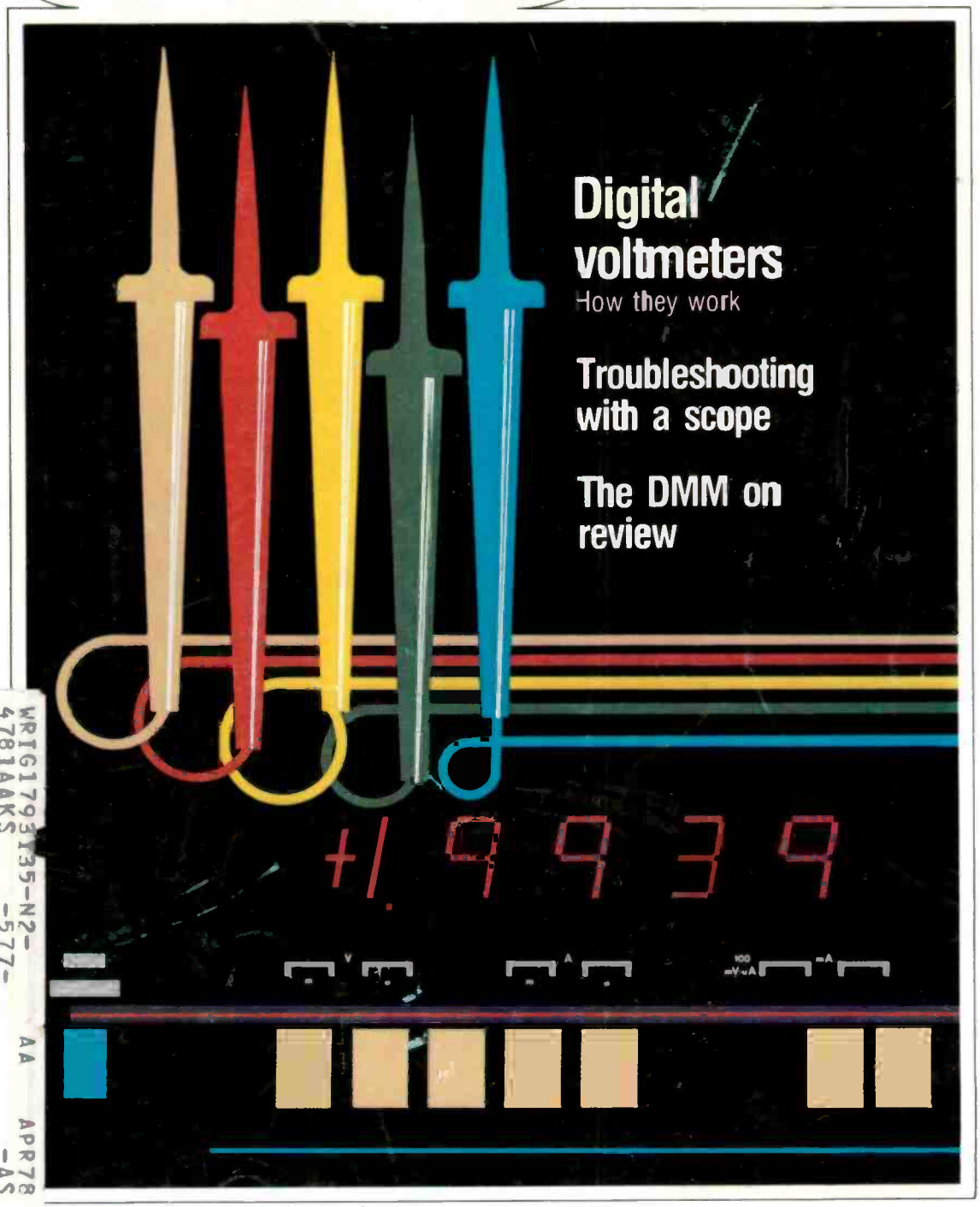
ET/D

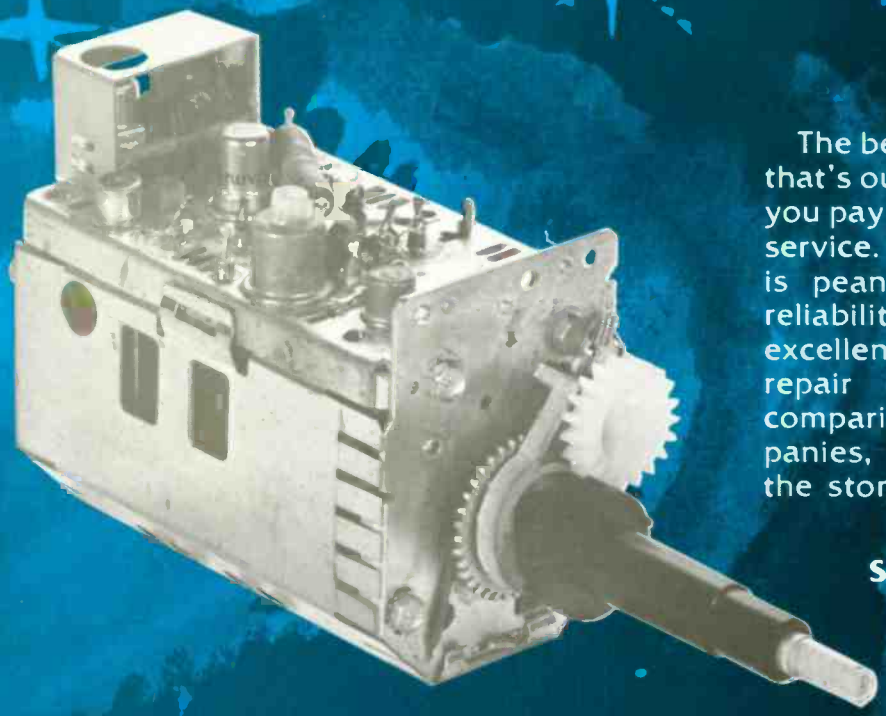
JUNE 1978 • $1.00

ELECTRONIC TECHNICIAN/DEALER
LEADING THE CONSUMER AND
INDUSTRIAL SERVICE MARKETS



A HARCOURT BRACE JOVANOVICH PUBLICATION

The Best of Everything Has It's Price... Even Tuner Service!



The best tuner repair service . . . that's our goal. You get only what you pay for even with tuner repair service. The price you pay at PTS is peanuts when you consider reliability and the standards of excellence we apply to every repair order. When you are comparing tuner service companies, price alone doesn't tell the story.

SAME DAY SERVICE

ORIGINAL OR SUPERIOR PARTS

ONE YEAR LIMITED WARRANTY

We Repair Them **All** . . . Any Make Or Model . . . Color, Black & White, Tube, Transistor or Electronic/Varactor!

PTS®

PTS ELECTRONICS, INC.

THERE'S A PTS SERVICENTER IN MOST MAJOR METROPOLITAN AREAS.
CHECK THE LIST AT THE RIGHT FOR THE ONE NEAREST YOU!

INDUSTRY REPORT

Some of Hy-Gain Assets Acquired By Telex

Five product lines of the bankrupt Hy-Gain Electronics Corporation have been picked up by Telex Communications, Inc. of Minneapolis. Purchased from Citibank of New York, present holder of Hy-Gain assets, were lines including: CB antennas, amateur antennas, marine antennas, amateur transceivers and marine transceivers. Telex did not acquire any of the CB radio inventory or CB radio manufacturing facilities. The latter remain the property of Citibank who has them up for sale.

Telex president, Ansel Kleiman, said, "It is important that the trade and consumers understand that any and all claims against the previous operation, Hy-Gain Electronics Corporation, should be filed with the Bankruptcy Court in Omaha, Nebraska."

Kleiman also stated that marketing, sales and distribution policies of the CB, marine and amateur products will remain essentially the same as previously. Any questions regarding any of the marketing or sales areas should be referred to Hy-Gain in Lincoln, Nebraska.

According to Kleiman, production at the Lincoln facility and shipments of some antenna products from finished goods inventory have already begun.

Key management people in Hy-Gain's antenna operation have also been retained, according to Kleiman. Howard Sachs, for example, will be general manager of the Hy-Gain division of Telex, and according to Kleiman, he has been able to reassemble most of his previous key staff and operations people.

General Electric Unveils One-piece Projector Television

GE's newest TV product—the Widescreen 1000 Home Television Theater—has now been introduced to the press and GE's regional representatives. The suggested retail price of $2800 is firm now and the product is ready for market—and its acceptance as a saleable product is now up to the consumer.

The Widescreen 1000 is a self-contained, rear-projection unit that offers approximately 1000 square inches of picture area, or three times the size of today's standard 25 inch color TV receivers. The new unit takes the same floor space out from the wall as GE's 25-inch color consoles. It is 70 inches long and 50 inches high and is constructed in more-or-less an L-shape.

Widescreen 1000 is the first single-tube, rear-projection unit produced by a major TV manufacturer. We (the ET/D editorial staff) have seen the unit in operation—and we were impressed. The self-contained feature—the controls and viewing screen all in one package—means that you don't have to battle with separate 'screen' placement. You just turn it on—and let the automatic color tuning system—produce the brightest single-tube color picture we've seen so far.

General Electric says they designed the Widescreen 1000 after extensive re-

search to determine the type of wide screen TV system consumers would purchase for their in-home use. It was learned that a fully self-contained, rear-projection unit with approximately 1000 square inches of picture area, was preferred by a wide margin of the consumers surveyed. Also, research results showed that such a unit should also have an automatic color tuning system, a remote control electronic tuning system, and high-quality sound.

GE's design engineers have followed the research findings and have included VIR broadcast controlled color, random access remote electronic tuning and dual speakers. And they have also designed the Widescreen 1000 for easy servicing.

Later on this year—when we review the TV manufacturers' offerings for 1979—we'll take a more detailed look at GE's Widescreen 1000. By that time, also, we'll have a better idea on the acceptance by consumers of the new product.

Dynascan's Sales For First Quarter of 1978 Are Down From Last Year

In the first three months of 1978, Dynascan Corporation, parent of B&K-Precision and Cobra brands, reported sales of $16.7 million, down from $37.4 million in the first quarter of 1977. However, the firm says their first quarter sales exceeded the sales of $16 million in the last quarter of 1977.

Last year's peak first quarter, the firm reports, resulted largely from the initial surge of sales of their newly introduced Cobra 40-channel CB models.

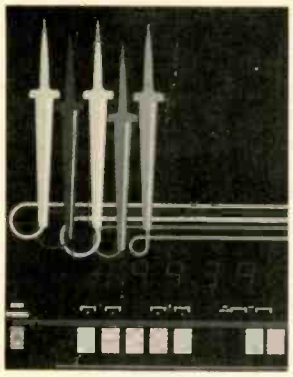
Earnings for the three months ended March 31, 1978 were $407,000 or 14 cents per share, compared with 59 cents per share in the first quarter of 1977.

Dynascan, however, reported steady

ET/D

ELECTRONIC TECHNICIAN/DEALER
LEADING THE CONSUMER AND
INDUSTRIAL SERVICE MARKETS

JUNE 1978, VOL. 100, NO. 6



On the cover: Our artist's conception of this "day of the digital meter." See The DMM Review on page 22 and Bernard Daien's article on Digital Voltmeters on page 16.

FEATURES

DEPARTMENTS

A HARCOURT BRACE JOVANOVICH PUBLICATION ABP ABC EIA

HARCOURT BRACE JOVANOVICH PUBLICATIONS. Robert L. Edgell, Chairman, Richard Moeller, President/Treasurer, Lars Fladmark, Senior Vice President, Joe Bilderbach, Vice President, James Gherna, Vice President, George Glenn, Vice President, Thomas Greney, Vice President, Ezra Pincus, Vice President, Harry Ramaley, Vice President, Lois Sanders, Vice President.

ELECTRONIC TECHNICIAN/DEALER is published monthly by Harcourt Brace Jovanovich Publications. Corporate offices: 757 Third Avenue, New York, New York 10017. Advertising offices: 757 Third Avenue, New York, New York 10017 and 43 East Ohio Street, Chicago, Illinois 60611. Editorial offices: 43 East Ohio Street, Chicago, Illinois 60611. Accounting, Advertising Production and Circulation offices: 1 East First Street, Duluth, Minnesota 55802. Subscription rates: one year, $9, two years, $15, three years, $19 in the United States and Canada. All other countries: one year, $20, two years, $35, three years, $45. Single copies: $1 in the United States and Canada; all other countries: $3. Second class postage paid at Duluth, Minnesota 55806 and at additional mailing offices.

POSTMASTER: Send Form 3579 to ELECTRONIC TECHNICIAN/DEALER, P.O. Box 6016, Duluth, MN 55806.

The new Sinclair DM 235 digital multimeter. 3⅓ digits...6 functions... fully portable. Under $80!

The new Sinclair DM235 is yet another example of outstanding Sinclair value-engineering. Developed from the Sinclair DM2 and world-beating PDM35 (already outselling all other digital multimeters), the DM235 provides full facilities for every application, including field servicing, testing and laboratory work. At a price no comparable digital meter can approach.

A new dimension in styling

Up till now, choosing a meter suitable for use on the bench and in the field hasn't been easy. Either you bought a bulky bench instrument (awkward to carry around) or a hand-held portable (difficult to use on the bench). The Sinclair concept is different. By keeping the thickness down to only a fraction over 1 1/2 inches, and the weight down to under 1 1/2 lbs., we've produced an instrument that has all the advantages of conventional bench meters, but that packs neatly into any tool kit or brief case.

A rugged construction giving total portability

Very rugged mechanical construction using all solid-state components.

Protected against accidental overload.

Size only 10 inches x 5.8 inches x 1.6 inches, weight less than 1 1/2 lbs.

Like every other Sinclair product, the DM235 comes to you with a 12 month repair-or-replacement warranty.

Find out more!

If you'd like full details of the DM235, its operation and its performance, and a complete distributor list, just send the coupon below. We'll send you all the facts by return mail.

The DM235 has all the performance you need—at around half the price of what you'd expect to pay. Send the coupon for the full story.

Sinclair Radionics
115 East 57th Street
Galleria
New York, N.Y. 10022

sinclair
Smaller, better.

A big, bright, unambiguous display

The DM235 has a full 3 1/2 digit display reading to ±1999. Large, high-brightness 0.3 inches LEDs give clear, unambiguous readings with an ultra-wide angle of view. And an LED display means proven lifetime reliability.

Six functions in 26 ranges

DC Volts	1 mV to 1000V
AC Volts	1 mV to 750V
DC Current	1μA to 1A
AC Current	1μA to 1A
Resistance	1Ω to 20 MΩ
Diode test	0.1μ A to 1 mA

10 MΩ input impedance

High accuracy

Basic accuracy of 0.5% (2 V DC range), other DC ranges and Resistance 1.0%, AC ranges 1.5% 30 Hz-10kHz. Temperature coefficient < 0.05 of applicable accuracy per °C.

Easy to use by anyone, anywhere

Automatic polarity operation, automatic placement of decimal point, and automatic out-of-range indication. Unambiguous reading of function and range selected from a single input terminal pair.

Basic operation from four standard C size disposable cells, providing complete independence of AC supply.

Line operation available via optional AC adaptor/charger.

A full range of optional accessories

DM235 meter complete with test leads and probe	$79.95
Eveready carrying case with lead storage compartment	$19.95
Rechargeable battery units	$14.95
AC adaptor/charger 117 V 60 Hz	$ 6.95
30 KV high voltage probe	$29.95

(All prices subject to Sales Tax)

The Sinclair credentials

Sinclair has pioneered a whole range of electronic world-firsts from programmable pocket calculators to miniature TVs—holding a world lead in innovative electronics. The DM235 embodies six years' experience in digital multimeter design, in which time Sinclair has become one of the world's largest producers.

To: Sinclair Radionics
115 East 57th St.—Galleria
New York, N.Y. 10022

Please send me full illustrated details of the new Sinclair DM235

Name _____

Position _____

Company _____

Address _____

Phone _____

See the DM235 at: Star-Tronic Dist. Co., Farmington, Mich. 313-477-7700; Crane & Egert Corp., Elmont, N.Y. 516-488-2100; Dytec Central, Arlington Heights, Ill. 312-394-3380; F.L.W. Inc., Costa Mesa, California. 714-751-7512; International Standard Components, Mountainview, CA. 415-964-4171; Ossmann Instruments Inc., E. Syracuse, N.Y. 315-437-6666; Par Associates, Denver, Colorado. 303-355-2363; Par Associates South, Sandia Park, N.M. 505-281-5602; Scientific Associates, Falls Church, VA. 703-573-8787; Southern Peripherals, Atlanta, Georgia. 404-455-3518 and Greenville, S.C. 803-233-1469. Available in Canada from Gladstone Electronics, Toronto, Ont. 416-787-1448.

AVAILABLE NOW! ONLY $5.90
JAPANESE TRANSISTOR SUBSTITUTION MANUAL

An invaluable Japanese to Japanese substitution guide for approximately 3000 transistors.

* Covers the 2SA, 2SB, 2SC, and 2SD series.
* Introduction includes a guide to understanding Japanese transistors.
* A 90-page, 8½" by 11", soft cover book.

JUNE SPECIAL

DON'T MISS OUT THIS TIME!

ORDER NOW!
LIMITED Q'TY

2SC 1306	$1.90	REG	$2.90
2SC 1307	$2.90	REG	$3.90

NO FURTHER DISCOUNT ON SPECIAL OFFER

Seeking Original Japanese Replacement Parts for CB, TV and Stereo Repair Use?

2SA

2SA 49	.59
2SA 52	.59
2SA 53	.59
2SA 70	1.10
2SA 101	.45
2SA 102	.59
2SA 234	.59
2SA 235	1.00
2SA 240	.90
2SA 329	.70
2SA 342	.90
2SA 353	.70
2SA 377	2.00
2SA 436	2.50
2SA 440	.90
2SA 473	.70
2SA 483	3.00
2SA 484	2.50
2SA 485	2.00
2SA 489	1.60
2SA 490	.90
2SA 493	.59
2SA 495	.45
2SA 496	1.10
2SA 497	1.60
2SA 505	1.20
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
2SA 564A	.59
2SA 565	1.10
2SA 566	3.40
2SA 606	1.60
2SA 607	1.60
2SA 624	1.10
2SA 627	3.60
2SA 628	.59
2SA 634	.70
2SA 640	.59
2SA 642	.70
2SA 643	.70
2SA 653	2.80
2SA 659	.59
2SA 661	.70
2SA 663	4.90
2SA 666	.70
2SA 671	1.40
2SA 672	.70
2SA 673	.70
2SA 678	.70
2SA 679	4.90
2SA 680	4.90
2SA 682	1.50
2SA 683	.70
2SA 684	.70
2SA 695	.70
2SA 697	.70
2SA 699A	.90
2SA 705	.70
2SA 706	1.60
2SA 715	1.40
2SA 719	.59
2SA 720	.59
2SA 721	.59
2SA 725	.59
2SA 726	.59
2SA 733	.59
2SA 738	.70
2SA 740	2.65
2SA 743A	1.60
2SA 744	4.90
2SA 745R	4.90
2SA 747	5.80
2SA 748	1.00
2SA 750	.59
2SA 755	1.60
2SA 756	3.70
2SA 758	5.80
2SA 764	4.40
2SA 765	4.90
2SA 774	.59
2SA 777	1.00
2SA 794A	1.00
2SA 798	.70
2SA 814	1.90
2SA 815	1.00
2SA 816	.70
2SA 818	1.30
2SA 837	2.80
2SA 839	2.15
2SA 841	.59
2SA 847	.59
2SA 850	.59
2SA 872A	.59
2SA 885	.70
2SA 908	11.00
2SA 913	1.20

2SB

2SB 22	.59
2SB 54	.59
2SB 55	.59
2SB 75	.45
2SB 77	.45
2SB 173	.45
2SB 175	.45
2SB 176	.45
2SB 178	.70
2SB 186	.45
2SB 187	.45
2SB 202	1.60
2SB 220	.70
2SB 303	.59
2SB 324	.70
2SB 337	1.60
2SB 346	.70
2SB 367	1.50
2SB 368B	2.15
2SB 379	1.10
2SB 381	.59
2SB 400	.59
2SB 405	.59
2SB 407	1.40
2SB 415	.59
2SB 434	1.20
2SB 435	1.40
2SB 440	.59
2SB 449	1.60
2SB 461	1.20
2SB 463	1.20
2SB 471	1.60
2SB 473	1.20
2SB 474	1.00
2SB 481	1.20
2SB 492	1.00
2SB 507	1.60
2SB 509	1.60
2SB 511	1.10
2SB 514	1.90
2SB 523	1.00
2SB 526C	1.30
2SB 527	1.60
2SB 528D	1.60
2SB 529	.90
2SB 530	4.40
2SB 531	3.40
2SB 536	1.60
2SB 537	1.60
2SB 539	4.90
2SB 541	4.40
2SB 554	10.00
2SB 556	4.90
2SB 557	3.40
2SB 561B	.70
2SB 564	.70
2SB 595	1.90
2SB 596	1.60
2SB 600	7.00

