes exceed the protection level. Next, a ferrite filter smooths sharp pulses that are below the clipping level of the suppressor.

Model 2AC fits the normal 2-pin AC outlets, and model 3AC is similar, but has the safety ground pin. Both are rated at 20 amperes, and either is priced at $14.95.

For More Details Circle (33) on Reply Card

Engineering Manual

Allied Electronics' 1978 Annual Engineering Manual and Purchasing Guide includes 238 pages of parts, components, supplies and equipment. Wire, cable, solid-state devices, test equipment, resistors, trimmers and potentiometers, transformers, switches, timers, connectors, relays, tools, cross-references, product and manufacturer indexes, and a microcomputer system are among the many items featured. Bulk pricing is offered. $1 covers postage and handling.

For More Details Circle (34) on Reply Card

Scanning CB

A **Sparkomatic** CB transceiver is designed around microprocessing ICs. The in-dash CBM-2 features a three-position switch on the newly designed microphone which provides the user with auto scan and memory scan in addition to a normal operating position.

The auto scan continuously monitors all channels in sequence. The memory scan monitors as many as five channels that previously were programmed into the memory bank. The memory can be reset by the user. A manual memory button allows a choice of only those channels programmed in the memory circuit.

The transceiver also features up/down electronic channel switching with automatic channel sequencing. A lock switch prevents accidental erasure of channels.

For More Details Circle (35) on Reply Card

For More Details Circle (40) on Reply Card

Compact VOM

A new 30,000 ohms-per-volt compact VOM has been announced by **B&K-Precision.**

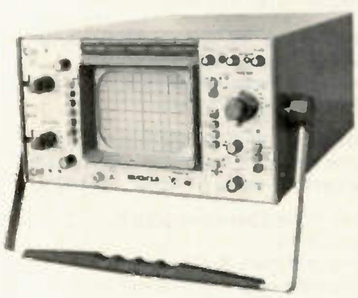
For testing the low resistances of coils, transformers, and motor windings, model 115 has a range with 5 ohms in the center of the scale. All four resistance ranges are fuse protected. In addition, four DC current ranges are included for checks of thermocouples and oil-burner controls. DC and AC voltage measurements extend to 1200 volts, or 12 KVDC with the optional HV-12 high-voltage probe adapter. The meter has a mirror, to eliminate parallax.

Suggested price is $37.50, with test leads and instructions included. A carrying case is optional.

For More Details Circle (36) on Reply Card

30 MHz Scope

The new LBO-520 scope from **Leader Instruments** has advanced



features such as dual-trace, 30-MHz response, internal delay, single-shot trigger, and high sensitivity.

Each vertical amplifier has a maximum sensitivity of 5 millivolts (.005 volts) per centimeter, and 10 ranges up to 5 VPP per CM. The 30-MHz bandwidth provides a rise time of 11.7 nanoseconds, permitting CB-radio carriers or digital waveforms to be viewed correctly. A 120-nanosecond delay line allows the leading edge of a pulse or square wave to be seen.

The fastest triggered horizontal sweep is 0.2 microsecond per CM, and 20 ranges provide sweep down to 0.5S-CM. Sweep magnification is X10. A single-sweep mode is provided.

Other features include: trace rotation (trace leveling), pushbutton operation, and warning lamps to indicate uncalibrated operation of manual variable controls.

LBO-520 scope sells for less than $1,000, complete with probes, manual, and accessories.

For More Details Circle (37) on Reply Card

Digital Multimeter

A five-function battery-operated digital multimeter has been introduced by **EICO.**

Featuring 3½ digits, model 270 is a compact DMM that utilizes the latest LSI technology. It measures AC and DC volts, AC/DC current, and resistance in 21 ranges. Automatic polarity indicators and overload protection are provided, plus 0.5-inch LED displays for digital readout to 1999.

The unit is supplied with test leads and a tilt stand. (Batteries not included.) Net price is $79.95 for the kit, or $109.95 factory assembled.