2SC

2SC 183	.59
2SC 184	.59
2SC 281	.59
2SC 283	.59
2SC 284	1.20
2SC 317	1.20
2SC 352A	2.50
2SC 353A	2.50
2SC 367	.90
2SC 369	.59
2SC 371	.59
2SC 372	.45
2SC 373	.45
2SC 374	.59
2SC 377	.70
2SC 380	.59
2SC 381	.59
2SC 382	.59
2SC 383	.90
2SC 387A	.59
2SC 388A	1.00
2SC 394	.59
2SC 403	.59
2SC 430	.90
2SC 454	.59
2SC 458	.59
2SC 460	.59
2SC 461	.59
2SC 478	1.10
2SC 481	1.60
2SC 482	1.50
2SC 484	1.60
2SC 485	1.60
2SC 486	1.60
2SC 493	3.90
2SC 495	.90
2SC 496	.90
2SC 497	1.60
2SC 509	.70
2SC 515A	1.40
2SC 517	3.95
2SC 535	.59
2SC 536	.59
2SC 537	.59
2SC 538A	.70
2SC 562	.70
2SC 563	1.10
2SC 605	.70
2SC 619	.59
2SC 620	.59
2SC 627	2.25
2SC 631	.90
2SC 632A	.45
2SC 634A	.59
2SC 642A	5.90
2SC 644	.45
2SC 645	.70
2SC 650	1.30
2SC 665H	8.50
2SC 668	.45
2SC 680	2.80
2SC 681A	5.80
2SC 684	1.10
2SC 693B	.59
2SC 696	1.95
2SC 708	1.90
2SC 710	.45
2SC 711	.45
2SC 712	.59
2SC 717	.59
2SC 727	1.90
2SC 730	4.40
2SC 731	5.80
2SC 732	.59
2SC 733	.59
2SC 734	.59
2SC 735	.59
2SC 738	.59
2SC 756	2.80
2SC 756A	3.00
2SC 763	.59
2SC 772	.45
2SC 773	.70
2SC 774	2.00
2SC 775	1.95
2SC 776	2.65
2SC 777	3.50
2SC 778	3.60
2SC 781	2.65
2SC 783R	3.60
2SC 784	.59
2SC 785	.59
2SC 789	1.00
2SC 790	1.40
2SC 793	2.80
2SC 799	3.60
2SC 802	3.60
2SC 815	.59
2SC 828	.45
2SC 829	.45
2SC 830H	5.90
2SC 838	.59
2SC 839	.59
2SC 853	.90
2SC 867	4.25
2SC 870	.59
2SC 871	.59
2SC 895	4.90
2SC 897	3.40
2SC 898	4.40
2SC 900	.45
2SC 923	.45
2SC 929	.45
2SC 930	.45
2SC 941	.59
2SC 943	.70
2SC 945	.45
2SC 959	1.50
2SC 971	1.00
2SC 982	.90
2SC 983	1.00
2SC 984	.90
2SC 994	3.90
2SC 996	3.40
2SC 1000BL	.59
2SC 1012	1.50
2SC 1013	1.10
2SC 1014	1.10
2SC 1017	1.40
2SC 1018	1.20
2SC 1030C	2.80
2SC 1047	.70
2SC 1051	4.40
2SC 1060	1.40
2SC 1061	1.40
2SC 1076	39.00
2SC 1079	5.90
2SC 1080	4.40
2SC 1096	1.00
2SC 1098	1.10
2SC 1111	3.40
2SC 1114	3.70
2SC 1115	4.40
2SC 1116	4.90
2SC 1116A	6.60
2SC 1124	1.30
2SC 1127	1.40
2SC 1161	1.90
2SC 1162	1.00
2SC 1166	.59
2SC 1167	6.60
2SC 1170B	6.60
2SC 1172B	8.50
2SC 1173	.90
2SC 1175	.90
2SC 1177	14.00
2SC 1189	1.20
2SC 1209	.70
2SC 1211D	.59
2SC 1212A	1.40
2SC 1213	.70
2SC 1215	.70
2SC 1222	.45
2SC 1226A	.90
2SC 1237	2.25
2SC 1239	3.90
2SC 1279	.70
2SC 1306	2.90
2SC 1307	3.90
2SC 1310	.59
2SC 1312	.59
2SC 1313G	.59
2SC 1316	8.50
2SC 1317	.45
2SC 1318	.45
2SC 1325A	7.60
2SC 1327	.59
2SC 1330	.70
2SC 1335	.70
2SC 1342	.59
2SC 1344	.59
2SC 1345D	.59
2SC 1346	.70
2SC 1347	.70
2SC 1358	5.90
2SC 1359	.59
2SC 1360	1.00
2SC 1362	.59
2SC 1364	.70
2SC 1377	4.90
2SC 1383	.59
2SC 1384	.59
2SC 1396	.70
2SC 1398	1.10
2SC 1400	.59
2SC 1402	4.90
2SC 1403	4.90
2SC 1407	.90
2SC 1419	1.10
2SC 1444	2.80
2SC 1445	3.00
2SC 1447	1.60
2SC 1448	1.60
2SC 1449	1.00
2SC 1451	2.25
2SC 1454	5.60
2SC 1475	1.40
2SC 1478S	.70
2SC 1509	1.10
2SC 1567	1.10
2SC 1567A	1.10
2SC 1584	8.50
2SC 1586	7.60
2SC 1624	1.30
2SC 1626	1.10
2SC 1628	1.30
2SC 1647	1.00
2SC 1667	3.40
2SC 1669	1.60
2SC 1674	.59
2SC 1675	.59
2SC 1678	2.25
2SC 1679	4.25
2SC 1681	.70
2SC 1682	.45
2SC 1684	.59
2SC 1687	.70
2SC 1688	.70
2SC 1708	.59
2SC 1728	1.90
2SC 1730	.59
2SC 1756	1.40
2SC 1760	1.90
2SC 1765	8.80
2SC 1775	.45
2SC 1816	3.90
2SC 1846	.70
2SC 1885	.70
2SC 1908	.59
2SC 1909	3.90
2SC 1913	1.20
2SC 1945	5.60
2SC 1951	1.10
2SC 1957	1.20
2SC 1969	4.90
2SC 1973	1.10
2SC 1974	1.90
2SC 1975	4.40
2SC 2028	.90
2SC 2029	3.90
2SC 2074	1.90
2SC 2076	.59
2SC 2091	2.80
2SC 2092	3.90
2SC 2098	4.90

2SD

2SD 16	5.90
2SD 28	2.50
2SD 72	1.10
2SD 75	.90
2SD 77	.59
2SD 81	3.00
2SD 90	1.60
2SD 91	1.60
2SD 92	1.90
2SD 93	2.80
2SD 118	4.40
2SD 130	1.20
2SD 141	1.40
2SD 142	2.00
2SD 143	2.80
2SD 178	1.10
2SD 180	2.50
2SD 187	.59
2SD 188	3.00
2SD 201	3.40
2SD 202	3.90
2SD 204	1.40
2SD 205	1.40
2SD 213	5.90
2SD 217	4.40
2SD 218	4.40
2SD 220	2.50
2SD 223	1.90
2SD 224	1.90
2SD 226A	1.60
2SD 227	.45
2SD 234	1.00
2SD 235	1.00
2SD 236	1.60
2SD 255	1.60
2SD 261	.60
2SD 287	3.70
2SD 288	1.40
2SD 291	2.80
2SD 300	5.60
2SD 313	1.10
2SD 314	1.20
2SD 315	1.20
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	3.00
2SD 371S	2.80
2SD 380	7.60
2SD 381	1.40
2SD 382	1.40
2SD 388	3.40
2SD 388A	4.40
2SD 389	.90
2SD 390	1.00
2SD 421	8.50
2SD 424	8.50
2SD 425	6.50
2SD 426	4.60
2SD 427	3.00
2SD 525	1.60
2SD 526	1.10
2SD 555A	6.60
2SD 610	1.90
SG 613(tv)	5.95

FET

2SK 198L	.90
2SK 23	1.10
2SK 30	.70
2SK 33	1.10
2SK 34	1.10
2SK 40	.70
2SK 41	1.10
2SK 49	1.30
2SK 55	1.30
2SK 61	1.40
2SK 68	1.30
3SK 22Y	2.55
3SK 35	2.25
3SK 37	3.00
3SK 39	2.25
3SK 40	2.25
3SK 41	2.50
3SK 45	2.50
3SK 48	5.90
3SK 49	2.50
MK 10	2.00

IC

AN 203	2.50
AN 214Q	3.00
AN 217	1.90
AN 239	7.00
AN 247	4.40
AN 274	3.40
AN 277B	2.40
AN 315	3.00
AN 328	3.90
AN 362	3.00
BA 511	2.90
BA 521	2.90
HA 1137	4.90
HA 1138	4.40
HA 1149	5.60
HA 1151	4.40
HA 1156	3.00
HA 1158	5.30
HA 1159	5.80
HA 1196	4.90
HA 1197	3.90
HA 1201	1.50
HA 1202	2.25
HA 1211	1.50
HA 1306W	3.70
HA 1322	4.40
HA 1339	4.40
HA 1339A	4.40
HA 1342A	4.40
LA 1111P	2.50
LA 1201	2.50
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
LD 3120	2.50
M51513L	4.90
M5152L	2.50
M51841P	2.80
M5320P	2.25
M53273P	2.80
M53274P	2.50
M53393	7.60
M54730 P	8.80
MPS U31	1.90
STK 011	7.60
STK 014	9.50
STK 015	6.60
STK 016	8.50
STK 022	11.00
STK 032	14.00
STK 435	8.50
STK 439	11.00
STK 502	8.80
STK 503	9.60
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
TA 7063P	1.60
TA 7064P	1.90
TA 7066P	2.00
TA 7074P	4.90
TA 7075P	4.90
TA 7076P	4.90
TA 7089P	3.00
TA 7102	5.80
TA 7106P	4.90
TA 7108P	1.90
TA 7109P	3.40
TA 7120P	1.90
TA 7122AP	1.90
TA 7124P	1.60
TA 7129P	1.90
TA 7130P	2.80
TA 7136P	1.30
TA 7146P	4.20
TA 7150P	4.40
TA 7159P	2.50
TA 7200P	4.60
TA 7201P	4.60
TA 7203P	3.70
TA 7204P	3.40
TA 7205P	2.90
TA 7310P	3.95
TA 78005M	5.80
TA 78005P	5.80
TA 78012M	6.60
TA 78012P	5.80
TA 78015M	6.50
TA 78015P	5.80
TBA 810 SH	3.70
TC 5080P	5.80
TC 5081P	3.40
TC 5082	3.90
TD 3505AP	8.50
UHIC 002	5.80
UHIC 004	5.80
UHIC 005	5.80
UPC 20C	4.40
UPC 41C	3.70
UPC 554C	2.80
UPC 555H	2.25
UPC 563	3.70
UPC 566H	1.60
UPC 576	3.70
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 1152H	3.40
UPC 1156	3.00
UPD 858C	9.50
PLL 01A	8.80
PLL 02A	8.80
SN 7400	.19
SN 7490	.60

DIODES

78L05	1.10
IS 84	.60
IS 188	.25
IS 332	.45
IS 953	.25
IS 1007	.45
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
VD 6B	.40
VD 6C	.40

ZENER DIODES

WZ 050	.45
WZ 052	.45
WZ 061	.45
WZ 071	.45
WZ 075	.45
WZ 081	.45
WZ 192	.45
WZ 260	.45
WZ 280	.45

PRICES MAY CHANGE WITHOUT NOTICE COD ORDERS WELCOMED

Minimum order $5.00 Ohio residents add 4% sales tax. Add $1.00 postage and handling
Quantity discount prices. Ask For Our Complete Price List. Mfg. inquiries Welcomed
All parts guaranteed against factory defect

TOLL FREE TELEPHONE

Nationwide 800/543-1607 Local 513/874-0220
Ohio 800/582-1630 874-0223
Hours: Mon. thru Fri. 10-7 Sat. 11-5

IMMEDIATE DELIVERY
WITHIN 48 HOURS

ON ALL TRANSISTORS IN STOCK
FOR MORE DETAILED INFORMATION
PLEASE ASK FOR OUR CATALOG

Circle No. 116 on Reader Inquiry Card

operations in their industrial products group, which includes B&K-Precision test equipment.

In a related move, the firm's president, Carl Korn, has announced that Dynascan, under the Cobra name, will enter the car stereo market later this year. Korn said, "We feel we can take advantage of the Cobra name and reputation by entering the auto-sound business with a high quality line of products, including radios, tape players, and accessories."

Color TV Prices Said to Run Counter to Inflation

An interesting point to pass along to your TV customers is the report from RCA that color television prices have actually declined 43 per cent over the past quarter of a century in sharp contrast to prices of such products and services as automobiles, health care and housing.

Roy Pollack, VP of RCA's Consumer Electronics Division, notes that since 1954 the average retail price of a color TV set has dropped from $1,000 to $575, despite tremendous advances in color TV set technology, reliability and safety.

"The cost of living, as everyone knows, has gone up dramatically during the same time span. If color TV prices had kept pace with the Consumer Price Index, the average retail price of a color TV set today would be about $1,300, or $725 higher than it is now," Pollack says.

In that same period, he adds, the average selling price of a new car has gone from $2,620 in 1954 to $6,120 in 1977, an increase of 134 per cent; the median price of a new one-family house from $12,500 to $48,700, an increase of 290 per cent; and health care spending, on a per capita basis, from $101 to $637, an increase of 531 per cent.

According to Pollack, there are approximately 130 million color and black-and-white television sets in American homes, or more than the number of automobiles, bathtubs, washing machines or refrigerators in use, and not far behind the telephone.

It's Las Vegas Again For Winter Consumer Electronics Show

Las Vegas will again be the site for the 1979 International Winter CES. The show will be held Friday, January 5 through Monday, January 8 at the Las Vegas Convention Center, according to William E. Boss, chairman of the Board of the Electronic Industries Association's Consumer Electronics Group, the show's sponsor and producer.

The 1979 show dates have been shifted one day later than previously slated to allow three full days to finalize construction of exhibits, and to facilitate air transportation for attendees who, for this show, will come from all 50 states and foreign countries.

ET/D

Richard W. Lay, *Editor (Chicago)*

Don W. Mason, *Managing Editor (Duluth)*

Alfred A. Menegus, *Publisher (New York)*

David J. Hagelin, *Assoc. Publisher (Chicago)*

Tom Greney, *Group Vice President (Chicago)*

John Paszak, *Graphic Design*

Roni Seger, *Production Manager*

Lillie Pearson, *Circulation Supervisor*

Gene Bailey, *Reader Service*

Dawn Anderson, *Classified Ad Mgr.*

Please submit editorial manuscripts to:
Editor, ET/D, 43 East Ohio St.
Chicago, Ill., 60611

ADVERTISING SALES

Please send all advertising material to:
ET/D,
Production Mgr.
1 East First Street
Duluth, Minn. 55802
(218) 727-8511

East Region
Alfred A. Menegus
757 Third Avenue
New York, N.Y. 10017
(212) 888-4382

Midwest Region
David J. Hagelin
43 East Ohio Street
Chicago, Ill. 60611
(312) 467-0670

Southern & Western Region
Chuck Cummings
613 N. O'Connor
Irving, TX 75061
(214) 253-8678

HBJ
HARCOURT BRACE JOVANOVICH PUBLICATIONS

Robert L. Edgell, *Chairman*
Richard Moeller, *President/Treasurer*
Lars Fladmark, *Senior Vice President*
Joe Bilderbach, *Vice President*
James T. Gherna, *Vice President*
George A. Glenn, *Vice President*
Thomas Greney, *Vice President*
Ezra Pincus, *Vice President*
Harry D. Ramaley, *Vice President*
Lois Sanders, *Vice President*

Formerly
RCA
Instruments

"At last... a digital VOM I can trust."

"I repair electronic equipment from TVs to computers. So I need dependable test equipment. That's why I was unhappy with the first digital VOM I bought — it never worked right and I couldn't trust it.

"Then I bought a VIZ WD-751A for $150. The first thing I noticed was its speed; even on AC (the "problem" scale for most DMMs) the readings come fast — in a second at most. And this DMM is fully protected against overload. Even if I set it on OHMS and put in AC, I can't damage it.

"I like how easy it is to read. Even in the bright sun, it doesn't wash out. And this DMM changed my thinking about LCDs in low light; if there's enough light to plug in the leads, there's enough light to read the display.

"With its LCD readout and low-power CMOS circuits, this meter draws less than 50mA, so its batteries last a long time. And its CMOS large-scale ICs assure me that it'll stay accurate over the long haul.

"I find this same quality built into all VIZ VOMs. Their WD-750A bench-type digital VOM has extra features like an analog reference meter which is center-settable for nulling and peaking; a floating ground; a detachable power cord for complete AC isolation; low-power ohms; and an extra 20 Megohm resistance range. Its metal case provides great rf shielding, and it has the same overload protection as the smaller WD-751A DMM. One service magazine I read just rated it excellent in performance — and I agree; in fact, in their test it even gave very accurate readings on DC having high ripple or pulses, where some DMMs are off by as much as 40%.

"For years I've known that analog VOMs aren't all the same, so why did I ever think that all 3½-digit DMMs would be the same? As my distributor told me, VIZ test instruments work right and they don't come back for repairs.

"These VOMs have convinced me that if VIZ makes it, it's made right."

VIZ Test Instruments Group

335 East Price Street Philadelphia, PA 19144 (215) VI-4-2626

The Circuit Tester line
Accuracy and stability assured

7002

FROM THE EDITOR'S DESK

In the past 15 years the number of electron tubes sold in the United States for all purposes has fallen 67 per cent. Five years ago most black and white TVs manufactured, and some 75 per cent of the color sets, carried mostly electron tube circuitry. Today all color, and black and white sets are considered 100 per cent solid state.

The "average" solid state color television set today has an estimated life of 12 years. It uses just over half the amount of electricity as its electron tube counterpart and runs much cooler.

Most of the figures I have just quoted, have come across my desk at one time or another from the Electronics Industries Association. Probably you were already aware of the trend, if not the specifics of the numbers themselves. I bring them to your attention for one reason. The reason too, is one I'm sure you already "feel." The amount of service per television set in the United States appears to be dropping too rapidly to sustain a whole service industry on its present scale indefinitely.

What these figures seem to tell all of us concerned with the state of the consumer electronics service market is that it seems highly unlikely that most consumer electronics business operations, except perhaps the very, very largest, will in the future be able to survive solely on the basis of television service alone.

So now what? If the above statistics hold true, doesn't that mean there will be a dropout, perhaps a sharp drop out, of the total number of television-only service shops? The answer, of course, is yes. But it needn't be taken as an insurmountable problem if we approach this circumstance with knowledge and confidence in our own abilities.

The "way out" for a professional service shop operation interested in maximizing profitability is as old as American business itself ... DIVERSIFICATION.

This brings up a very important point. In an environment abounding with new applications in electronic gadgets, gimmicks, tools and appliances, it seems highly likely that the service shop that will survive the "belt tightening" we are likely to experience in the future is the one that will go out and aggressively seek these new avenues leading to developing service areas.

Put another way, has your shop ever considered expanding into the many growing numbers of new opportunities? What about home security alarm and protection systems, closed circuit television surveillance systems for home and industry, or biomedical equipment servicing, marine and communications electronics, radar ranges and other appliances, plus many, many more opportunities. And, did you realize that the total annual service bill for business oriented small computer systems in now $3.7 billion a year and this figure will grow at an estimated 90 per cent a year for the foreseeable future?

These figures and the questions they raise should be very interesting to anyone seriously considering an expansion of their current service base. They at least tell you along which lines you should be directing your thoughts if you find your present service business situation too finely restricted to *only one* type of electronics servicing.

Sincerely

Richard M. Lay

From blisters to boxes to bags.

Mallory's got the winning team for your solderless terminal needs.

Mallory solderless terminals are available now — packaged to suit your needs. These crimp-type terminals and connectors fit virtually all popular applications and come in a complete range of sizes from 26 through 4/0 AWG.

Buy the winning team for convenience and reliability. See your Mallory Distributor. Or contact Mallory Distributor Products Company, a division of P. R. Mallory & Co. Inc., Box 1284, Indianapolis, Indiana 46206. (317) 853-3731.

MALLORY

Capacitors • Controls • Fastening Devices • Resistors • Security Products • Semiconductors • Solderless Terminals • Sonalert® Signals • Switches

Circle No. 121 on Reader Inquiry Card

NEWSLINE

APRIL BIGGEST MONTH YET FOR TV SALES TO DEALERS. For the first time in the month of April -- any April -- total TV sales to dealers totaled more than a million units, according to the latest EIA report. And the "merry month of May" started its first week breaking records -- up 65.5% from last year. In April, color sales were up 21% from a year ago, and B-&-W sales were up 7.8%.

ELECTRONIC PARTS ORDERS INDEX UP, TOO, IN '78. Also, according to figures from the Electronic Industries Association (EIA), the index on dollar value of new orders received for electronic parts for the first four months of 1978 was up 14.65% from the dollar value of orders during the same period a year ago. When measured against orders received during a comparable period in 1969, 1970, and 1971, orders through the first four months in 1978 are running 106.40% ahead. Orders received include capacitors, coils, connectors, filters, relays, switches, resistors, sockets, transformers, reactors and loudspeakers.