For More Details Circle (38) on Reply Card

Bench Kit

Five new test-instrument kits comprise **Heath's** "starter" bench kit. The IT-5283 signal tracer provides AF and RF signal tracing, audible volt/ohm indication, and substitute-speaker functions for general radio and hi-fi servicing.

The IM-5284 multimeter measures AC and DC voltage to 1000 volts, DC current to 1000 milliamperes, and has four ranges for resistance measurements to 100 megohms. Output from 310 kHz to 110 MHz, divided into five bands, and usable to 220 MHz with harmonics, is the feature of the IG-5280 RF oscillator.

The IG-5282 audio generator features sine and square wave functions, and switchable ranges from 10 Hz to 100 kHz. Separate resistance, inductance, and capacitance ranges are featured in the IB-5281 RCL bridge.

For More Details Circle (39) on Reply Card

Features of these products were supplied by the manufacturers, and are listed at no charge to them. If you want factory bulletins, circle the corresponding number on the Reply Card, affix a stamp, list the required information, and mail the card.

the marketplace

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"NO MORE SLOW TIMES!" IN SECOND PRINTING—WHAT YOUR SHOP COULDN'T FIND UNTIL NOW! PACKAGE PLAN, PORTIONS PRINTER-READY, SERVICE CONTRACTS, ANNUAL SCHEDULES, REPORT FORMS, AND MORE! DETAILS $3, COMPLETE PACKAGE $59.95. PECK'S PLAN, DEPT. "SMC", BOX 64, HILLSDALE, NY 12529. 4-78-3t

STEREO REPAIR SHOP test equipment, manuals, lots of misc. Marc Ditz, 1511 Division, Charleston, Ill. 61920, (217) 345-4698. 4-78-1t

TEST EQUIPMENT—B&K 177 VTVM ($60), B&K 1077B Television Analyst ($295), B&K 415 Sweep Marker Generator ($295), B&K 501A Semiconductor Curve Tracer ($65), Sylvania CK1500X Test Jig and many adapters ($275), REM CRU-1 Cathode Recovery Unit/CRT Tester ($165). Or buy all for $1100. All pieces, four years old or less. Like new. Staley Electronics, RR 3, Box 269, Cloverdale, Ind. 46120. Phone (317) 795-4127. 4-78-1t

SEEKING ORIGINAL JAPANESE TRANSISTORS, IC's, FET and diodes for CB, TV and stereo repair? See our full page ad in this issue for listing of parts and prices. Write or call TOLL FREE for our complete list and compare prices. FUJI-SVEA ENTERPRISE, Dept. ES, P.O. Box 30323, Cincinnati, OH 45240. Nationwide: (800) 543-1607. Ohio: (800) 582-1630. 4-78-4t

Education-Instruction

REPAIR TV TUNERS—High Earnings; Complete Course Details. 12 Repair Tricks. Many Plans. Two Lessons, all for $2. Refundable. Frank Bocek, Box 3236 Enterprise, Redding, Calif. 96001 8-76-tf

Educ.-Instruction (Cont.)

MAKE PC BOARDS. Step-by-step "how-to" manual with build-it-yourself equipment plans, charts, and illustrations. For Polyez and Film-Chemical processes. $4.98 plus 50 cents P&H. Century American Instruments, Box 1014, Dept. 414, Placentia, CA 92670. 4-78-2t

IF YOU'RE A PROFESSIONAL, you need a professional Service Invoice. Write for our Catalog of Service Forms, Pricing Guides and Invoices and see why they're better. Tech Spray, Box 949, Amarillo, Texas 79105. 4-78-3t

CONVERT ANY TRANSISTORIZED TV TUNER to a tuner substituter. Plans $2.00. New accelerated Radio & T.V. course. RADIO TELEVISION TRAINING, Box 279, ES-48, Syracuse, N.Y. 13206. 4-78-1t

WV 98C, TRC 12⅔, Freq. counter to 600 MHz. Herbert—188, Minersville, PA 17954. 4-78-1t