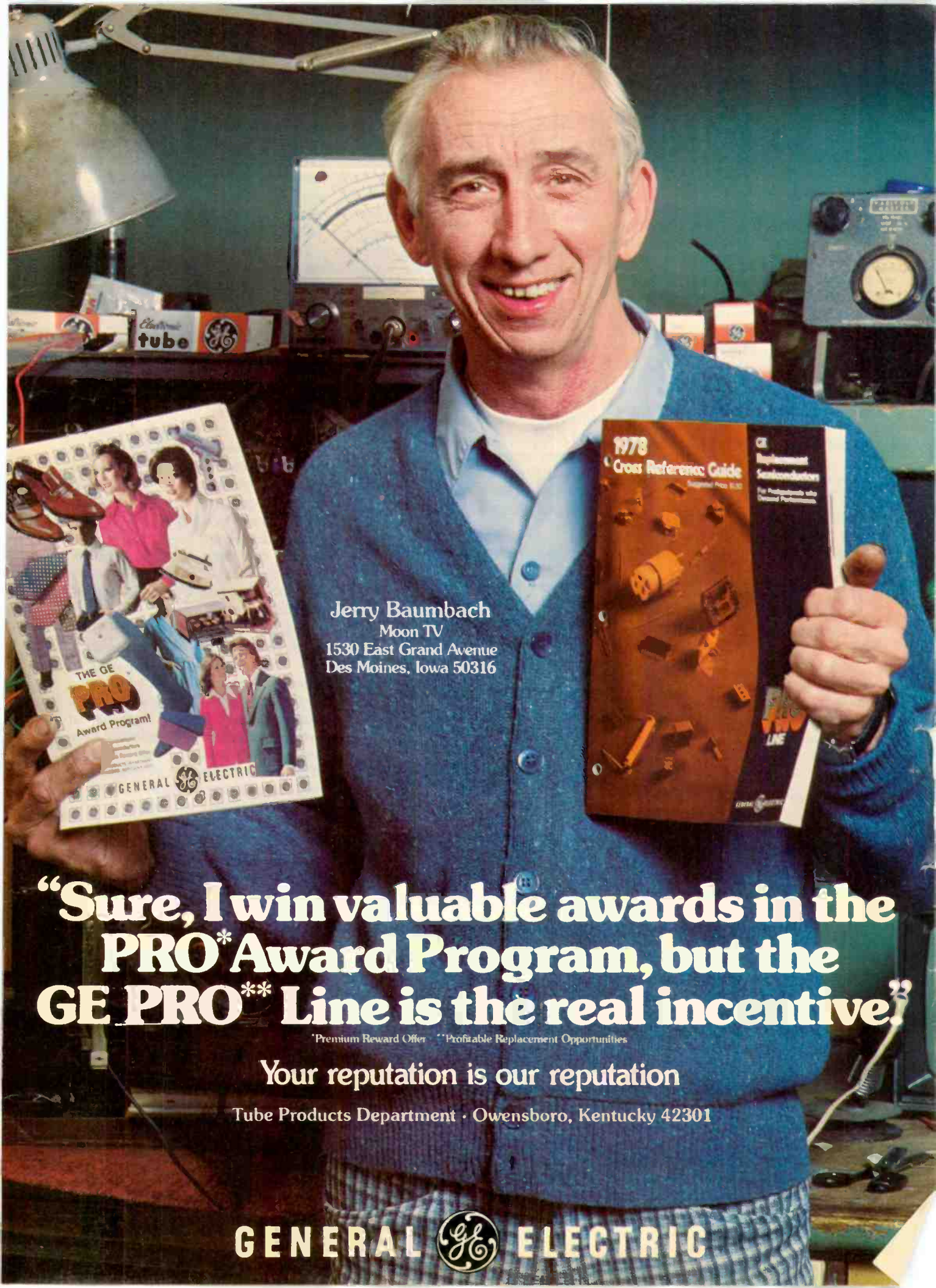
SUN LIGHTS UP THE NAVAJO INDIAN RESERVATION. The country's largest Indian reservation -- the Navajo Nation at the junction of the New Mexico, Arizona, Utah, and Colorado boundaries -- is turning to the sun for needed electricity and water. Faced with the need to improve living conditions without expensive power lines, the Indian Health Service has contracted with the Solarex Corporation of Rockville, Maryland, to install roof-mounted solar panels at homes on the reservation. Each installation, which costs $400, supplies electricity for a 15-watt fluorescent lamp, a 3-gallon-a-minute water pump and an 80-ampere-hour battery to provide energy storage for nighttime operation.

ZENITH'S FIRST QUARTER SALES DOWN FROM LAST YEAR. Zenith Radio Corporation says a decision to reduce distributor color television inventories resulted in a reduction in sales for the company from the 1977 period. Company earnings for the first quarter of 1978 were, they report, $1.1 million, or 6 cents a share, compared to $6.0 million, or 32 cents per share, in 1977. Sales for 1978's first quarter were $214 million, compared to $231 million in 1977.

PANASONIC PRICES SLATED TO GO UP AGAIN THIS SUMMER. Panasonic executive vice president Ray Gates told a spring sales meeting in Florida that the firm's prices, which were increased on the first of the year, will definitely have to go up again in July. Increases will average 5 to 7% and will be highest in Panasonic and Technics brand stereo products, and lowest in TV.

MEDICAL MICROCOMPUTERS TO PRODUCE $1.3 BILLION MARKET. Sales generated by microcomputer-based medical systems will cumulatively total $1.3 billion over the next ten years, according to a study by Frost & Sullivan, NY-based research firm. "Not only will microcomputer systems find a place in medical applications not now covered by minicomputers, but it also is evident that the micro will invade current minicomputer markets as well," the study says, adding advanced microtechnology will radically change the traditional market profile.

MATSUSHITA ELECTRIC EARNINGS SET COMPANY HISTORY. Matshushita Electric Industrial Co., Ltd., reports consolidated earnings and sales for the three months ended Feb. 20, 1978, that set records for any first quarter in the company's history. Matshushita is Japanese parent firm for "Quasar" and "Panasonic" companies.



Jerry Baumbach
Moon TV
1530 East Grand Avenue
Des Moines, Iowa 50316

"Sure, I win valuable awards in the PRO* Award Program, but the GE PRO** Line is the real incentive!"

*Premium Reward Offer **Profitable Replacement Opportunities

Your reputation is our reputation

Tube Products Department · Owensboro, Kentucky 42301

GENERAL ELECTRIC

LETTERS

HELP WANTED

Can someone tell me where to get troubleshooting and technical information for the circuits used in closed circuit television and those used in computer TV readouts.?
Elton Brabham
2103 Glynwood Drive
Savannah, GA. 31404

I like your magazine, and especially the Tekfax, very much. Also, need some help. I have an old Rider Chanalyst, Model #11, I would like to obtain service notes for. Does anyone know of a firm we could contact for this information?
Walt Finkbeiner
New Jersey Avenue
Absecon, N.J.

We have an American Bosch radio model 48 or 49 (according to the instruction manual). It was manufactured by American Bosch Magneto Corp, Springfield, Mass. about 1929. Am very interested to find out its value. It works perfectly. Can you help?
Jeff Pelzel
108 Water St. S.W.
Sleepy Eye, Minn. 56085

I need help in finding two tubes that have turned out to be hard to get. Maybe one of your readers has one, or can point me in the right direction. The tubes are an EL11 and an AZ11. Thanks.
Walt's TV Service
379 Burns Road
Millville, N.J. 08332

Does anyone know where I could find a schematic for a HI-LO 8 Channel Scanner? The only identifying marks on it are RBM-Serial 21737. I think it was manufactured somewhere in Montana. Thanks.
R.M. Burleton TV
Box 235
Oakfield, Wis. 53065

I hope your readers can help. I have tried every place to get the schematics and the original copies (or duplicates) for the following products: RCA Television Calibrator, Model WR-39C; RCA TV sweep Generator, Model WR-59B; Industrial Television, Inc. VHF-UHF Field Strength Meter, Model IT-105RB; B&K-Precision Tube & Transistor Tester, Model 650, Test Panel 610; Precision Apparatus Co. Volt-Ohm-Meter Series 40; Neo-Tronics, Inc. Intensitester Model 101; and Service Instruments Co., Align-O-Pak Model BE-2.

I'll appreciate any help I can get.
Robert J. Huber
2030 Winne Court
Dubuque, Iowa 52001

I need information and a schematic for a UHF TV sweep generator, Model NRK-153 manufactured by Standard Coil Products Co. Thank you.
Durward McLohon
Wenner Gren Lab
University of Kentucky
Lexington, Kentucky 40506

LOOKING FOR ASSISTANCE

I have a Knight KG-625 VTVM, which needs the movement replaced, or repaired. As the Knight Company is no longer in operation, I would like help in either getting the meter movement repaired, or finding a new or used replacement. Someone gave me three different addresses of repair businesses but none of them answered my letters.

I sure would appreciate some help on this matter. It is a Knight KG625 with a 200 μA movement, and it's too good a meter to junk.
James S. McIntyre
Star Route, Box 607
Pettus, W.V. 25153

TIPS ON BUYING WHOLESALE

With reference to a letter appearing in your April, 1978 issue, from a Mr. Richard W. Dambrun, who is in need of information on purchasing wholesale parts, I believe I can offer some helpful advice.

If you are legitimately engaged in the servicing business, i.e., hold a state sales tax license, in addition to any other licenses which may be required to carry on such a business in your location, then you should have absolutely no problem in buying parts at 'wholesale' or 'dealer net' from authorized parts distributors or jobbers.

You will benefit greatly, and can offer better service to your customers, by establishing a friendly, close working relationship with a parts wholesaler in your locality. He will be glad to work with you in obtaining hard-to-get parts, assisting in the selection of substitute parts, and supplying you with manufacturers' catalogs, price lists, and valuable information.

To locate a bona-fide supplier, check the yellow pages under "Television Parts & Supplies–Wholesale." Pay them a visit–present your business card and introduce yourself. Check on the brands of tubes and semi-conductors they carry–GE, RCA, Sylvania, or whatever. Ask frankly what discount they normally offer to dealers such as yourself. 40% off list is standard in the industry. Discounts usually run higher for tubes, excepting picture tubes. Fifty to sixty per cent is common, depending upon the distributor. As a service dealer, it has been my experience that it is not necessary to buy in quantity to obtain these discounts. You are apt to get more favorable discounts on tubes, however, by buying most or all from one distributor–for you become a more 'regular' customer of his.

Ask him for 'suggested retail' price schedules for tubes and semiconductors. Then you can compare. And, of course, these are the prices you can fairly charge your customers. Ask for a Mallory general catalog; it shows net (wholesale) prices. So, then you'll have another basis for comparison. And bear in mind that slight price increases may only reflect inflation–which you should pass along to your customer.

I hope this information will prove helpful.
Max McKahan
MM Television & Radio
Westville, Indiana

WHERE IS SEARS?

Why is it Electronic Technician/Dealer stopped printing Sears' schematics? Years ago Sears diagrams were in your Tekfax department. Also, Sears parts are hard to get. Is there anything you can do to help?
C. Nellum
Terre Haute, Indiana

EDITOR: We are, or course, dependent on the manufacturers for supplying us with their schematics and other technical information. As far as we can tell, ET/D stopped printing Sears schematics when Sears stopped supplying them. However, we will look into the matter. They should be included in Tekfax.

"When our customers are satisfied they pass the word. And we grow."

"The computer puts service information right at our fingertips, so service is faster."

"You have to love what you're doing to be a successful servicer—and I do."

"Our computer lets us spend time on service, not paperwork."

Walter Groce, Coastal TV, New Orleans, Louisiana

It began with a radio kit

Walter Groce's interest in electronics began when he assembled a CB radio kit in 1960. Later Groce went to work at his father-in-law's television shop and went back to school to become an electrical engineer. Today Groce guides Coastal TV, one of the key servicing agencies in the greater New Orleans area.

Unique facilities

About a year ago Coastal TV moved to a one-story building that had been used by an oil company as a training center for service station personnel. Groce made use of such exisiting features as a pair of hydraulic lifts, which were adapted as service benches, air conditioning, the paneled and carpeted office area, and ample parking space with room for future expansion.

There are seven work benches in the shop and an impressive variety of scopes that are mounted on specially built roll-about stands. An outdoor antenna system brings area broadcast signals to the technicians' work benches and a color bar signal is injected into the distribution system.

Technician Mike Dean displays the Coastal TV shirt-and-tie approach to servicing.

Service work

Coastal TV concentrates on service work for retailers, including mass merchandisers. For that reason, three technicians work in the shop and three work outside, using radio-equipped trucks.

Technicians work 8 AM to 5 PM, Monday through Friday with a half day every other Saturday. A bonus arrangement allows technicians to receive one-third of all net profits over their pre-determined quota.

Every morning each technician calls the service customers on his daily list to reaffirm a need for service, obtain pre-service information and set a time for the visit.

The outside technicians leave service contract forms to obtain business for Coastal TV. Two contract followup mailings are made to the consumer during the warranty period.

"Shirt and tie" look

Groce believes in the "shirt and tie" approach to the servicing business. His technicians follow his example, both in the shop and when making house calls.

Groce is a practicing technician who enjoys computer work.

When Groce decided to add a computer to his business, he decided to buy instead of lease. To keep the computer busy, Coastal TV provides data processing services for other dealers, including special mailings and service contract processing, for a fee.

Coastal TV uses the computer to store customer service records, warranty registration data, parts inventory, payroll and employee performance statistics and to print Coastal TV's service contracts. Coastal TV's warranty offerings include a nine-month extension of the 90-day factory labor coverage, and one year contracts thereafter for parts and labor coverage.

Groce is selective about service contract customers. He uses the computer to pinpoint "bad risk" customers who seem to have more than the average number of service calls under the warranty.

Additional programs and a larger capacity computer are planned. Groce sums up the future for Coastal TV: "The possibilities are big, really big."

For a FREE subscription to the RCA COMMUNICATOR, the periodical with practical ideas for TV service people, write to RCA Consumer Electronics 1-455, 600 N. Sherman Dr., Indianapolis, IN 46201.

RCA

Consumer Electronics Division
600 N. Sherman Drive
Indianapolis, IN 46201

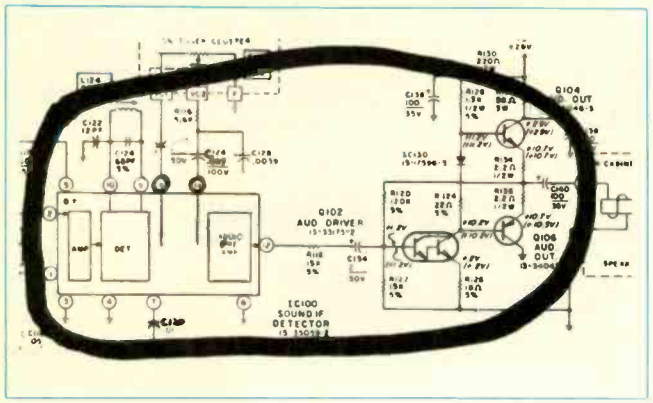
Better Service Through Better Communications

Circle No. 128 on Reader Inquiry Card

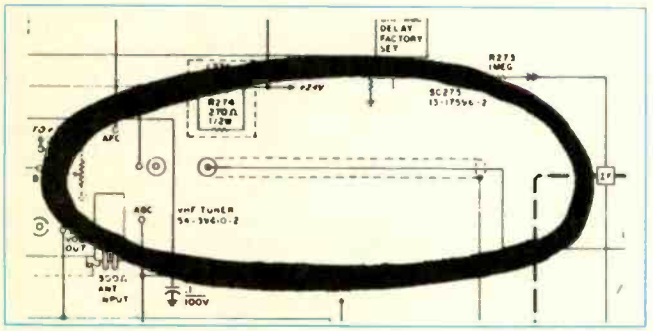
SERVICE SEMINAR

GTE SYLVANIA

Color TV Chassis E08—No sound.
Probable cause is defective IC100, Q104, Q106, or Q102. Replace defective component.



Color TV Chassis E21-6—Snowy picture. AGC voltage does not change with signal strength.
The IF cable is probably shorted near plug.



GENERAL ELECTRIC

YA Chassis, 13- and 17-inch—Bottom and/or Top Foldover
With bottom foldover, possible causes are: Yoke, with shorted vertical winding. Usually, R650 on vertical module will overheat; or, Convergence module (EP93X64) with a bridge circuit diode breaking down under load, or shorted. Usually R810 on the module overheats. In case of *bottom or top foldover,* the cause may be a defective horizontal output transformer. Due to outputs from pin 8 and 10 of the HVT not being equal. DC output from scan diodes (Y646 and Y642 on vertical module) should be approximately equal. Difference in outputs should not be greater than 2 volts.

MAGNAVOX

T981/2/7 TV Chassis—Video washout and retrace lines.
These symptoms appear at low brightness level with Videomatic Off when R304 opens. The picture is normal at medium brightness levels and above. R304 is soldered to one of the terminals on the HV tripler. The resistor is 820K and must be replaced only with Magnavox Part No. 230161-10.

R304 is only used on certain versions of these chassis. These versions are those T981 chassis whose HV is set to 27KV and T982-7 chassic whose HV is set to 28.5KV. The version numbers are as follows: T981-08,09,11 and T982-12,13,14,15,16 and T987-11 and 12.

RCA

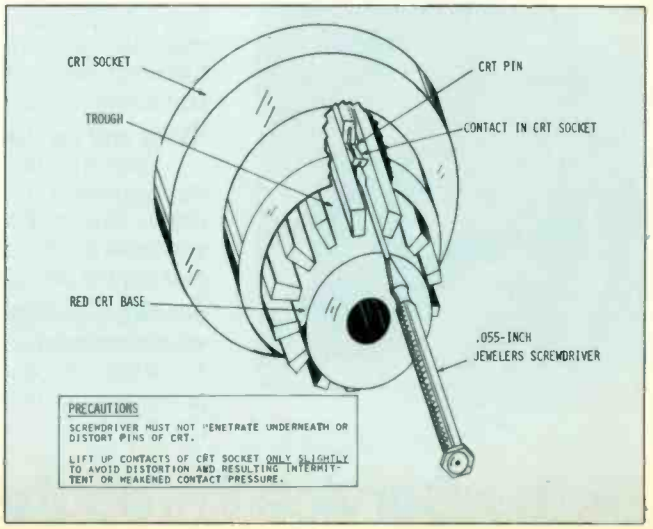
Color TV Chassis CTC 74—Relay K201 drops out when instrument is turned on.
To correct, check for shorted or leaky CR205 (43V zener diode) and/or Q201 (protective control switch transistor).

ZENITH

Color TV Chassis 13GC10—No reception on low VHF channels. All other channels are O.K.
Probable cause is an open 5.7 VAC winding on the power transformer.

Color TV Chassis 25EC58—After set warms up, a slight vertical retrace is visible, and becomes more visible longer set is on.
Resistor R260 (75K ohm, ½W), part No. 63-9947-17, is faulty.

Color TV Chassis "J" line—CRT sockets binding to CRT.
The CRT sockets of the video output module may in some instances bind to the base of the CRT in early production 13 and 17 inch "J" line receivers. This condition could be due to the contacts of the CRT socket binding near the bottom of the troughs of the CRT base. If binding does occur, do not pull excessively in trying to remove the socket, or you could break the CRT. Instead, obtain a "B" size jeweler's screwdriver. Carefully insert it within the troughs of the CRT base and gently "pry" each one of the contacts slightly as shown in illustration below. NOTE: BE SURE NOT TO ALLOW THE SCREWDRIVER TO PENETRATE UNDERNEATH AND DISTORT THE PINS OF THE CRT. ALSO, BE VERY CERTAIN NOT TO "PRY" THE SOCKET CONTACTS TOO MUCH, SINCE EXCESSIVE FORCE WILL DISTORT THE CONTACTS AND REDUCE CONTACT PRESSURE. INTERMITTENT OR NO OPERATION MAY RESULT. After each one of the 11 contacts of the CRT socket has been lifted gently, the CRT socket/module should pull off the CRT base with only a moderate amount of force. Mechanical changes have been implemented in later production receivers which will prevent the possibility of the aforementioned binding.



Here's a new tool repair shops can really use.

Aside from your fine work, what are you doing to make your customers return to you with more repairs? A nice smile and "thank you, please call again" may not be enough.

Well, Sylvania has come up with a new tool that's sure to help you turn every customer into a steady customer. It's a 5 - year warranty* that you can now offer on replacement picture tubes.

So now not only can you offer the best in replacement tubes, but also have a 5 - year backing from GTE Sylvania—one of the largest electronics corporations in the world.

For more information on how we can help your repair shop business just contact your nearest Sylvania distributor or GTE Sylvania, Distributor and Special Markets Division, Seneca Falls, N.Y. 13148

SYLVANIA | GTE

*LIMITED WARRANTY. LABOR NOT INCLUDED

Circle No. 117 on Reader Inquiry Card

Digital voltmeters

What goes on—inside

A detailed examination of the inner workings of a typical DVM.

By Bernard Daien

The digital voltmeter is a "must" device for service technicians to study, as it is a stepping stone into today's more complex electronics. The DVM provides an insight into analog-to-digital conversion (ADC), counters, decoders, and various types of readout displays, all of which are common in non-entertainment electronics, and are now appearing in the newer entertainment electronics as well.

Technicians today face two different systems, digital and analog; often both are used in the same piece of equipment. There has to be a means of translating one into the other in order to enable signal flow back and forth. The ADCs are one of the "interface" circuits which make this signal flow possible. They will be encountered frequently, so the modern technician must make an effort to understand them.

Most DVM articles discuss the advantages of digital meters at some length. This article is limited to an introduction to "how a DVM works" in simple terms. The uses of a DVM can be found in sales literature, and are not covered here.

The DVM comes of age

In the past, DVMs were costly because they required many components. In recent years, however, integrated circuits (ICs) have grown both in numbers, and in complexity. Today there is an IC available for almost any desired function. This implies that we must start thinking in terms of functions, instead of looking for a defective component.

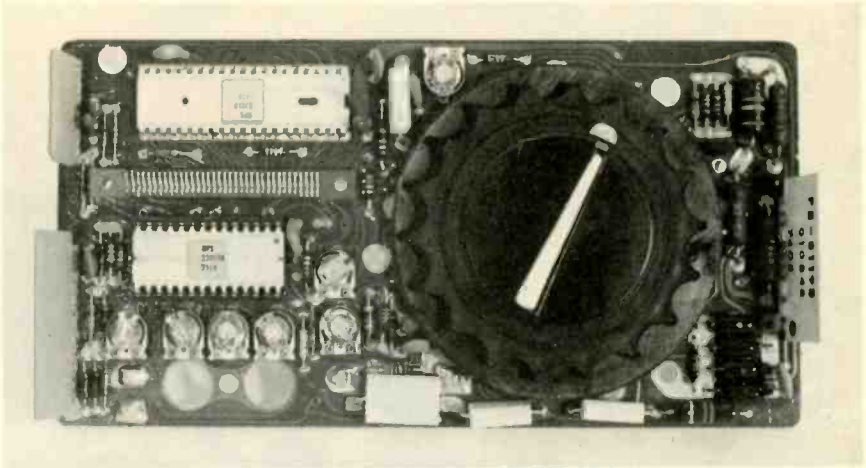


Fig. 1–A view of the inside circuitry of a typical DVM, showing the use of complex ICs, and just a few discrete parts. (Courtesy, Dana Instruments.)

To relate to what you already know, chroma demodulators in all the new sets are ICs. The question in servicing is, "Is the IC good or bad?" So it is with DVMs ... they have become practical for service work because the IC has made possible low cost, lightweight, compact designs. The photo in Fig. 1 of the interior of a DVM shows how only a few ICs and other components are required.

DVMs are now so popular that the service technician will find it advantageous to know about them, in the same way that he knows about the old standby, the volt/ohm/milliameter.

The readout

Since DVMs display information in a series of numerals, a digital readout is necessary. This article covers the electronic aspects of the various readouts, but omits such optical parameters as lenses, filters, etc.

Several types of displays such as light emitting diodes (LEDs), liquid crystal displays (LCDs), and gas discharge devices (similar to neon tubes) are in current use. All use the same standard "seven segment" (plus decimal point) format for numeric (numbers only) readouts, shown in Fig. 2. This demonstrates the identification for the *segments* using the standard letter symbols.

Thus, to make the number "7" appear, segments A, B, and C would be energized. To make the number "3" appear, segments A, B, C, D and G would be energized. If the decimal point is used, DP is energized. One important point should be noted now for later use. Although only seven segments are needed to form any number from zero through nine, we need *TEN* combinations of inputs in order to form these ten numbers. That makes things a little complicated—seven segments, but ten input combinations. Seven segments have only seven input connection lines, but those seven lines must carry ten combinations of input signals. We will get back to this subject later in the article.

Gas discharge tubes require hundreds of volts to operate, but draw only a few hundred microamperes *per segment*. LEDs are solid state diodes which emit light when forward biased. They have less than two volts forward drop, with a typical current drain of 10

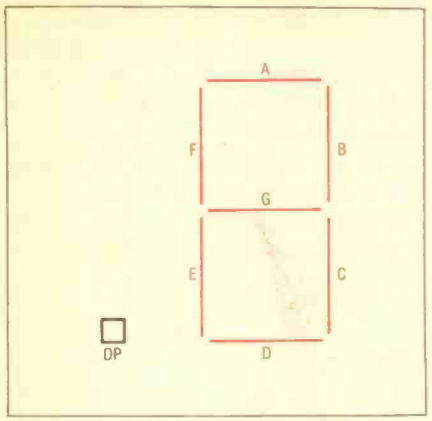


Fig. 2–The standard "seven segment" format for numeric readouts.

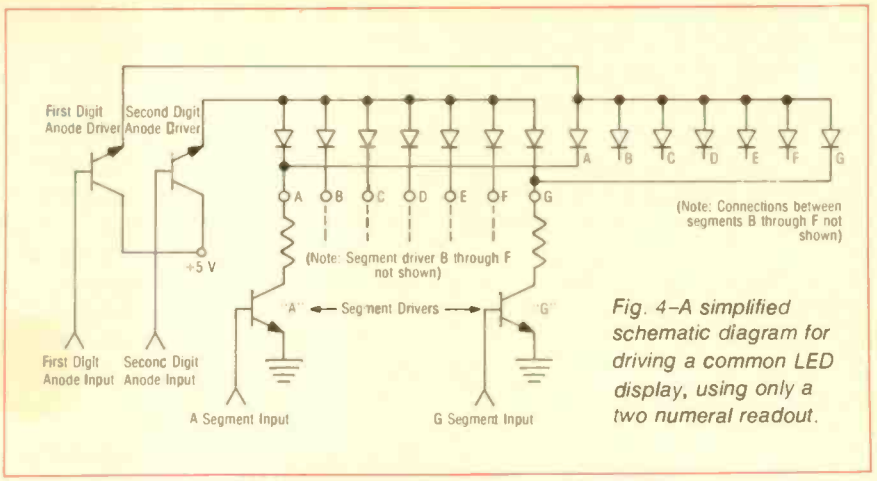


Fig. 4–A simplified schematic diagram for driving a common LED display, using only a two numeral readout.

Pin 1—Cathode A Segment
Pin 2—Cathode F Segment
Pin 3—Anodes E, F, G, DP
Pin 4—No connection
Pin 5—No connection
Pin 6—DP Cathode
Pin 7—Cathode E Segment
Pin 8—Cathode D Segment
Pin 9—Anode C, D
Pin 10–Cathode C Segment
Pin 11–Cathode G Segment
Pin 12–No connection
Pin 13–Cathode B Segment
Pin 14–No connection

Fig. 3–Pin connections for a common anode, single digit display with decimal point.

milliamperes *per segment*. Larger numerals draw more current, and more current is drawn also when higher brightness is desired. Thus one 7 segment number can draw a total of 70 ma if the number "8" is desired—and if four numbers are illuminated at the same time, the total current becomes quite large for a battery pack. To reduce the average current, it is common to use "multiplexing," which consists of turning the numerals on and off so rapidly that the eye is deceived into seeing a steadily lit numeral. One way to do this is to turn each number in the display on in sequence—thus a four number display would have each number lit for one-fourth of the time, but all four numbers would appear to be lit simultaneously. Any form of rapidly turning on and off is also called "strobing," and there are many ways to accomplish the same purpose.

Liquid Crystal Displays fall somewhere between the high voltage/low current gas tubes, and the low voltage/higher current LEDs. But there is one important difference—while the gas tubes and LEDs operate on DC, the liquid crystals operate on AC, usually about 15 volts peak/peak. This is at a frequency from 30 to a few hundred cycles, drawing only a few microamperes *for an entire display!*

Liquid crystals do not generate light like LEDs. Instead, they modify the light coming from an external source. They consist of a liquid held between two glass plates. The glass plates have transparent electrically conductive coatings which form the segments. Energizing a segment causes the liquid in that area to change its light conductance.

There are several ways in which light conductance can be modified—the light can be "scattered," or the liquid can act like a polarizing filter. The light source can be daylight which is reflected—or a lamp behind the LCD, which is conducted. Some of the newer displays use a little radioactive material to provide the necessary glow, since without light the LCDs cannot be seen.

Since each type of display has different drive requirements, the circuitry must vary, but much of the circuitry is similar. We will examine the LED display, and its driver, since it is used so often with service type DVMs.

Since LED displays consist of a number of diodes, we can tie either all the anodes, or all the cathodes together (common anode, or common cathode displays), to reduce the number of leads. Look at the pin connections for a common anode, single digit display (with decimal point, shown in Fig. 3.)

This display is on a standard dual-in-line-package (DIP) with 14 pins. The anode leads on pins 3, 9, and 14 are jumpered together externally. If the anodes are connected together internally, only 9 pins need actually be used for this one numeral readout.

Now supposing we need a four numeral readout—how many pins would actually be required? You may be surprised to discover that we would need only 12 pins, and therefore could get by with a standard DIP package. Here's how it's done. Recall what we said earlier about multiplexing—only one digit on at a time. We can tie all the A segments together on all numbers, tie all the B segments together, etc. We then bring the common anodes of each numeral out to a separate line. Thus, we can determine which numeral is lit by energizing only the anode of the desired number.

If we want the number "3" on the second digit, we energize the A, B, C D, G segments on *all* numbers, but we energize only the anode of the second number. Presto—"3" appears only on the second numeral. Now you can see that multiplexing not only saves power, it also saves lots of display drivers. Here we have shown how only seven segment drivers can be used to drive a *four number* display, with a total of 28 segments. We switch each common anode on in turn, thus sequentially strobing the numbers.

Another way to look at multiplexing is to remember it as the time sharing of a circuit, something which has been done in communications for a long time.

By now you should be starting to see the driver requirements for multiplexing. Fig. 4 is a simplified schematic diagram for driving a common anode LED display, using only a two numeral readout for simplicity, but the same circuit can be extended to more numbers as required.

Only two of the LED segment drivers are shown for each of the numbers. Actually, seven are required, one for each segment with the decimal point omitted for simplification. Since there are two numbers in the display, two

anode switching transistors are shown. When No. 1 anode is "on," +5v is applied to the common anode of numeral one. Depending on which segment drivers are also "on," current can flow through the appropriate segments of numeral one to form a lit number. All other numerals remain dark.

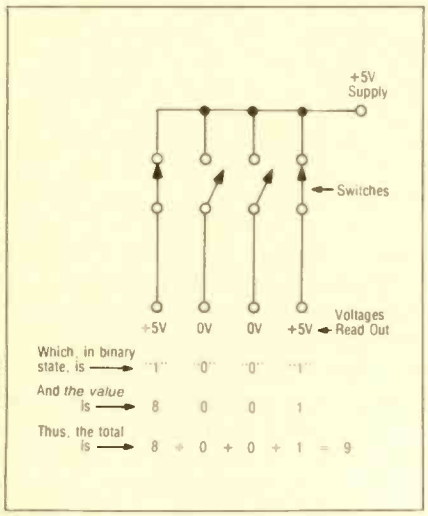


Fig. 5–A wiring diagram showing digital signals coming in over four separate wires. Table at bottom shows, with setting of switches, the decimal number line in binary.

drivers built right into the display itself. There are also "alphanumeric" displays which show not only numerals, but letters as well—and there are "LED Matrixes" which are a display with many dots distributed uniformly. Depending upon which dots are lit, numbers, letters, and symbols can be selected, depending upon what is required. Of course, these have more internal connections, and more complex driver arrangements. Some common symbols are "=, +, −, ÷, ×," and even square root symbols, etc.

Analog to digital conversion

Why do we need ADC? The input signal

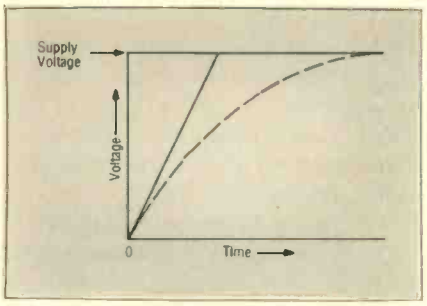


Fig. 6–The "charging time" of a capacitor from a voltage source, through a resistor, and from a "constant current source."

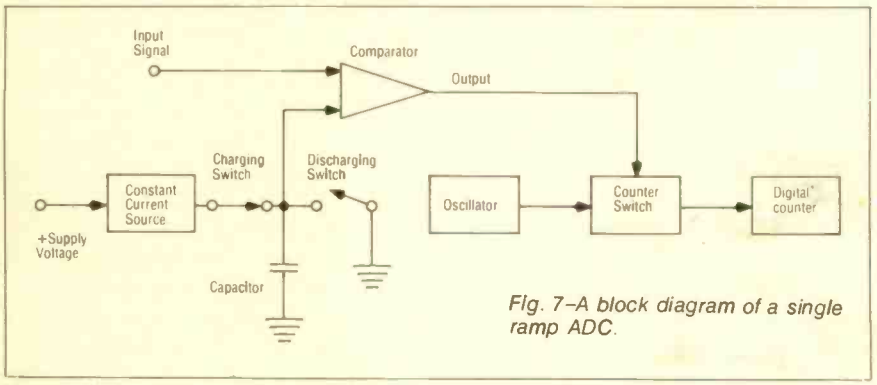


Fig. 7–A block diagram of a single ramp ADC.

The current is limited by the series resistors to the proper value for the LED segments. All the switching transistors are usually on one IC called a "Driver," but the resistors, which dissipate some heat, are often external.

Remember, it is also possible to have common cathode displays with the polarities reversed, and some changes in the driver, but the basic principle of operation remains unchanged. Also, multipurpose ICs are commonly used for drivers, performing several functions. They are called by several names, depending upon the functions performed, such as, "decoder-drivers," "multiplexed decoder-drivers," etc. The decoding function is explained later, at a more suitable point in this article.

Finally, some displays have the

is analog (linear), and can be of any value. Binary (digital) calculations are done with signals of definite "steps" in order to achieve accuracy. The operations in a DVM are performed digitally, with digital circuitry. Thus, we must convert our analog signal input into digital form for operational purposes, in order to achieve the needed accuracy. There are many ways to accomplish ADC, but we will look at the methods used in most service DVMs.

Before going further, we must touch on the "binary system" of math, since it is the basis for what follows. In binary we use only two states, "0" and "1". A zero is commonly indicated by the absence of voltage, or a low voltage, while a one is indicated by the presence of several volts. If we examine four columns of figures in the decimal system in everyday use, we discover that, starting at the righthand side, and moving toward the left, each column has ten times the value of the preceding column, as shown below. (The number 1 was used in each column, although any other number between zero and nine could have been used.)

Number	1	1	1	1
Value	1000	100	10	1
Total	1000+100+10+1	=	1,111	

or, as spoken, "One thousand, one hundred and eleven." Notice that in speaking, we acknowledge that each column represents ten times more than the preceding column, as we call out the thousands, the hundreds, the tens, etc.

Now, let's do the same thing in binary, where there are only "0s" and "1s."

Number	1	1	1	1
Value	8	4	2	1
Total	8+4+2+1	=	15	

Notice that each column has only twice the value of the preceding column, and that with four digits we can go from a total of zero to a maximum of 15.

Now let's implement this with a wiring diagram showing digital signals coming in over four separate wires, as in Figure 5. Note that there are only two possible states for each line, zero with the switch open and zero voltage on the output, or a "1" with the switch closed and +5v on the output. There is no uncertainty, which is why binary operations do not introduce errors.

Now examine the table at the bottom of Figure 5. It shows how, with the switches set as shown, we are representing the decimal number line, in binary. As we previously demonstrated, we can set the switches to give us any number from zero, up to 15, with four lines, using binary (digital). Since the right hand column has the least value, it is said to represent the "least significant bit" (bit of information). The left hand column has the "most significant bit" since it has the greatest value. Now we can proceed.

Voltage to frequency ADCs

One ADC system that is in use today is the "voltage to frequency" (V to F) converter. A resistance/capacitance oscillator has its frequency controlled by changing its bias current in accordance with the input signal being measured. As

the input signal changes, the oscillator frequency varies with it. A frequency counter with a digital readout displays the oscillator frequency, and thus, indirectly, the input voltage. The system works, but has some problems which tend to produce errors, and are difficult to correct inexpensively. The relationship between voltage and frequency must be linear over a very wide range of frequencies. The oscillator is, of course, variable. It is easy to make a fixed frequency oscillator, such as crystal controlled, very stable. It is much more difficult to make a variable RC oscillator stable and linear with voltage. To overcome these problems, the "single ramp" converter is often used.

Single ramp converters

This system uses the "charging time" of a capacitor as its basis. If we charge a capacitor from a voltage source, through a resistor, we get the typical "time constant curve" shown in the dashed lines of Fig. 6.

If we charge the capacitor from *a constant current source,* the curve becomes a straight line (the solid line in Fig. 6). The reason is that a capacitor charged through a resistor has a steadily increasing voltage, which leaves less voltage drop across the series resistor. The charging current through the resistor depends upon the voltage across the resistor—thus the current keeps diminishing, and the capacitor charges at an ever slower rate. When a constant current source is used, the charging current is constant, and the voltage rises linearly on the capacitor. It should be noted that constant current sources are built right into many ICs.

Once we have a linear charging voltage "ramp," we can build the basic single ramp converter in Figure 7. The capacitor is charged linearly from the constant current source. *After a definite fixed period of time,* the discharge switch is closed, bringing the capacitor voltage back to zero, as shown at the top of Figure 8. This process is repeated continuously.

The resulting sawtooth ramp is applied to one input of the comparator. (A comparator is a differential input amplifier, with two inputs, one output, and very high gain). Due to the gain, a very small input signal drives the output to the limit of its capability. Depending upon which input is the larger, the output is either a "1" or a "zero." The unknown input signal applied to the other input of the comparator is shown superimposed on the ramp in Figure 8. At the moment the ramp voltage exceeds the unknown signal, the comparator changes state. This occurs at the moment marked "X" on Fig. 8.

During all this, a very stable fixed oscillator is running continuously. The oscillator output is shaped into pulses and fed into the digital counter through the counter switch, as indicated in Fig. 7.

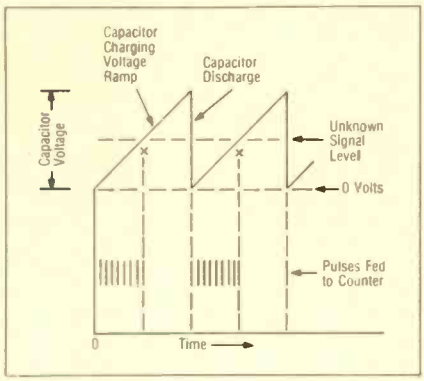


Fig. 8–The charging pattern of a single ramp ADC.

The counter switch is controlled by the output of the comparator, and the switch is closed only during the interval that the ramp voltage is less than the input signal, as shown on the bottom of Fig. 8.

Consider what happens if the input signal increases. Point "X" would move higher on the ramp. It takes longer for the ramp voltage to rise to a higher level. During the longer time interval more pulses are passed to the counter, causing a higher reading. Again we read out voltage by counting pulses.

Since the oscillator is now fixed, we can use a crystal oscillator with excellent stability. Thus, the single ramp system is an improvement over the V to F system, and is often used in low cost DVMs. There are still some remaining problems. The ramp must be very linear, and parts drift in value with time and temperature, adding to the error. Various ingenious cures have been used for these problems, but it is easier to prevent than cure them. This is done in large part by the improved ramp system which follows.

Dual slope conversion

A basic dual slope ADC is shown in Fig. 9. In this system the *unknown input voltage* is used to charge the capacitor through R1. The resulting ramp is applied to one input of a comparator. The other input of the comparator is grounded (at zero potential). As the capacitor voltage rises above zero, the comparator switches its output state, causing the counter switch to close. No pulses from the oscillator can be passed on to the digital counter, because a second switch, ganged with the input charge/discharge switch, is open at this time. Thus there is no count during the charging of the capacitor. This is shown in Fig 10.

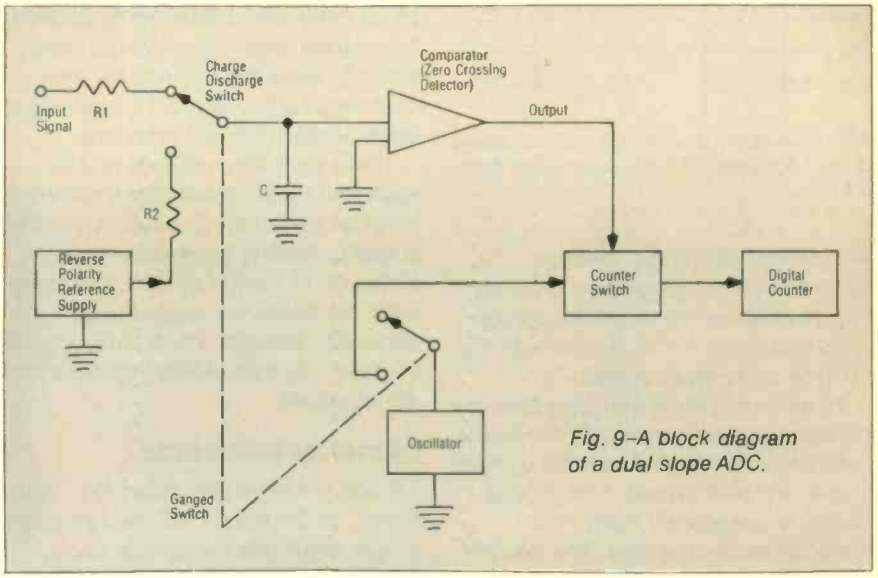


Fig. 9–A block diagram of a dual slope ADC.

After a predetermined fixed charging time interval, the input charge/discharge switch disconnects the capacitor from the input signal source, and connects it to the reference supply. This reference supply *is always of opposite polarity to the input signal,* therefore it tries to charge the capacitor in the opposite polarity. In order to do this, the charge which was already on the capacitor due to the input signal, must be overcome. As a result, the capacitor voltage falls toward zero (runs down). When the capacitor reaches zero, the comparator switches state, and opens the counter switch. The oscillator pulses, which were permitted to pass to the digital counter during the time the input switch

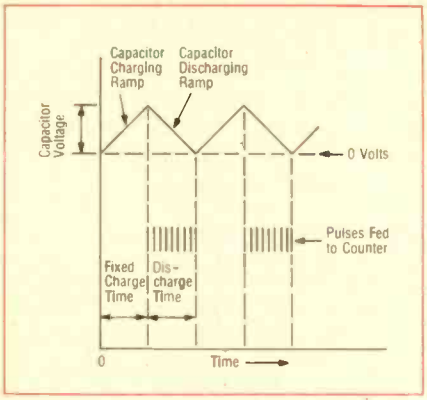


Fig. 10–The charging pattern of a dual slope ADC.

Input Pulse	Output of FF 4 "8's"	Output of FF 3 "4's"	Output of FF 2 "2's"	Output of FF 1 "1's"
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1

Fig. 12–A truth table showing output states of all 4 flip flops for every input pulse from 0 to 9.

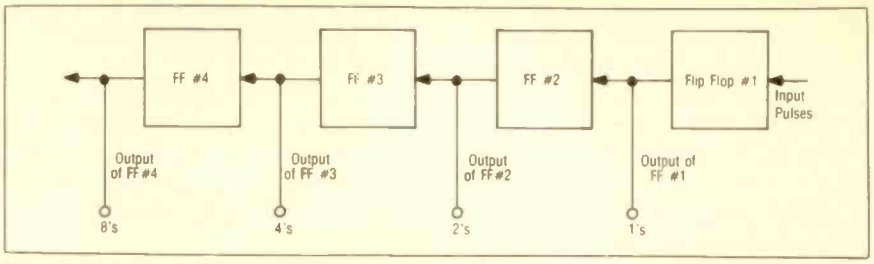


Fig. 11–A chain of 4 binary dividers (bistable flip flops), used as a counter with 4 binary coded output lines.

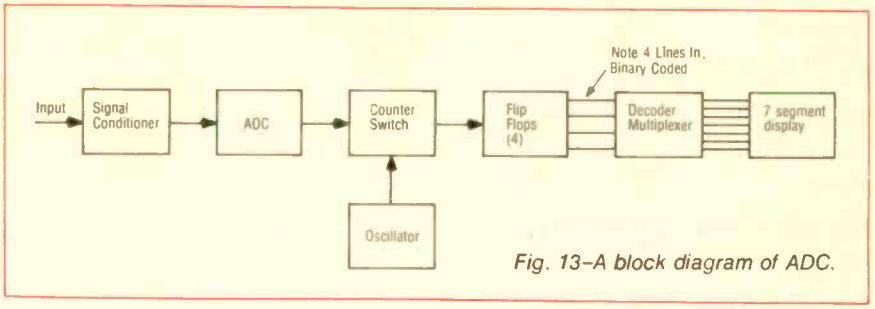


Fig. 13–A block diagram of ADC.

was in the "discharge" position (remember the "ganged switch"), are cut off again as the capacitor voltage goes below zero. This is shown in Fig. 10. The cycle then repeats.

To sum up, pulses can pass from the oscillator to the counter only during the time the counter switch, and the ganged switch are both closed. The ganged switch is closed only during the capacitor discharge time. The counter switch is closed only during the time the capacitor voltage is greater than zero. The higher the input voltage, the longer it will take to discharge the capacitor, and the higher the count on the digital counter readout. In this case the comparator functions as a "zero crossing detector."