Help Wanted

OUTSIDE SERVICE TECHNICIANS. Paying top wages for best qualified men. Qualifications for position: total honesty, industrious, ten or more years direct television experience, non-drinker, non-smoker, must be able to work without supervision. Present employees grossing over $20,000 yearly. Send resume to American Television Service, 1032 South State, Orem, Utah 84057. 2-78-4t

ELECTRONIC TECHNICIANS—MOTOROLA, leader in two-way radio communication, presently has openings throughout the U.S. for technicians and supervisors experienced in the installation and maintenance of communications systems (two-way, paging, microwave and CCTV). If interested in good salary and excellent fringe benefits send your resume and geographical preference to: BOB CLENDENIN, MOTOROLA, COMMUNICATIONS & ELECTRONICS, INC., 1821 N. Office Square, Room 200C, Schaumburg, IL. 60196. Equal employment opportunity/affirmative action employer. 3-78-3t

Business Opportunity

SAVE HUNDREDS OF DOLLARS on high quality, dependable, American Made, MATV Head-Ends, V/V, U/V Converters, Camera Modulators, at factory-direct prices. Send $5.00 (or your MATV Installers Letterhead). "Information", Box 809, Boynton Beach, Fla. 33435. 1-78 5t

TELEVISION SALES SERVICE established twenty years major brands mid Ohio growing community. Modern store, central location, gross exceeds $100,000. Owner retiring. Principals Only. Electronic Servicing, Dept. 515, P.O. Box 12901, Overland Park, Kansas 66212 3-78-2t

$5,000 BUYS A COMPLETE SHOP valued wholesale at over $16,000. Complete line of recent Sencore test equipment, all generations of RCA and Quasar panels, most Zenith and GE panels, 6 years of Sams subscriptions (app. 900 in 3 file cabinets), RCA, Quasar, Zenith and Western Auto factory service literature, complete line of Sylvania transistors, RCA tubes, adequate small parts for an isolated area, hand tools and much more. Could come in and take over this good business in a small town with no competition, within 25 miles of Kansas City. Call Louisburg Electronic Center, (913) 837-2578 evenings. 4-78-1t

TV SERVICE SHOP—Excellent opportunity, 1977 gross $50,000 = 25% over 1976 gross. My net, $28,000. Fully equipped shop (all late model test equipment) in nice leased bldg. Parts, tubes, test equip., benches, etc. included. Write: TV Service Shop For Sale, 11132 Susan Dr., Salt Lake City, Utah 84070, or call (801) 571-3753 or 486-5635. 4-78-1t

TV TECHNICIAN! Increase your income up to $60,000 yearly. Rent-lease-sell TVs new-used, even from comfort of your home. Basic Preliminaries $4.00. Perry's TV Leasing, Box 1407, Santa Maria, CA 93456. 4-78-6t

Trading

SAMS TR AND CB books for trade. Anyone having extras to trade please contact: Blankinship TV, 1216 Main, Rusk, Texas 75785. 4-78-1t

Wanted

START ELECTRONIC FACTORY IN YOUR HOME. GET STARTED IN YOUR SPARE TIME. ONE MAN OPERATION. EXPECT BIG PROFITS. EXPERIENCE NOT NECESSARY. PRACTICALLY NO INVESTMENT. WRITE FOR FREE LITERATURE TELLING HOW. ELECTRONIC DEVELOPMENT LAB, DEPT. A, BOX 1535, PINELLAS PARK, FL 33565. 8-77-tf

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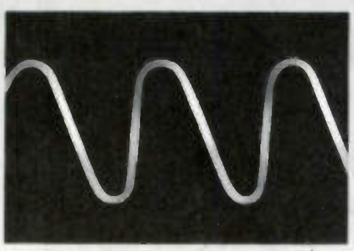
Two Emmys for VIR. One to the signal. One to General Electric for using it first.



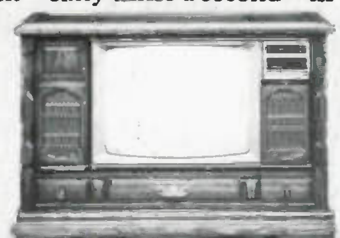
The National Academy of Television Arts and Sciences made two awards last year for outstanding achievement in engineering development.