Let's see what the advantages of this system are over the single slope ADC. First, since the capacitor is charged by the input signal itself, noise on the input tends to cancel out. Random noise spikes are both positive and negative, and "average out." This is better noise immunity than the single slope, which compares the *instantaneous* input signal to the ramp. A spike of noise could thus cause a false reading. To prevent this, some form of filtering must be used with the single slope method.

Further, since the dual slope system depends upon discharging the charge caused by the input signal, we have both an *up* ramp, and a *down* ramp. Errors in the system which affect the up ramp, similarly affect the down ramp, thus canceling out the effect. This gets rid of many component drift problems.

There are other methods of ADC, each with certain advantages, some are very fast, some very accurate, some well suited to feeding information to a computer or control system. In service work the needs are ruggedness, portability, low cost, 1% accuracy, ease of repair—and the ADCs just described are adequate.

Signal conditioning

Till now we have discussed the "input signal" as if it were a DC voltage of the proper amplitude for our circuits to handle, but this is not the case. We may want to measure very small, or very large voltages, or AC, or ohms, or current. Therefore, we do exactly the same thing we have been doing with VTVMs, scopes, etc. We amplify small signals, divide down large ones, rectify AC, and convert current into voltage with a precise sampling resistor. Ohms are measured by applying a constant current source to the resistor and measuring the resulting voltage drop. (Changing the voltage level as needed is called "scaling.")

The above is sometimes called "signal processing," but the function is the same. Now you know what the block titled "signal conditioning" is on the DVM block diagrams. Simple enough?

Decoders

Earlier in this article we touched briefly on binary numbers and circuits, "zero" and "one" states, etc. We also discussed the basics of displays. Now we can start putting the pieces together.

Since LED displays have adopted the seven segment format for numeric readouts, we need seven drivers for the seven segments. In turn, we need seven input lines for the seven drivers. But, as you will soon see, we only have four input lines available from the counter. What we are saying is that the counter output is on four binary lines. Since four binary lines, representing 1s, 2s, 4s, and 8s can provide a total of 16 combinations (0 to 15), we have more combinations than are needed to make the ten numbers for each digit on the display, using only four lines.

But what sort of circuit can we devise that will take four binary input lines, and convert them to seven output lines, driving seven display segments? To complicate matters, the inputs are binary, but the outputs are a peculiar combination required to light the proper segment pattern in order to form each numeral. The IC that does this is called a "decoder," and has many devices inside it to accomplish some fairly complicated logic. While we are at the decoding process, another step is often added --- strobing. To do this with discrete components would probably require a hundred or more transistors ... so you see what was meant earlier in this article about ICs making DVMs practical, and about ICs being store-bought *functions*.

Up to now the ADCs described all fed their outputs into "digital counters." Such a counter is a device that displays the *total of the input pulses occurring*

continued on page 53

DODGE, NO.1 IN VANS, ANNOUNCES 1978.

AND THE NEWEST, MOST VERSATILE, MOST MANEUVERABLE VANS YOU CAN BUY.

THE NEW DODGE VANS GIVE YOU SOLID REASONS WHY DODGE IS THE NO.1 SELLER OF VANS.

1. ALL-NEW SEATS. They're more comfortable, they're more colorful, and now you can order them in plush fabrics. Mounted on curved tracks, the new seats allow a higher position for the shorter driver and more headroom for the taller driver. Optional high-back Command seats are shown.

2. MORE DOORS MORE WAYS. Now you can have your choice of optional sliding or standard hinged side cargo doors on all our vans. And we offer the only full-width single rear door in the industry. Maxivan with the Vision Van option gives you rear quarter windows that wrap around the corners for ease in backing up.

3. HIGHLY MANEUVERABLE. Our turning circle, tighter than Ford's or Chevy's, gives you greater maneuverability.

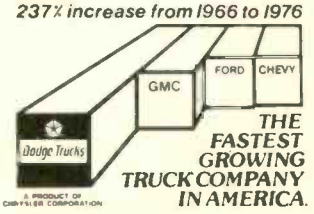
4. 23MPG HWY/ 17MPG CITY. EPA estimates for Dodge Tradesman B100, with standard 225-cubic-inch six-cylinder engine and manual transmission. Not bad for such a hard-working machine. Your mileage may vary according to vehicle condition, equipment, and how it is driven. California mileage lower.

5. HISTORICAL TOUGHNESS. Of all the Dodge trucks registered in the past ten years, 96 out of 100 are still in operation. (Source: *Trucks in Operation.*) That's better than Ford . . . better than Chevy.

6. MORE ROOMINESS. Maxivan is eight inches longer this year for extra cargo space. And all our vans have more room up front this year.

7. SOME NEW OPTIONS. Trailer-towing packages for up to 7000 pounds gross trailer weight. Six different kinds of radios including two units with 40-channel CB. Sky Lite sun roofs, air conditioning, and more.

Buy or lease one or a fleet . . . at your Dodge Dealer's.



NO.1 IN VANS AND WAGONS.*

* Passenger van-type vehicles known in the industry as wagons.

Circle No. 107 on Reader Inquiry Card

The DMM on review

A look at what's available

A survey of digital multimeters that fit the servicer's needs and pocketbook

This month as sort of a companion-piece to Bernard Daien's article on the 'inner workings' of the typical DVM (page 16), we have surveyed those test instrument manufacturers who offer one or more digital multimeters that satisfy both the budget and servicing needs of the majority of ET/D readers. Not included, of course, are those instruments designed for use in laboratory research which generally reach above $500 in cost.

We found, in the preparation of this review, a fair degree of confusion, or at least inconsistency, in the industry in the use of the initials—DVM and DMM. DVM, of course, refers to the Digital Volt Meter, and DMM to Digital Multimeter.

By strict definition, a DVM measures only volts by way of digital display. A DMM measures volts and/or current and resistance. By this definition, all of the instruments in this review are DMMs. In fact, all of the instruments described measure DC and AC volts and current *and* resistance. One of the instruments also measures capacitance.

Hopefully, we have included all American producers of the lower priced DMMs—but undoubtedly we have missed someone—either because they failed to respond to our queries, or because they are so new they are not yet listed in the current directories. We'll appreciate learning of any omissions.

In our contacts with the manufacturers we asked for a photo and a description of the DMM which they thought best fits the needs of our readers. We have indicated those firms producing more than just one DMM, and we have included their mailing address. We recommend that you contact them for their literature if the interest so moves you.

Ballatine

Fluke

Heathkit

Sencore

Ballantine's Model 3028B (3½ digit)—This is a lightweight, portable RMS responding DMM with a lowest full scale range of 20 mV. It has 10 μV resolution and can measure to 100 milliohms. Features a .43 inch orange LED display—full EMI shielding—'hi' and 'lo' ohmmeter circuit—front panel zero adjust—protection against overloads up to 1200 volts AC and DC. Pushbutton controls cover 35 ranges: AC/DC voltages from 10μV to 1200 V; AC/DC current from 10 nA to 2A; resistance from 10 milliohms to 20 megohms. Automatic polarity. Among options is analog meter for peaking and nulling. Chargeable battery powered. Priced at $295. (Other DMM's available) *Ballantine Laboratories, Inc., P.O. Box 97, Boonton, N.J. 07005*

B&K-Precision's Model 2810 (3½ digit)—This DMM offers basic DC accuracy of 0.5%. Auto-zeroing on all but the 10Ω range minimizes set-up time. The 10Ω range, with .01Ω resolution helps find shorted transformer windings. Has hi/lo ohms switch, independent of range switch, with 4 ranges available. Overload protection on all 29 ranges. Is protected against RF interference. AC/DC voltage ranges are 100mV,1V,10V,100V,1000V. DC-AC current ranges are: 1mA,10-mA,100mA, 1000mA. Resistance ranges are: 10Ω, 100Ω, 1kΩ, 100kΩ, 10MΩ. Automatic polarity. Chargeable battery operated. Priced at $119.95. (Other DMM's available.) *B&K-Precision/Dynascan Corp., 6460 W. Cortland St., Chicago, IL 60635.*

Data Precision's Model 1350 (3½ digit)—This is a bench-operated DMM that measures DC volts from 100μV to 1200V, AC volts from 100μV to a full 1000 V RMS, resistance independently in both high (2.8V) and low (300mV) excitation from 100 mΩ to 20MΩ, and both DC and AC current from 0.1μA to 2A. Overload protection allows the 1350 to take ± 1200 DCV on any range continuously without loss of calibration, or a 6000V spike on any voltage input for 500 ns without damage. Ranges are: DCV—100μV to 1200V: ACV—100μV to 1000V; AC Current—0.1μA to 1.999mA; Ohms—100mΩ to 19.99MΩ, with Hi/Lo excitation. Line-powered. Auto Polarity. Priced at $169. (Other DMMs available). *Data Precision Corporation, Audubon Road, Wakefield, MA. 01880.*

Data Tech's Model 30A. (3½ digit)—This will operate either as a portable or bench-top instrument, featuring a Beckman display with

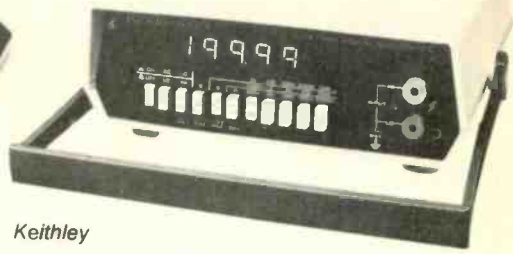
B&K-Precision

Data Precision

EICO

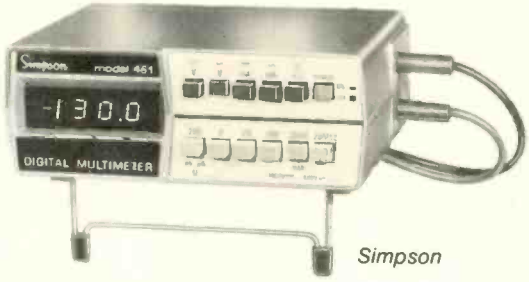
Data Tech

Philips



Keithley

Non-Linear



Simpson

Sinclair

Hickok

VIZ

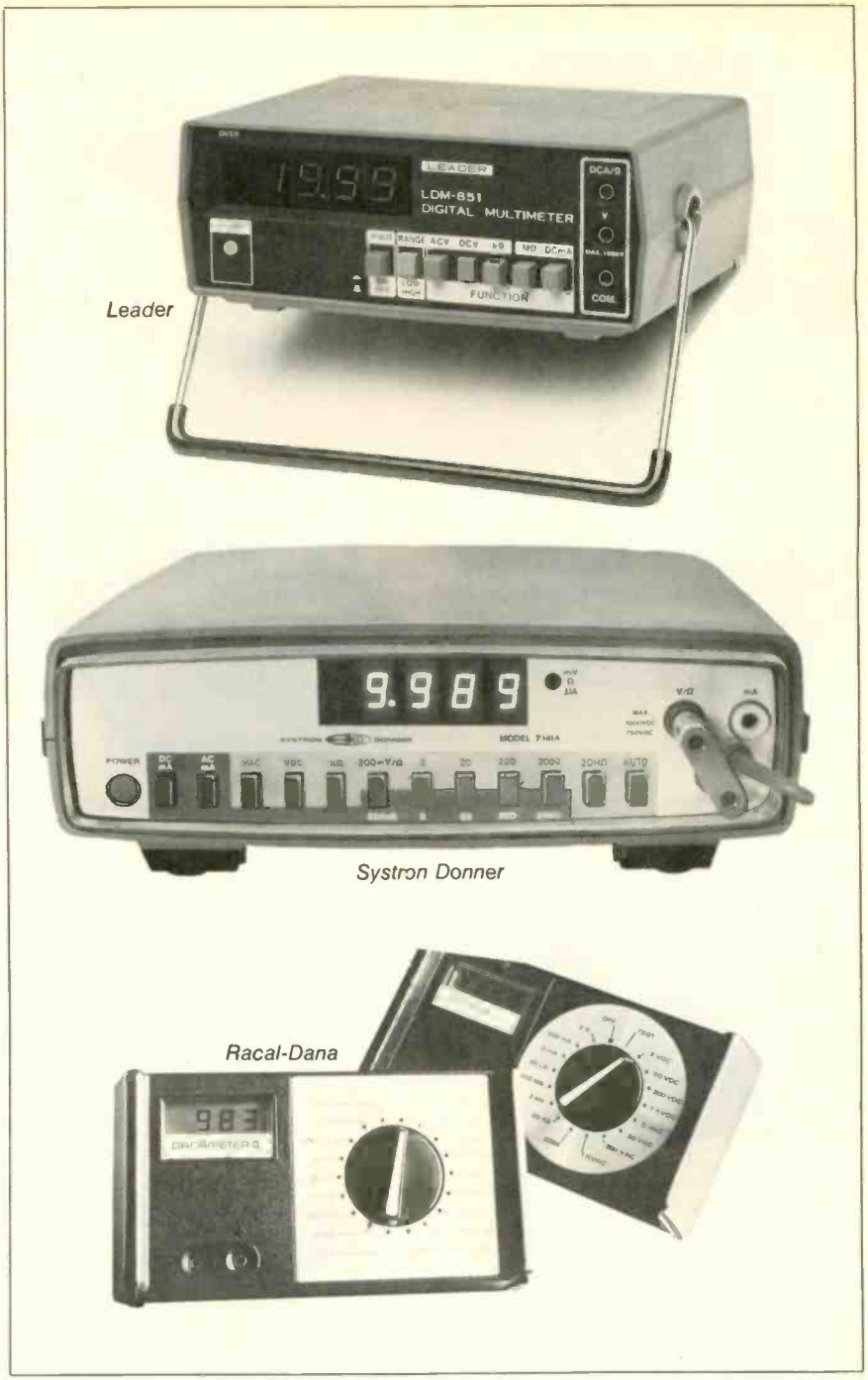
Weston

low power requirement. Is said to operate 16 hours with battery recharging. Offers 4999 counts with a full 1 through 5 readout in the first position. Ranges are: DCV—500mV to 1KV with 100μV resolution; ACV—500mV to 1KV; Ohms—500Ω to 50MΩ with 100mΩ resolution; AC/DC current—500uA to 5A with 100nA/100μA resolution. Powered by 4 "D" NI Cad batteries, or charger, or both. Shipped with battery charger eliminator. Priced at $289. (Other DMMs available) *Data Tech, 2700 So. Fairview St., Santa Ana, Calif.*

EICO's Model 272 (3 digit)—Battery operated with four penlight cells, the new model 272 is completely portable, of hand-held size. Features 0.3-inch LED readout, automatic zero, automatic polarity, and automatic overload indication. Measures to 1000 VDC, 600 VAC, up to 1000 AC and DC milliamperes, and resistance in kilohms up to 1 megohm. Accuracy on DC volts is ± 0.5%; other functions, ± 1%, overload protection is provided by diodes and built-in fuse. AC adaptor may be used if desired for line operation. Factory-assembled and calibrated. Priced at $69.95. (Other DMM's available). *EICO Instrument Co., Inc., 108 New South Rd., Hicksville, N.Y. 11801.*

Fluke's Model 8020A (3½ digit)—This DMM uses a Liquid Crystal Display that offers 200 hours of service on a 9-volt battery, with an indicator that signals 20 hours of remaining battery life. This is a hand-held portable instrument that features a conductance function to check leakage resistance to 10,000

Triplett



Leader

Systron Donner

Racal-Dana

megohms, in addition to the AC/DC voltage, current and resistance measurements. Measures 26 ranges for 7 functions, and in addition, offers a diode test function for testing of semiconductor junctions. Has automatic zeroing and automatic polarity and Hi/Lo ohms. DC accuracy is 0.25% of reading. Priced at $169. (Other DMMs available) *John Fluke Mfg. Co., Inc., P.O. Box 43210, Mountlake Terrace, WA 98043.*

Heathkit's Model IM-102—This DMM is available in kit form or already assembled. Display of voltage, current and resistance measurements is on cold-cathode display tubes. Five voltage and five current ranges are used for both AC and DC. The full-scale voltage ranges are 200 millivolts to 1000 volts (500 volts maximum on AC) and the current ranges are from 200 microamperes to 2 amperes. The six resistance ranges are from 200 ohms to 20 megohms. Overload protection is provided in the DC voltage ranges by high input impedance—the majority of voltage and current ranges have an overrange capability. AC powered. Priced at $249.95. (Other DMM's available) *The Heath Company, Benton Harbor, Michigan 49022.*

Hickok's Model 334 (3½ digit)—A line-powered bench-type instrument, this DMM offers 5 ranges of AC and DC voltage and current plus 6 ranges of ohms with automatic decimal point, polarity and overrange. AC and DC volt ranges are 0-199.9mV, 1.999, 19.99, 199.9 and 1200 volts (1000 volts AC). Accuracy for DC volts is 0.2% and 0.5% for AC volts. Response is 2.5 readings/second. Features a green fluorescent, 7 segment non-blinking display. Fuseless protection is provided on volts and ohms. A shielded/isolation probe is included. Priced at $234. (Other DMMs available). *Hickok Instrument Co., 10514 Dupont Avenue, Cleveland, Ohio.*

Keithley's Model 179 (4½ digits)—Model 179 is a full-function, trms-responding bench-type DMM with a ½-inch LED display. It offers measurement of AC and DC voltages from 10μV to 1200V (1000V on AC), current from 10nA to 2A and resistance from 0.1Ω to 2MΩ. The TRMS AC feature is said to give waveform-insensitive accuracy to measurements of noise, SCR controllers and switching regulators. Also features Hi/Lo ohms, 1000-volt overload protection on ohms, and 0.04% + 1 digit accuracy on DC volts and ohms. Pushbutton controls. Normally line-powered, but optional rechargeable battery pack is available. Priced at $289. (Other DMMs available). *Keithley Instruments, Inc., 28775 Aurora Road, Cleveland, Ohio 44139.*

Leader's Model LDM-851 (3½ digit)—One button, semi-automatic range switching is one of the major features of the LDM-851, a battery-operated LED display multimeter. Equipped with a crystal controlled signal generator, the instrument offers range coverage from 1mV to 1000V in 16 ranges in AC/DC volts; DC current, and fully automatic 20mΩ resistance range measurements. Also provides overload protection on all ranges, and automatic polarity. Also 'low' battery indicator in readout. Accuracy in DV volts is 0.5%. powered by 4 "C" cells. AC adapter is optional. Priced under $200. *Leader Instru-*

ments Corp., 151 Dupont St., Plainview, N.Y. 11803.

Non-Linear's Model LM-350 (3½ digits)—Designed for service bench and portable work, and for panel-mounting, the LM-350 operates on three AA-size batteries, or with optional rechargeable NiCad batteries and charger. The meter features a Liquid Crystal Display with automatic polarity, decimal and overload indication. DC and AC Volts range is 1, 10, 100 and 1000. Kilohms resistance range is 1, 10, 100, 1000 and 10,000. Current range is 1 mA, 10mA, 100mA and 1A. Accuracy in volts and ohms is 1% of reading. Optional accessories include: high voltage probe, tilt stand, carrying case and panel-mount flange. Priced at $125. (Other DMMs available). *Non-Linear Systems, Inc., Box N, Del Mar, California 92014.*

Philips' Model PM2517 (4 digit)—This DMM offers the servicer the choice of either an LED or LCD display. It is a battery-powered, hand-held portable meter with an autoranging feature. It measures true RMS, with 0.1% resolution and accuracy is 0.2% of reading ± 0.1% of scale. The AC/DC current range goes to 10A. Among optional accessories is a temperature probe. Operates on 4 1½ volt cells or an AC adaptor. Overload protection in all ranges except 10A. Priced at $295. (Other DMMs available); *Philips Test Instruments, Inc., 85 McKee Drive, Mahwah, N.J. 07430.*

Racal-Dana's Model 2000A (3½ digit)—Called the Danameter, this DMM is a hand-held, portable instrument that weighs one pound and features a liquid crystal display. It also offers automatic decimal point and polarity. Basic accuracy is .25%. ranges include: DC/AC Volts—2V, 20V, 200V and 1KV; DC current—20uA, 2mA, 200mA and 2A; AC current—2mA, 1A full scale; and ohms—200Ω, 20KΩ, 2MΩ and 200mΩ. Overload protection on all ranges. One 9V battery is said to power meter for one year. Priced at $199.50. (Other DMMs available). *Racal-Dana Instruments, Inc., 18912 Von Karman Ave., Irvine, CA 92715.*

Sencore's Model DVM 37 (3½ digit)—This portable DMM operates on batteries or on AC with power adapter. It features a 0.3" red LED display with automatic negative sign indicator, decimal, and overrange. Ranges offered are: DCV—0 to 2, 20, 200,2000 V; ACV—0 to 2, 20, 200, 1000V; AC/DC current—0 to 200uA, 2, 20, 200, 2000mA; Ohms—6 ranges in low and high power. Fused overload protection. Weight, 2¼ pounds. Priced at $248. (Additional DMMs available). *Sencore, Inc., 3200 Sencore Drive, Sioux Falls, S.D. 57107.*

Simpson's Model 461 (3½ digit)—This DMM comes complete with nickel-cadmium batteries and a 120 VAC battery charger/adapter. It is portable, but doubles as bench instrument. It features a 0.3 inch LED display, recessed insulated jacks for test leads, a pushbutton selection of 26 ranges which include: DC voltages to 1 KV, AC voltages to 600 V, resistance ranges to 20 megohms, and AC/DC current ranges to 2 A. Meter has 0.5% accuracy on DC volts, automatic polarity and zeroing and high input impedance of 10 megohms. Priced at $130. (Other DMMs available). *Simpson Electric Co., 853 Dundee Avenue, Elgin, IL 60120.*

Sinclair's Model PDM-35 (3½ digit)—One of the lowest priced DMMs on the market, the PDM-35 weighs only 6½ ounces. It features an LED display, automatic polarity, resolution of 1 mV and 0.1 nA, direct reading of semiconductor forward voltages at 5 different currents, resistance measurement up to 20 mΩ, and 1% of reading accuracy. It has 4 ranges in DV volts, 1 in AC volts, 6 ranges in DC current, and 5 resistance ranges. Operates on 9 volt battery, or AC adapter. Sells for $49.95. *Sinclair Radionics, Inc., 115 East 57th St., New York, N.Y. 10022.*

Systron Donner's Model 7141A (4½ digit)—This DMM is one of a series of four DMM introduced by the firm offering a choice of DC accuracies of either 0.02% or 0.05%, and with a choice of current or dBm measuring modes. All models feature auto and manual range selection. DC voltage from ± 10 microvolts to ± 1000V is measured in 5 ranges. AC voltage measurements can be made from 10 microvolts to 750 V in 5 ranges. A true RMS AC converter permits accurate measurements of triangles, pulses, square waves or distorted sinewaves up to 20 kHz. Pictured is Model 7141A, lowest priced of the four, at $395. (Other DMM available) *Systron-Donner Corporation, Instrument Div., 10 Systron Drive, Concord, CALIF 94518.*

Triplett's Model 3300 (3½ digit)—This is a hand-held, portable DMM that covers 22 ranges of measurements, including hi and low power ohms. It features autopolarity, out of range indication and overload protection up to 600 volts in all ranges with special 2A/600Vfuse arrangement. It is powered by 4 1½ V Ni Cad batteries and includes an AC adaptor charger. Display is .3 inch LED. Weighs approximately 10 ounces with batteries. Priced at $175. *Triplett Corporation, Bluffton, Ohio 45817*

Weston's Model 6000 (3½ digit)—This is a hand-held, portable, battery-powered DMM that weighs 22 ounces with batteries. It features autoranging, auto-zeroing and an automatic overrange indicator, plus a full 10 amp AC/DC measuring capability. Display is by high contrast Liquid Crystal, with display backlighting for dark location. The backlighting is an optional feature, as is manual range hold for fixed range operation. Calibration adjustment, fuse and batteries available from outside case. Priced at $195.00. (Other DMMs available) *Weston Instruments, 614 Frelinghuysen Ave., Newark, N.J. 07114.*

VIZ's Model WD-750-A (3½ digit)—This DMM, called the Digital VoltOhmyst, provides pushbutton selection of measurement ranges for AC and DC volts, current and resistance. It features a built-in analog panel meter for peaking and nulling, hi-and-lo-power ohms, AC or battery operation, autopolarity, and RF shielding. Separate input terminals for voltage and current are provided so that voltage and current measurements can be made without changing leads. Has 7-segment LED display. Priced at $267.00. (Other DMMs available). *VIZ Test Instruments, 335 E. Price St., Philadelphia, PA. 19144.* ETD

Anyone can

Raytheon did it.

We just made it easier for you to replace more than 100,000 semiconductors. We did it by replacing the old RE number system with easier-to-use, universal REN numbers.

Now all 362 different types (including 67 new types) of our semiconductors for home entertainment service are at your fingertips faster. Without the fuss and bother of cross-referencing numbers. Our new numbering system exactly corresponds to the one most often used by the service industry. Best of all for you, our streamlined product line meets 95% of your service needs.

But that's all we changed. Using this new red book still opens the way to all of Raytheon's famous advantages. Highest quality. Highest availability. Immediate delivery.

Our new replacement guide and a new inventory starter kit, REN-K2494, are immediately available at your Raytheon distributor. Get this coupon to your distributor, or directly to us. Raytheon Company, Distributor Products Division, Fourth Avenue, Burlington, MA 01803. 617/272-6400.

Rush me a copy of your new Raytheon semiconductor replacement guide.

RAYTHEON

- ☐ I presently use Raytheon semis.
- ☐ I am not presently using Raytheon semis.
- ☐ I want more info on the REN-K2494 Starter Kit.

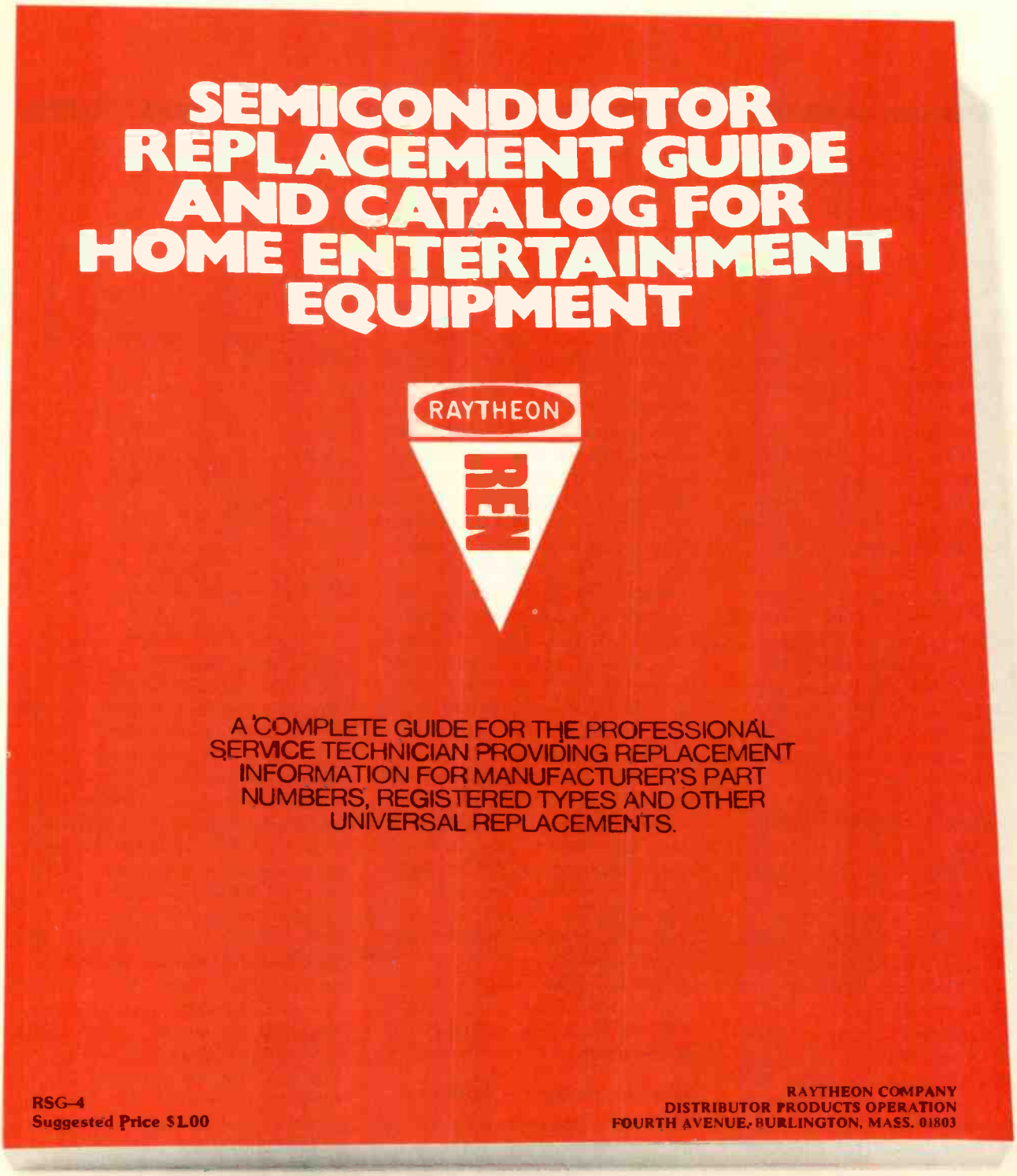
The name of my semiconductor distributor is _____

My name _____

Address _____

City _____ State _____ Zip _____

be replaced.



Circle No. 131 on Reader Inquiry Card

Troubleshooting with a scope

The triggered sweep way

Why triggered sweep oscilloscopes are necessary for today's electronic circuits.

By Robert L. Goodman

The sophisticated microprocessors and IC's in use today require scope test instrument performance capability beyond that obtainable with a conventional narrow-band service oscilloscope. As digital pulse switching speeds increase, as transit time is pared, as frequency limits go even higher, and as circuit timing becomes more critical, the triggered sweep oscilloscope is not a luxury item on the service bench—but a necessity.

A triggered-sweep scope is required to lock onto narrow and fast rise-time pulses found in today's solid-state devices, and to locate transient spikes that will quickly damage IC's and transistors. This type scope is also a must for troubleshooting today's digital count-down and logic circuits.

Bandwidth Vs. rise-time

The oscilloscope is the only instrument that allows you to look right into the circuits to be observed for troubleshooting. In order to obtain a true picture of the waveform you wish to observe, a wide-band scope is required to see each little wiggle and squiggle of the voltage or current signals under test. And to do this, a wide-bandpass triggered sweep scope with a fast rise-time is required. As we shall see, rise-time and band-width go hand in glove.

Usually rise time is considered the more important "spec" for fast triggered-sweep scopes and pass-band (bandwidth) is used for the recurrent-sweep service scopes. However, the two are very closely related, mathematically. The scope operation can be considered satisfactory when fast pulse signals produce little or no overshoot or ringing.

The illustration in Fig. 1 may help you to visualize the connection between bandwidth and rise-time. The bottom scope trace shows a pattern of a 5 MHz signal with horizontal time-base (sweep) set to view 5 saw pulses. Note that the upward pulse slant is not very steep, thus a slower rise-time. In the top trace for 10 MHz that will show 10 pulses, you will note that the slant is at a much steeper slant, indicating a faster rise-time.

Rise time is the time required for the leading edge of a pulse to rise from 10% to 90% of its final value. A good triggered-sweep scope should have a rise time of 40 nanoseconds up to 10 nanoseconds or less. Figure 2 should help illustrate the pulse rise-time more clearly.

As stated previously, rise-time and bandwidth go together. A 10 MHz scope will have approximately 35 NS rise-time; a 30 MHz scope band-width should have about 12 NS rise-time; and a 50 MHz scope will have approximately a 7 NS rise-time. These figures will, of course, vary from one scope to another.

In other words, a scope that can only see the 3.58 MHz color burst is now very inadequate for today's fast digital circuits.

Narrow pulses & spikes

Even with a good wide-band triggered-sweep scope, some precautions must be used in order to see narrow pulses and spikes. Let's now look at a few of these.

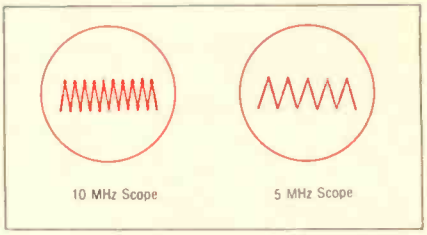


Fig. 1—Comparison between band-width and rise time.

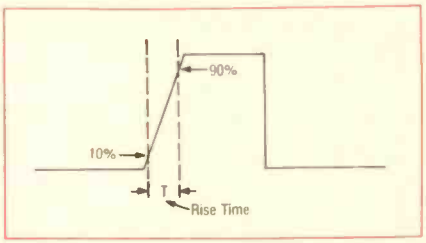


Fig. 2—Diagram of rise-time.

Because of the random nature of spikes and/or pulses that may be caused by arcs or solid-state faults, the scope can not grab onto them with a "rock-solid" lock. In order to lock onto narrow spikes and pulses, you must adjust the time-base generator (horizontal sweep speed control) up and down the frequency range and then manipulate the trigger level and polarity controls on the sync locking controls. The spikes may only show up intermittently and may be very faint. In fact, it may help to crank up the CRT brightness and use less vertical amplifier gain. This is because the spike usually has a very high amplitude, and you might miss seeing it. Note one such spike shown in Figure 3. This was found on a 24 volt regulated B+ line in a color TV receiver.

Another example would be the narrow spike or pulse with a duration of 25 nanoseconds that shows up while using a 10 MHz band-width

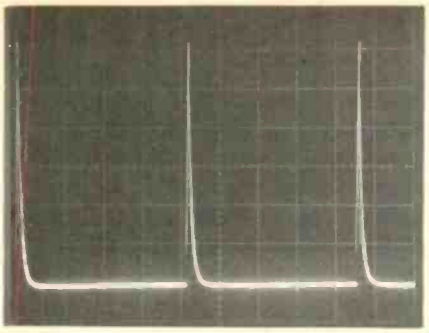


Fig. 3—Spikes found on regulated 24 B+ line.

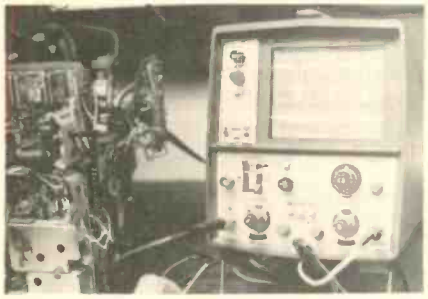


Fig. 4—Scope in use looking for spikes.

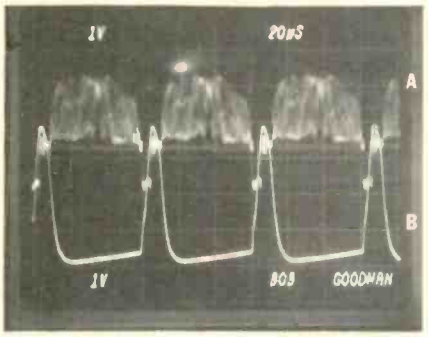


Fig. 6—Correct keying pulse and burst alignment.

scope. You would not see it on your scope because it has approximately a 35 nanosecond rise-time. The pulse would be long gone by the time the scope trace could react to such a fast rise-time.

The photo in Figure 4 shows one of the new model Tektronic dual-trace scopes connected to a solid-state color TV chassis in order to track down some spike problems in the horizontal sweep system.

Dual-trace phase checks

When the relative phase (timing) of two signals or pulses must be known, or when the status of two waveforms must be compared simultaneously, only a dual-trace triggered-sweep scope will give you a meaningful measurement. For example, let's examine how to use the dual-trace scope to check for proper coincidence of the 3.58 MHz color burst and horizontal keying pulse in the chroma section of a receiver—a technique that

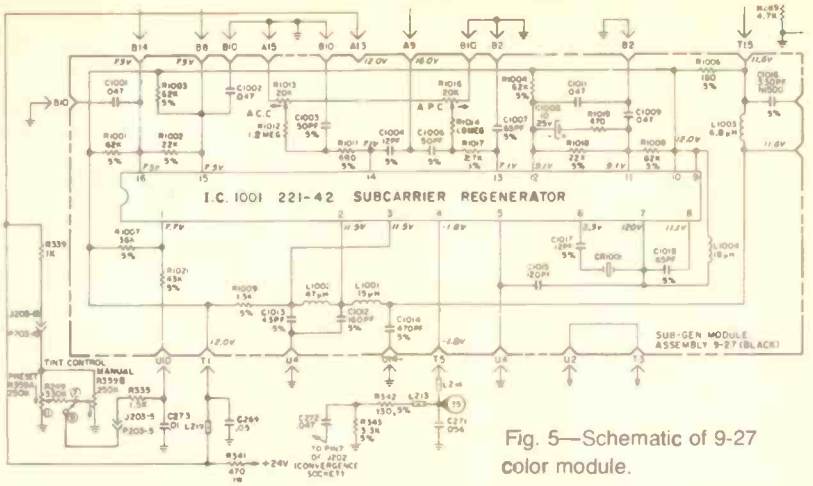


Fig. 5—Schematic of 9-27 color module.

can be used for tube, IC or transistor equipped sets.

Because many of the color processing circuits are keyed to the horizontal sweep flyback pulse for timing and gating purpose, an accurate check of these pulses for timing and phase is imperative. If the horizontal keying pulse is out of time (phase-shift), a complete loss of color or intermittent color fadeout will be the result. With a mis-timed keying pulse, the 3.58 MHz signal on the back-porch of the horizontal sync pulse will not be processed by the burst amplifier and then fed onto the color AFC control circuits.

For this scope procedure we will use a Zenith color set with a 9.27 module (Fig. 5) to check the horizontal gating pulse timing with the 3.58 MHz color burst. The gating pulse is fed in at terminal T5 of the module and the scopes B probe can be connected at this point. The keying pulse is used for separation. For comparison on the dual-trace scope, the color burst (composite video) is picked up with probe A at pin B14 of the 9.27 module. With the time-base generator on the scope set at 20 μs per division (horizontal sweep rate), the color burst and gating pulse should be aligned for a properly timed signal as shown in the dual-trace photo (Fig. 6). Also check for correct shape and peak-to-peak amplitude.

Should timing of the horizontal gating pulse be "off," the color may fade out intermittently. If timing is way off, there will be a complete loss of color. The mis-timed gating pulse shown in Fig. 7 dual-trace photo could be caused by a faulty coupling capacitor or pulse winding on the sweep transformer. Do not overlook the possibility that a fault in the horizontal phase detector (AFC) may cause a gating pulse error.

These same dual-trace triggered-sweep scope techniques can be used to check proper pulse timing of the horizontal AFC stage, AGC keying system, color demodulator stages and any type of feed-back or phase-locked-loop (PLL) circuit operation.

Remember, when checking signal pulses that are timed to the horizontal sweep rate, that these signals can be locked correctly only by applying horizontal sync pulses from the TV chassis (that are transmitted from the TV station) to the external-sync jack of the scope. The reason is that all picture and color information is referenced to the horizontal sync pulses generated at the TV studio.

Vertical sweep problem

This was an actual no-picture, case-history trouble with a Zenith 23FC45 chassis. The set had no raster and fuse F203 was found to be open in the vertical sweep stage. A good module (9-92) was installed and the replacement fuse opened again in about 20 seconds.

This seemed like a short in the deflection yoke so it was changed along with the complete convergence and pincushion assembly. Still no raster, and the fuse opened again. All voltages around the 9-92 vertical module shown in Fig. 8 were correct. So—it was time for the scope.

On the third scope check at pin W3, a good bit of hash was seen with the scope (Fig. 9) on the +35 volt DC supply line. A nice smooth scope trace, as seen in Fig. 10, should have been found at this test point. Checking back into the power supply (Fig. 11), we found filter capacitor C218, a 1000

mfd unit, had become open. An open filter on the +35 volt pin U2 would cause the same problem. A new filter put the set back into operation.

Remember, it is always a good idea to check out the B+ lines for any ripple or hash and to be on the alert for points in the circuit that should not have signals, but do have some. Find out why there is a signal at these points—and it's a good chance you will have solved your problem.

VITS and VIRS

Actually VITS stands for 'vertical interval test signals', but could also mean 'very important test signals', as related to color TV troubleshooting now, and even more so in the future. The VITS and VIRS signals are located on vertical scan lines, numbers 16 through 20, located within the vertical blanking bar. You can tell if the TV station is transmitting these signals by rolling down the vertical blanking bar as shown in Fig. 12. The appearance of these dots and dashes will change from time to time as the network or station engineers punch up various combinations of test signals.

Some of the VITS signal variations are as follows: a multiburst signal, large rectangular window pulse, sine-squared pulse, and modulated or unmodulated staircase. Some of these are shown in the dual-trace scope photo in Fig. 13. The most valuable VITS check for the TV technician is the multiburst test signal shown in Fig. 14. Because each of the six multiburst signals are transmitted at the same amplitude, they can be used for TV receiver troubleshooting. The multiburst signal can be used to track down problems in the tuner, IF stages, video and chroma amplifiers, plus antenna and cable TV systems.

By observing the amplitudes of these multiburst test signals after they have passed through various stages of the color receiver, the overall frequency response can be evaluated. Thus, the VITS signals can be used to see if the set has circuit problems or needs alignment.

A good place to start tracking down trouble in the color chassis with the VITS signals is at the video detector. This test will help isolate the fault to before or after the detector stage. It's the old "divide and conquer" routine. If the multiburst looks good at the

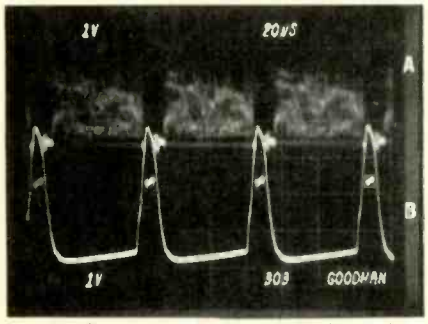


Fig. 7—Out-of-time horizontal keying pulse.

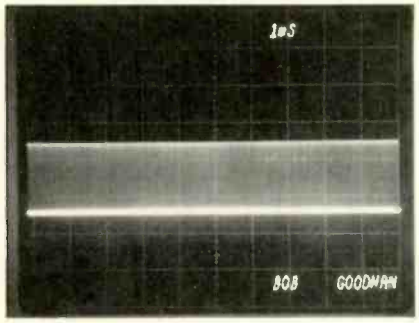


Fig. 9—Hash on −35 volt supply line.

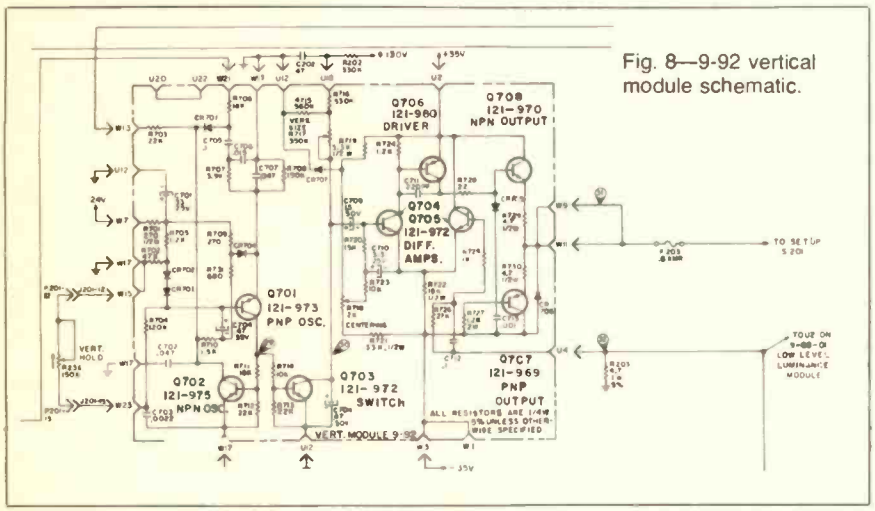


Fig. 8—9-92 vertical module schematic.