An Emmy to the Electronic Industries Association committee that developed the VIR signal. And an Emmy to General Electric "for the first application of the Vertical Interval Reference (VIR) signal system to television receivers."

When the VIR signal is added to the picture signal, stations can automatically correct the color balance even though distortions may have occurred on the way. The development of VIR was a big step for color broadcasting.

With the VIR signal system established, the next challenge was to design a TV set that could use it. So General Electric developed the VIR Broadcast Controlled Color System. And won an Emmy of our own.

With computer-like circuitry, GE VIR color sets automatically adjust color and tint—sixty times a second—in accordance with the VIR signal broadcast with many color programs.



Since all the sophisticated VIR control circuits are on one plug-in module, you can bypass and remove them in minutes. The set keeps working with manual color controls while you exchange or repair the module. And simple service instructions are packed with each set.

Too bad they don't give an Emmy for trying to make your servicing job easier. We think we'd win it hands down.

THIS IS GE PERFORMANCE TELEVISION.

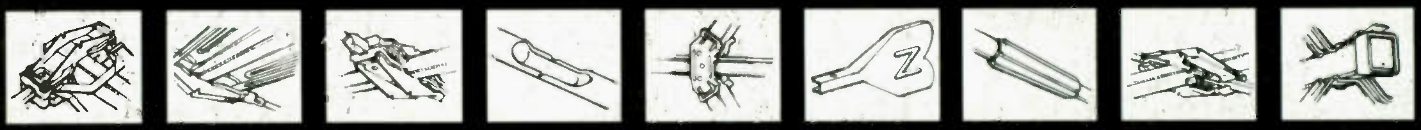
GENERAL ELECTRIC

For More Details Circle (2) on Reply Card

Zenith's full line of antennas, featuring

CHROMATENNA II™

with 18 ways you can count on for optimum picture quality!



Transmission Line Termination bleeds off static charges thru antenna system ground. Terminal stub improves front to back ratio on lower channels.

Aluminum Construction of all key metal parts works to eliminate rusting—provides long life. **Golden-Color Alodine Finish** is conductive—helps improve electrical performance!

High-Impact Plastic Insulators double-lock each element to the boom for extra bracing and durability.

FM Block reduces FM gain up to 12dB. Remove to receive full FM gain.

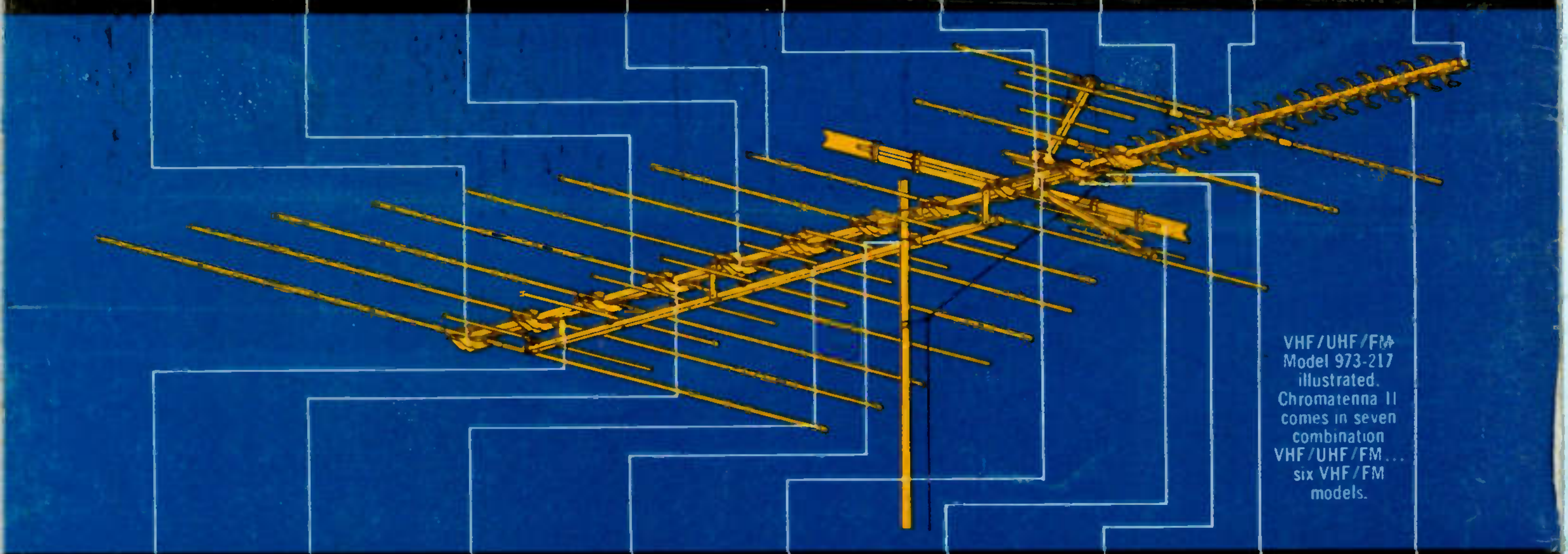
Corner Reflector Bracket improved with larger tabs. (Combination models only.)

Zenith Dipole on UHF. (Combination models only.)

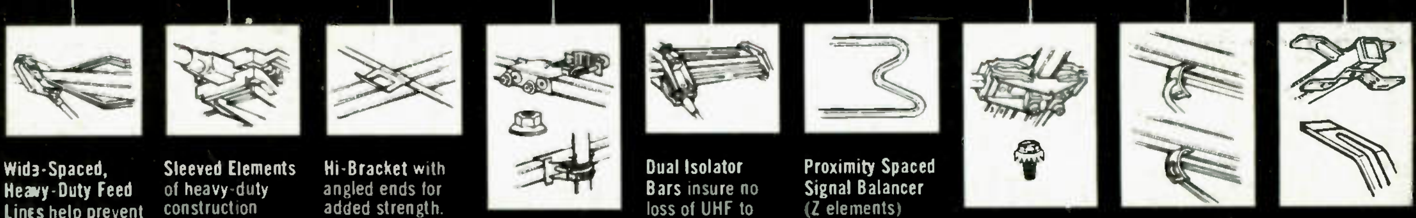
VHF Colinear Directors provide extra signal boost on both low and high band VHF.

Loading Straps—metal plates close to first VHF element insulators provide compensation for Lo and High band by tuning the first driven element with extra capacity.

Rugged 1" Square Boom provides extra strength compared to many round-type booms.



VHF/UHF/FM Model 973-217 illustrated. Chromatenna II comes in seven combination VHF/UHF/FM... six VHF/FM models.



Wide-Spaced, Heavy-Duty Feed Lines help prevent shorting from heavy build-ups of snow or ice.

Sleeved Elements of heavy-duty construction afford extra bracing and protection.

Hi-Bracket with angled ends for added strength.

U-Bolt Mounting provides a larger clamping area; larger locking nut with teeth an integral part assures a more rugged U-BOLT arrangement.

Dual Isolator Bars insure no loss of UHF to VHF signal transfer. (Combination models only.)

Proximity Spaced Signal Balancer (Z elements) provides automatic taper control of periodic driver, improves impedance matching and signal leveling on both Lo and High band channels. Improves Channel 7 pattern.

Electrically Matched Terminals With Stainless Steel Screws eliminate mismatch... protect against rusting, and provide positive electrical contact with improved no-strip stainless steel serrated washers for the take off terminals.

Strain Relief Insulator accomodates either 300-OHM twin-lead, Foam lead or Coax downlead.

Optional Break-away UHF Wing Directors provide maximum gain of standard UHF channels with optional coverage of Hi UHF channels and translator frequencies when broken off. (Combination models only.)

Zenith has quality do-it-yourself antenna kits—UHF only, VHF YAGI and Stereo FM antennas as well as a complete line of reception aid equipment. See your Zenith distributor for news of his exciting, money-making Spring programs and Catalog No. 902-17601

ZENITH®
The quality goes in before the name goes on®

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