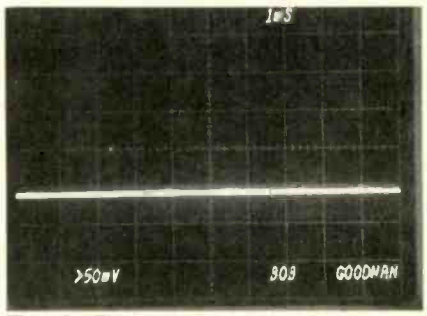


Fig. 10—The scope should produce a smooth line at pins U2 and W3 of 9-92 module.

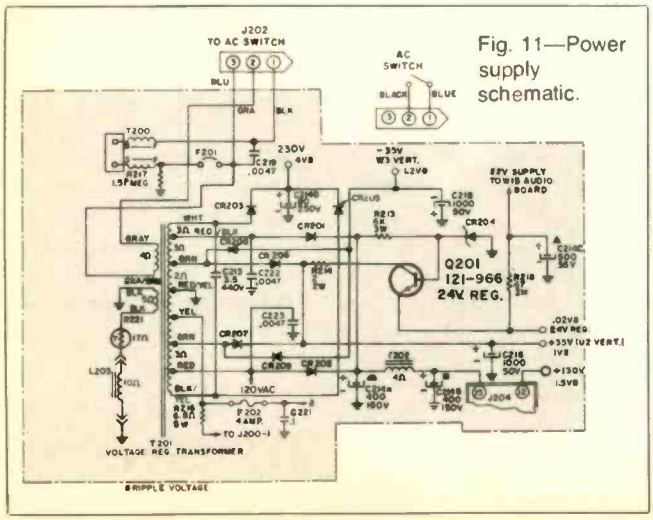


Fig. 11—Power supply schematic.

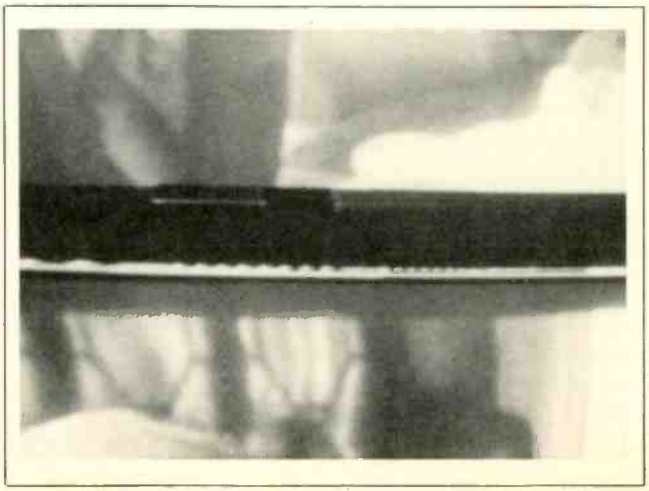


Fig. 12—Blanking bar with VITS.

detector, then check it on other channels. If some channels look good but others show some distortion, then suspect the tuner, cable TV system, or antenna problems. Should you find the VITS below par at the video detector on all channels, it's a good chance the IF amplifiers have a fault or are mis-aligned. However, do not overlook cable TV troubles, also. Note the top trace of scope photo in Fig. 15 that has a dual VITS multiburst signal. The multiburst has a suck-out at around 1.5 MHz that was caused by poor cable termination.

Now, if the multiburst test signals all look correct at the detector for all channels, but the color picture is not normal, then you have narrowed the problem area down to the video and/or chroma amplifiers. Note that when checking the VITS signals in the video and chroma stages, these signals may be lost to the blanking pulses fed into these stages. In order to observe VITS pulses in these stages, the vertical blanking pulses will have to be disabled.

On many properly aligned IF amplifiers, you will find that the 3.5 MHz to 4 MHz multiburst pulse will have a lower amplitude. This will be a normal condition due to the IF response curve.

VIRS test signals

VIRS is an abbreviation for the vertical interval reference signal, and is a reference signal inserted during the vertical blanking interval of a color program transmission. It is used to smooth out variations in color programs throughout the TV network system by allowing the engineers to adjust for various chroma signal parameters. The VIRS signal helps to keep the color information similar when station programs change or TV set channels are switched. A drawing of the VIRS signal is shown in Fig. 16, as it appears on line 19 of the picture scan which has a duration of 63.5 microseconds.

The VIRS stays with a TV program from point of insertion to its final destination. The VITS is generally used only over certain portions of the TV systems and is usually taken out and reinserted point-by-point. You can tell if the VIRS signal is being transmitted by rolling down the vertical blanking bar and looking for a yellow line on the left half of the bottom portion of the blanking bar. Refer to the drawing in Fig. 17 for the location of the yellow line.

GE's VIR system

Some model GE color sets now have a VIR "broadcast controlled" system for automatic adjustments of color intensity and tint. The system operates by processing the vertical interval reference (VIR) signal transmitted on the 19th line of each field of the TV video signal. As of October 1975, the FCC has designated the 19th line of each picture field for this test signal. However, the TV stations are not required by law to carry the VIRS signal.

The GE color control VIR module contains 5 plug-in IC's and 30 transistors to detect and process the VIRS signal. The module is connected by plugs to the main color chassis. The module's circuitry is divided into four separate blocks. Let's now take a look at two of these blocks.

Binary counter & decoder

The VIR module performs several basic functions. It detects the 19th line of each transmitted video field and recognizes the presence of a VIR signal. Note binary counter and decoder circuits as shown in Fig. 18. As you see, there are many pulses to check out with the scope.

The module also develops a DC color-controlling voltage by processing the VIR related portion of the receiver's simulated blue drive signal. And the circuitry then develops a DC tint-controlling voltage by processing the VIR related portion of the TV receiver's R-Y signal.

Line recognizer

A detailed schematic in Fig. 19 shows the line recognizer stages found in the VIR module. The line recognizer signal outputs to the module's controller stages exit the unit and are as follows:

1)—A 63 microsecond keying pulse

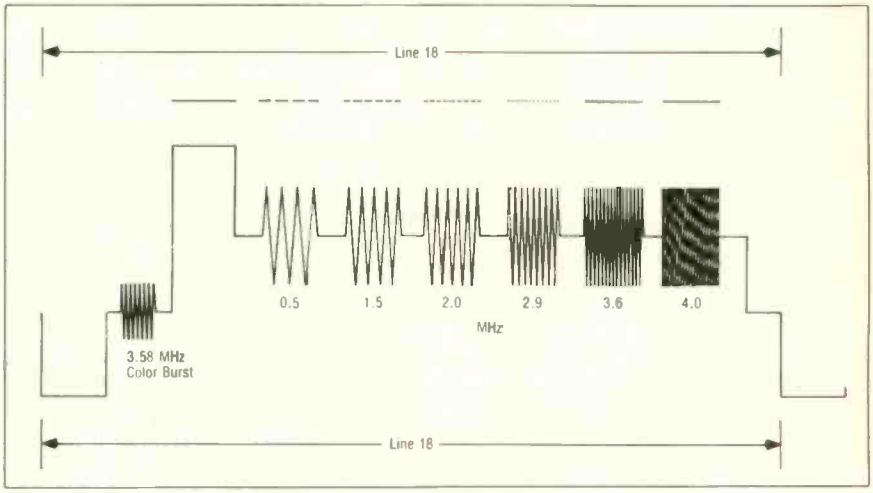


Fig. 14—Multiburst VITS test signals.

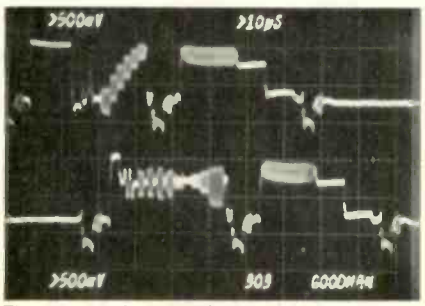


Fig. 13—Various VITS signals on dual-trace pattern.

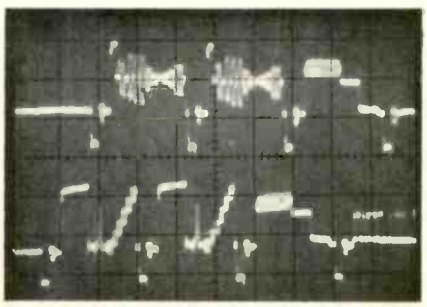


Fig. 15—Note "suck-out" on top trace of multi-burst.

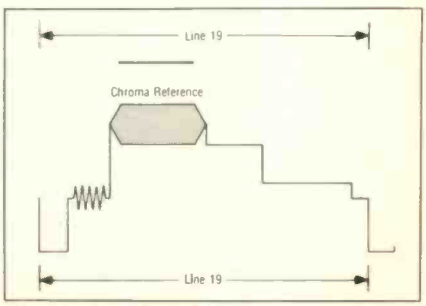


Fig. 16—Drawing of ideal VIRS signal.

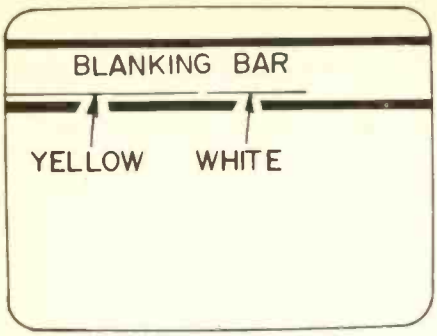


Fig. 17—Yellow VIRS line location.

corresponding to the 19th line of each composite video field.

2)—A 15 microsecond keying pulse corresponding to the chrominance reference interval of the VIR signal occurring on line 19.

3)—A 35 microsecond keying pulse corresponding to the black reference interval of the VIR signal on line 19.

4)—Two DC switching voltages that are developed in response to the presence or absence of a VIR signal on the 19th line of the composite video information.

The line recognizer makes extensive use of the digital logic circuitry to accomplish its functions.

There are many more circuits and stages involved in the VIR automatic color control system. However, operating details of the complete VIR system is beyond the scope of this article.

To troubleshoot this VIR color control system, the technician will be required to use an accurate triggered-sweep scope to check pulse width of 15 µs and 35 µs duration from the line recognizer, plus various pulse widths in the other stages. The line recognizer has many critical timing circuits that are necessary to produce its precisely controlled outputs. Thus, this is just another of the many reasons why the TV electronics technician will be required to have, and know how to operate, a high quality dual-trace triggered-sweep scope.

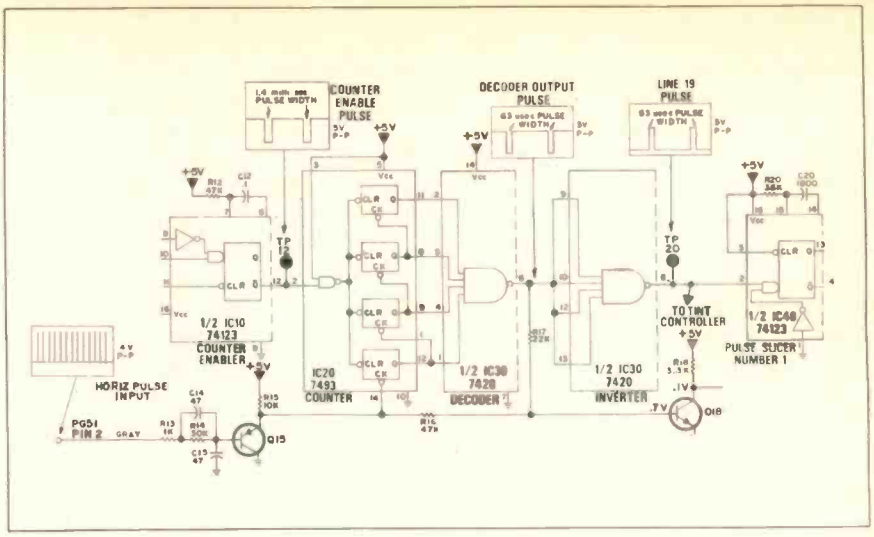


Fig. 18—Binary counter, decoder, and inverter stages.

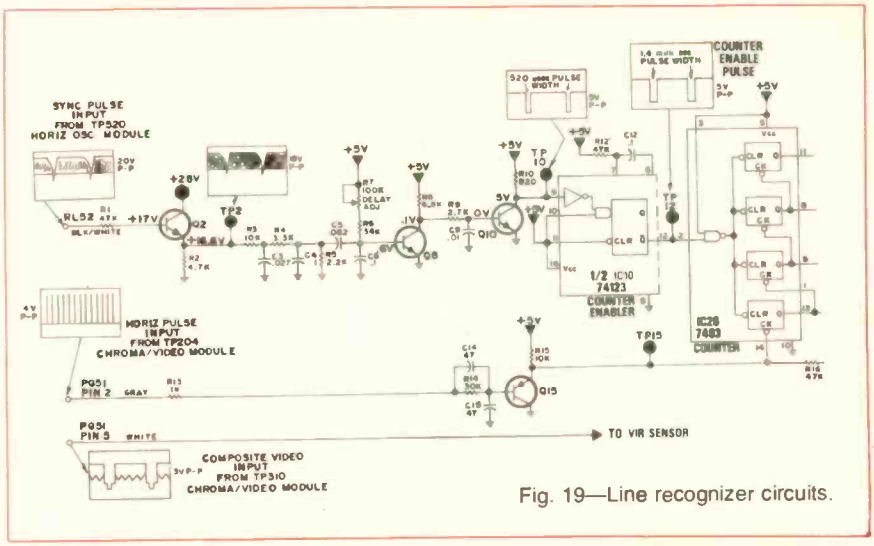


Fig. 19—Line recognizer circuits.

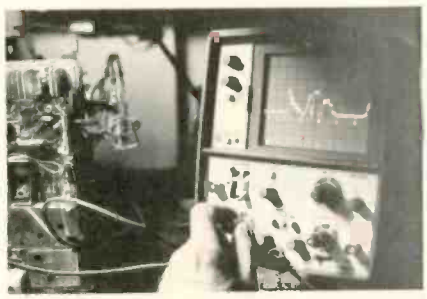


Fig. 20—Scope set-up to look at VITS signals.

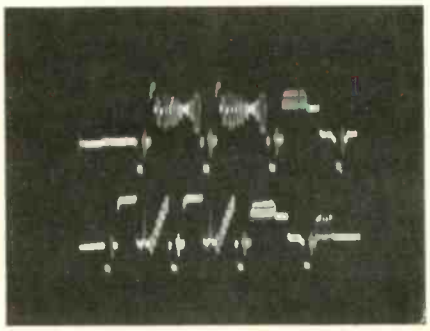


Fig. 21—Dual-trace scope pattern viewing both odd and even VITS signals.

VITS with a scope

Again, a triggered-sweep oscilloscope is a must for viewing the VITS test signals. The recurrent sweep service type scope cannot be used to look at the VITS.

The vertical amplifier of the scope is connected at the output of the TV set's video detector with a X10 probe. Set the time base generator (horizontal sweep oscillator) to the vertical rate, or about 2 or 5 microseconds. An external trigger pulse can be taken from the set's vertical sweep stage. This will lock-in the VITS and give a very steady wave form. Now turn the horizontal sweep expansion (magnification) to 15X. Next, turn the horizontal position (centering) back and forth until the proper VITS pulses are in view. Note in Fig. 20, the Tektronix scope being used to view VITS pulses from a GE color chassis.

The scope's CRT is swept only for a brief interval each frame, thus the waveform will be dim during the VITS display. The scope needs a very high brightness and intensity level. Hence when viewing the VITS, the brightness control on the scope should be cranked up to is maximum level until the VITS waveform is obtained and then lowered and adjusted for good focus. The use of a viewing hood will also help in looking at this dim trace. The scope should have at least a 10K accelerating voltage.

Some of the newer scopes when

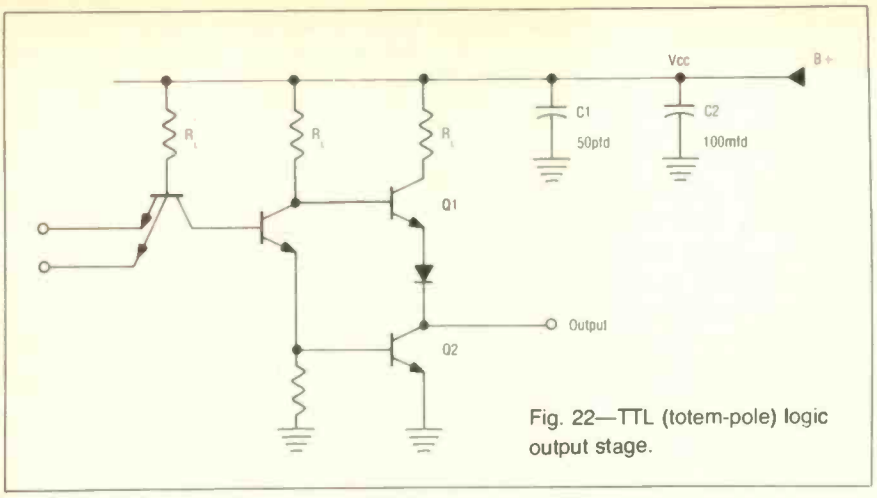


Fig. 22—TTL (totem-pole) logic output stage.

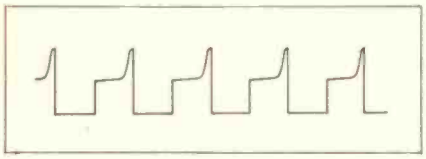


Fig. 23—Spikes occur when pulse goes to low state.

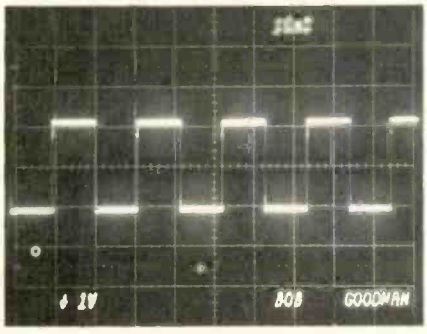


Fig. 24—Normal logic pulse at collector of Q2.

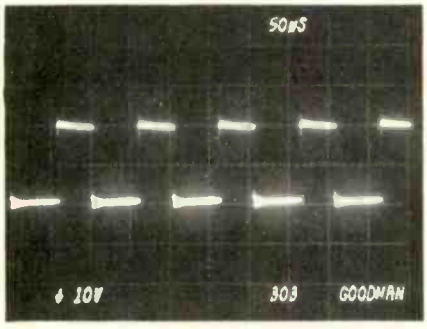


Fig. 25—Narrow spike on high pulse mode due to open filter capacitor.

switched into their TV mode have hold-off circuits and filters to lock onto the VITS and you will not have to use any external vertical sync pulses from the TV Chassis.

Set everything up on the scope as with a single trace scope, but connect both vertical amplifier probes to the same point (video detector, etc.) and then put the scope into the dual-trace mode. You will now see both fields of the VITS pulses as shown in Fig. 21. In this scope trace pattern you are actually viewing both odd and even lines. Most scopes seem to lock-in better in this dual-trace mode and you can get a better view of the VITS.

Digital logic systems

In addition to the repair of TV, radios and stereo, today's electronic technician is being called upon to service digital logic systems as found in remote TV control tuning units, TV video games, (TTY's) TV typewriters, video terminals, and microprocessors.

At the heart of most digital systems, whether they are TV video games, TTY's, or microprocessors, there is some type of square wavepulse generator. This is referred to as a 'clock'. These clock signals are used to control and time the whole system. In other words, the clock pulse is used as a reference to all of the other circuits. If the clock is not running or producing the proper pulses, then the whole system will be shut down. Thus, the first check with the scope for logic devices is with the clock for correct pulse output. This one check may solve the problem.

Most of the modern digital circuits now use TTL (transistor-transistor-logic) for their operation. For your reference, check the TTL output circuit diagram shown in Fig. 22.

When a TTL circuit is switched from a low to a high state, transients occur on the supply voltage because of the TTL totem pole output. When going high, this totem pole output is short-circuiting the B+ supply voltage during a brief period. When the TTL output goes from LOW to the HIGH state, transistor Q2 is turned off and Q1 goes on. However, filter capacitors C1 and C2 are placed at each of the TTL output stages to keep these spikes from getting onto the B+power supply line.

continued on page 53

BULLETIN BOARD

Electro/mechanical Maintenance and Assembly Tools and accessories are detailed in the latest catalog from Techni-Tool. Catalog No. 23 for 1978, in 209 pages, contains over 10,000 individual items for electro/mechanical work. There is a color section on tool kits and cases, with products for both professionals and experimenters. An exclusive feature is "Design-a-Kit," which allows the individual to design a tool kit to his own specifications. All items are priced in the new publication. Available free from *Techni-Tool, Inc.*, Apollo Road, Plymouth Meeting, PA 19462.

Portable Electrical Testing Equipment is covered in the latest full line, short form catalog and price sheet from a.w. Sperry Instruments. The catalog, MES-100, contains detailed specifications for the firm's line of snap-around ammeters, multi-testers, insulation testers, voltage indicators, and accessories. The price sheet lists the suggested trade prices along with instructions on how to purchase the instruments. Available free from distributors, or from *a.w. Sperry Instruments, Inc.*, 245 Marcus Boulevard, Hauppauge, N.Y. 11787.

A Security Alarm Monitoring System, called Amcest, is actively offering its services on a nationwide basis to professional electronics service shops seeking expanded business opportunities through selling and installing alarm systems for home and industry. The Amcest monitoring system requires the use of digital communicators that 'dial' the telephone when a sensor is activated, contacting in turn police or fire departments. The communicators are leased to the installer by Amcest. In addition, a marketing service is offered to help installers make sales. It includes sales literature and help in making sales demonstrations. For information, call toll free to *Amcest Corporation,* Linden, N.J.—800-631-7370. New Jersey residents call 800-492-4051.

Crystals for Radio Communications equipment are described in a new eight-page catalog from Standard Communications. The new literature covers crystals for land mobile, marine, business, industrial and amateur equipment. Included is data on the firm's extensive line of private channel and two-tone paging products. Full crystal ordering information is provided with delivery assured in 24 hours. Available free from *Standard Communications Corp.*, Frequency Management Div., P.O. Box 92151, Los Angeles, CA 90009.

Electronic Test Equipment, Tools and Accessories are catalogued in abundance in the new 1978 catalog from Fordham Radio. Included are illustrations, specifications and prices for test equipment from 14 nationally-known manufacturers, plus antennas, audio accessories, CB equipment, and servicing tools and accessories. Almost anything required for electronic servicing and experimentation is included in this new mail order catalog. Available free from *Fordham Radio,* 855 Conklin st., Farmingdale, N.Y. 11735.

The Chek-A-Color TV Test Jig is described in a new six-page, illustrated brochure from GTE Sylvania. The brochure explains how the CK3000 can be used to test 62 brands and over 10,000 color television models. It contains information on such features of the test jig as diagnostic time, non-obsolescence, 13V in-line picture tube,

available accessories including versatile adapter kits and individual adapters, and a cross reference chart. Included is a setup manual registered in the owner's name for periodic updates, complete operating instructions, and a set of companion universal extensions and set up items. Brochure is available free from *GTE Sylvania distributors*.

Potentiometer Joy-stick Controls are described in the latest catalog from Mouser Electronics. The new 88-page catalog covers the firm's expanded line of joy-stick controls that includes the 10K, 50K and 100K values in linear taper. These items have been added to the firms linear and audio taper potentiometers, in single turn standard ½ watt, single turn sub-mini, ¼ watt, or single turn sub-mini thumb wheel, ⅛ watt, in standard values with or without switches. The catalog is free from *Mouser Electronics*, 11511 Woodside Avenue, Lakeside, CA 92040.

Videocassette Recorder Schematics and service data are now available in a new Photofact series. Each volume is devoted to a specific VCR manufacturer, and includes all service data, instructions and replacement parts lists. The first publication, VCR-1, is a 128 page book for Sony VCRs, available now. VCR Photofacts for RCA, Zenith, JVC, Magnavox, Panasonic and others will follow. For further information, contact *Howard W. Sams & Co., Inc.*, 4300 W. 62nd St., Indianapolis, Indiana 46206.

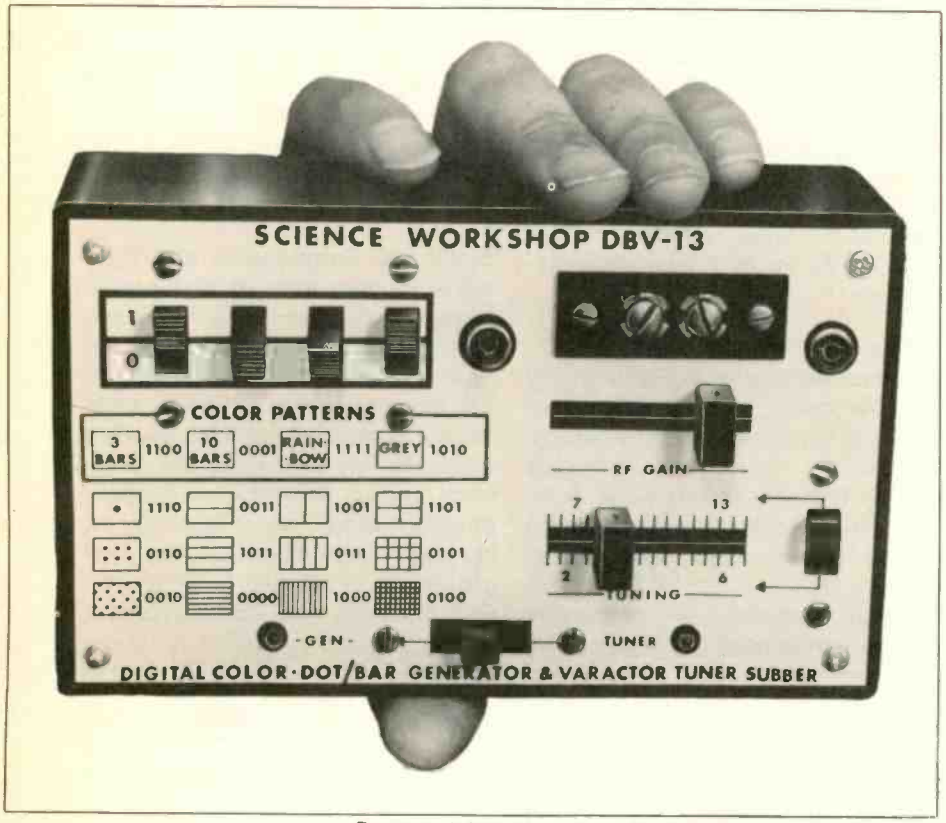
An RF Data Manual, packed with complete data sheets, practical application notes and cross-references, is now available from Motorola Semiconductors. Said to weigh two pounds, the new 736-page volume describes RF Power Transistors with outputs up to 150W, plus impedance matching networks, mechanical RF construction techniques, biasing, reliability, noise figure, as well as discussions of SSB linearity, broadbanding and power combining. Available for $3.50 from *Motorola* distributors.

A Cross-reference Guide to Semiconductors is available in the latest technical manual (X78) from Workman Electronics. The new publication features almost 138,000 crosses plus full technical specifications. A full range of solid state products including RF power types, zeners, SCR's, FET's, rectifiers, VCC's, diacs, SBS's, as well as replacement silicon and germanium devices are included in the some 900 newly announced types. Available free from *Workman Electronics*, P.O. Box 3828, Sarasota, Florida 33578.

Three New Amateur Headphones are described and illustrated in a new brochure from Telex. Usable in 3.2 to 20 ohm applications, the new lightweight headphones have magnetic transducers with rising frequency response for use with S.S.B, voice frequency and C.W. The brochure gives specifications and features for models HTC-2, and over-the-head unit, HMC-2, a featherweight model, and HFC-91. Literature is free from *Telex Communications*, 9600 Aldrich Ave. So., Minneapolis, Minn. 55420.

Electronic Components and Hardware, in more than 20 new product groups, is detailed in the newly published 1978 catalog from the Herman H. Smith Co. Approximately 10,000 items are featured in the 104-page, multicolored publication. Included are binding posts, Mil-Spec jacks, fused test leads, probes, BredBlox and BredStix, projection lamps, power terminals, lacing cords, and rubber bumpers. Available free from *Herman H. Smith, Inc.*, 812 Snediker Ave., Brooklyn, N.Y. 11207.

TEST INSTRUMENT REPORT



For more information about this instrument, circle 145 on the Reader Service Card in this issue

Science workshop's DBV-13

3-in-1 test instrument

By Don W. Mason

We selected this instrument as the subject for this month's report because of the small size of the box, or case, (2-inch by 3-¾-inch by 6-¾-inch) and the number of test functions packed into it. It looked like the perfect size for in-home servicing—and we wanted to find out if it actually performed the functions as promised. We also were intrigued with the price—$89.95.

After going through the paces with several TV chassis, both tube and modular, we were pleased with the performance of the DBV-13. It utilizes all of the latest IC technology and utilizes it well.

The varactor tuner-subber portion of the DBV-13 uses vari-cap diodes to provide electronic, rather than mechanical, tuning. It has a MOSFET R.F. stage with 4 varactor tuned circuits. It works with all tuner types—switch, turret or varactor.

To use the tuner-subber, the normal connections are made—antenna to the instrument and IF output to the set's tuner IF output or to almost any point in the video IF stages (between grid, base, plate or collector and ground). An internal blocking capacitor prevents damage to the subber or to the TV.

After setting the RF gain sliding switch to mid-range, the channel is selected by a sliding tuner switch. This is the only minor negative point about the instrument. The sliding tuner is a little imprecise and you have to sometimes hunt a bit for the channel you want. But it is a very minor problem considering the performance of the rest of the instrument.

The digital color-dot/bar generator portion of the DBV-13 was the most intriguing. The IC chip, which really is the heart of the generator, contains a crystal controlled master (clock) oscillator. All of the sync, blanking and video signals are derived from (and phase-locked to) the master clock by digital counters.

The operation of the generator is accomplished by a digital switching technique. You use only four slide switches to select any one of 16 patterns in accordance with the digital code imprinted on the front panel. For example, to select a single center dot pattern, you use the digital code 1110. This is set up by pushing the first three slide switches up into the "1" position and pushing the 4th slide switch down into the "0" position.

Patterns are received on the TV at channel 3 (a factory setting) but output can be changed to channels 4 or 5 by an easy adjustment of the RF oscillator trimmer, is located under the front panel.

The patterns available with the DBV-13 can be seen in the photograph accompanying this report.

Actually, the DBV-13 offers a third test function—that of a variable DC voltage bias supply for troubleshooting AGC, AFC, AFT, ACC and other control voltage operated circuits.

The bias supply is provided through the instrument's antenna input terminals and the RF gain control. The antenna terminals serve as the bias supply's output terminals, and the RF gain control varies the voltage available which is from 0 to approximately 13 volts. The polarity is negative on the left and positive on the right of the output terminals.

To prevent damage to transistors in the TV tuner or IF stages, the DBV-13 bias supply is "current limited". Internal series resistance of at least 5,000 Ω eliminates the possibility of burn-outs.

The new instrument is powered by three 9-volt batteries. They are connected in series and a three terminal voltage regulator is used to maintain the correct voltage for the instrument. The 13 volts which are available at the tuner antenna terminals for the variable bias supply also provides a convenient battery test point, making it unnecessary to open the instrument to test the batteries.

To check the batteries at this test point, you measure the voltage and record it. This voltage is part of the instruments regulated voltage and therefore will not change as the batteries age,

continued on page 53

Carl Meyer
President, A to Z TV Service
Clinton & Harlem Streets
Buffalo, New York 14224

"I buy from the source–GE. They're the world's largest supplier of receiving tubes."

Your reputation is our reputation

Tube Products Department · Owensboro, Kentucky 42301

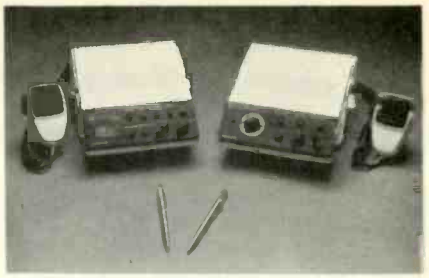
GENERAL ELECTRIC

DEALER'S SHOWCASE

Car Stereo Units

Circle No. 146 on Reader Inquiry Card

Two new AM/FM/MPX/Tape player/Digital Clock in-dash car stereo units have been introduced by *J.I.L.* Model 874-E is an 8-track version and Model 634E is a stereo cassette version. Both deliver a maximum of 20 watts of RMS power per channel when a power boost switch is activated. The two new models utilize miniaturized computer circuitry which includes Scan/Pause and Seek/Lock features. In place of the conventional AM/FM dial scale, the units provide a fluorescent vacuum display of channel frequency, as well as time readout from the built-in digital clock. The new units provide four programmable push buttons with the capability of selecting four AM and four FM channels.



Marine radiotelephones

Circle No. 147 on Reader Inquiry Card

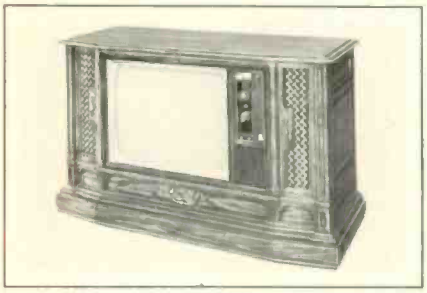
Two new fully synthesized marine radiotelephones have been introduced by *Motorola*. Called the Nautilus 220 and 440, the new units are part of the firm's line of Triton VHF two-way marine radios. Housed in weather and corrosion-resistant cases, the new units are said to be small and easy-to-mount. The 220, designed for pleasure boats, offers 25 watts of talk power—and because it does not rely on crystals, can be programmed for 12 channels and two additional weather channels while the customer waits. The Nautilus 440 is

suitable for all types of craft, and will pick up every major channel in the U.S. It features a liquid crystal channel display and a dual programmable memory function.

Color TV With VIR

Circle No. 148 on Reader Inquiry Card

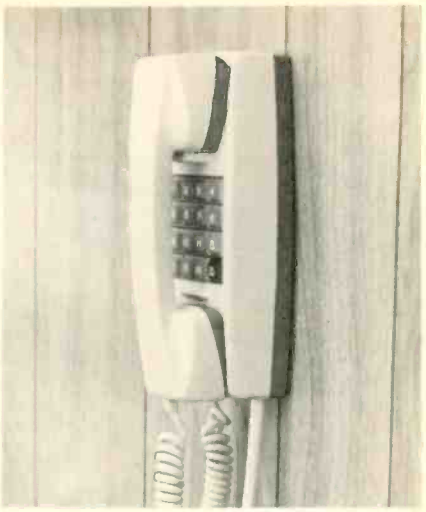
Two new 25 inch diagonal color television receivers with VIR have been introduced by *Panasonic*. Designated CT-2558 and CT-2598, the two new models feature IC circuitry that detects the broadcaster's VIR (Vertical Intervel Reference) signal and electronically compensates for incoming color intensity and tint. If no VIR signal is contained in the incoming signal, a "ColorPilot" feature in the new chassis automatically takes over the color compensation task. Both models have Video Sensor, an automatic roomlight sensing device which adjusts the picture to surrounding light conditions.



Intercom Systems

Circle No. 149 on Reader Inquiry Card

Two new intercom systems with a slim, contemporary appearance have been introduced by *Bogen*. The new systems



are said to provide high intelligibility, push-button speed and optional paging tie-in without the need for a central exchange or elaborate installation. Called

For a limited time only WESTON offers this handsome carrying case...FREE...with any Model 6000 DMM you buy.

That's right! With any Weston Model 6000 DMM you buy between May 1 and August 31, you will get . . . absolutely FREE . . . this handsome, sturdy carrying case. Leather grained for a look of elegance, the expanded vinyl is rugged and easy to keep clean. The pouch style makes it simple to remove or replace the meter. The case, worth more than $15, comes with a handle for easy carrying, and a snap-loop for hanging from a belt.

The Model 6000 is the renowned "Drop-Proofed" digital multimeter with standard built-in autoranging for its five measurement functions over 26 broad ranges. All ranges, including resistance, are provided with complete overload protection and automatic zero calibration.

The Model 6000 comes with a "Hold" feature to retain the LCD reading after the probe is removed. This allows measurements to be made in crowded circuitry or high voltage areas with greater safety. The meter is housed in a high impact molded plastic case to isolate inputs and to provide greater ruggedness and durability. The inside of the 6000 is coated with a conductive paint to shield the circuits from industrial radio frequency interference noise and insure more accurate readings. A sturdy, patented plastic handle makes the meter easy to carry, acts as a tilt stand during bench operation, and folds down to protect the display face during storage.

The Model 6000 also has two new optional features . . . a manual range hold button to override autoranging, and a display backlight button for reading the meter in very low illumination areas.

You get all of these features in the Weston Model 6000 DMM . . . and you also get, absolutely FREE, a handsome, sturdy carrying case for extra protection. Be sure to get in on this FREE, limited-time offer. Call your nearest Weston sales office now!

SANGAMO WESTON
Schlumberger

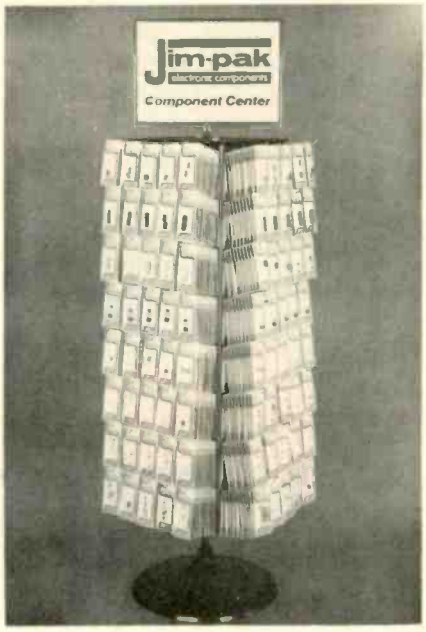
WESTON INSTRUMENTS
a DIVISION of SANGAMO WESTON, INC.
614 Frelinghuysen Avenue, Newark, New Jersey 07114 Tel. (201) 242-2600
Canada: 1480 Dundas Highway, Mississauga, Ontario (416) 277-3191
Europe: Ingolstadter Str. 67a 8München 46, W. Germany (49-89) 31-70-31

the Bogen-Phone TQ system, the new products have a common intercom line connecting all phones with selective calling with the push of a button. The new models give a choice of connecting two, five, nine or thirteen stations. Up to four buttons can be pressed at one time to initiate a conference call.

Electronic Components

Circle No. 150 on Reader Inquiry Card

A new line of electronic components, blister-packed for retail sales, is now available from *James Electronics*. Called the Jim-Pac line, the new line includes over 200 of the most popularly used integrated circuits, diodes, LEDs,

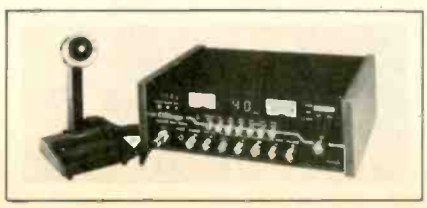


switches, transistors, capacitors, resistors, sockets and connectors. All components are packaged for immediate sale and are fully guaranteed. An advertising program is available to authorized dealers.

AM/SSB CB Base Station

Circle No. 151 on Reader Inquiry Card

A new CB base station transceiver for both AM and single sideband operation has been introduced by *TRS Marketing, Inc*. Designated the Challenger 1400, the new unit covers all 40 channels on either AM or lower and upper sidebands, and includes dual speakers. Built-in SWR and output power meters are featured along with an LED channel read-



out, LED operating mode indicators and an "On the Air" indicator lamp. The design includes phase-locked loop frequency synthesis, MOSFET front-end design, and multiple lattice-type dual IF ceramic filters. The unit also features a built-in LED digital clock with three adjustment speeds. Suggested retail price is $549.95.

Mobile Tape/FM/AM Stereo

Circle No. 152 on Reader Inquiry Card

A new mobile high fidelity cassette tape player with an AM/FM stereo receiver is new from *Royal Sound*. Designated Model RS-3110, the new unit, designed for in-dash installation, features an automatic electronic seek-and-search scanning system or manual tuning, LED dial illumination and LED stereo, AM and FM indicator lights for the tuner section. The tape section has automatic tape reverse for continuous play and locking fast forward/fast rewind controls. An optional preset adaptor that allows the user to choose 5 AM or FM stations in any combination is also available. Model RS-3110 retails for $550, and the preset adaptor sells for $60.

Mobile CB Radio

Circle No. 153 on Reader Inquiry Card

A new mobile CB transceiver with a twin ceramic selectivity filter to reduce adjacent channel interference or "bleed-over" has been introduced by *E.F. Johnson Co.* Called the Viking 260, the new unit also features a noise blanker system in combination with an automatic noise limiter which is said to help elimi-

nate electrical and impulse-type noise. The Viking 260 also a PLL frequency synthesizer and a calibrated squelch that allows the user to pre-select the exact signal strength he wants to receive. A "PowerBar" LED meter gives visual reference to activity on channels, even if it is below the squelch level. Suggested retail price is $199.95.

NEW PRODUCTS

Electronic Tool Kit

Circle No. 154 on Reader Inquiry Card

A new electronic tool kit for the manager-supervisor who is occasionally called into the field is new from *Jensen Tools*. Designated the JTK-95, the kit contains more than 40 tools selected to perform a wide range of service and repair tasks. Included are pliers, cutters, screwdrivers, nutdrivers, wrenches, soldering equipment, etc. Most of the tools are mounted on a single pallet in an attache-style tool case with a simulated reptile skin cover. The bottom of the case is free of partitions, so when the pallet is removed, it serves as a regular attaché case.

TV Pattern Generator

Circle No. 155 on Reader Inquiry Card

A new series of TV test instruments has been introduced by *Visual Information*. The new instruments use digital technology to provide a wide variety of test functions for both monochrome and RBG color television at various scan rates. Performance evaluation is possible with the new instruments to 1000 tv line resolution at up to the 1225-line scan rate. Signal rise and fall times typically are 10 nsec. All circuits are on plug-in printed circuit cards, and integrated circuits are socket mounted for easy maintenance. Designated Signal Sources 1203 and 1204, the units feature built-in precalibration of pattern content for up to four scan rates. In addition, Sync Source 1302, a multi-rate sync generator accessory, can be built into the pattern generator to provide test signals and patterns.

Sealing Putty

Circle No. 156 on Reader Inquiry Card

A new synthetic rubber-type putty for repairing electrical wires, cables and conduits for sealing joints and seams has been introduced by *Oneida Electronics*. Called "Premi-Putty," the new material

SOMETHING YOU ALWAYS WANTED BUT WERE NEVER ABLE TO OBTAIN...

ET/D's Modern Serviceshop Management Manual

. . . It's a textbook for the independent electronics service technician who is actively engaged in consumer and industrial service markets.

Prepared by the editors of ELECTRONIC TECHNICIAN/DEALER, this comprehensive management guide is must reading for all service technicians and dealers who have to cope with the day-by-day problems of running a small business.

ET/D "Modern Serviceshop Management" will focus on three major categories:

- BUSINESS MANAGEMENT—with chapters on basic accounting procedures, ratio analysis, planning for profit in the business environment and current asset management.
- SERVICING OF ELECTRONICS EQUIPMENT—with chapters on troubleshooting transistorized circuits, modern test equipment, digital electronics, industrial control systems and modern serviceshop layout.
- NEW BUSINESS HORIZONS—with chapters on whether to expand your business, contract service, business opportunities in medical electronics and service business opportunities in small industrial settings.

This manual is in the works now, so order your copy now by sending in your order with remittance. No service shop should be without this manual from one of the outstanding book publishing houses in the country.

ET/D

ELECTRONIC TECHNICIAN/DEALER
LEADING THE CONSUMER AND
INDUSTRIAL SERVICE MARKETS

HBJ A Harcourt Brace Jovanovich Publication

CLIP AND MAIL TO:

ET/D MAGAZINE
1 East 1st Street
Duluth, Minnesota 55802

Please send_____copy(ies) of ET/D's Modern Serviceshop Management at $12.95* per copy. Enclosed is a check for $_____to cover the cost of the textbook plus shipping and handling expenses. ET/D Modern Serviceshop Management will be shipped immediately following publication.

NAME _____

COMPANY NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

Mail this order blank along with your payment to:
Book Dept. ET/D Magazine
1 East 1st St.
Duluth, Minnesota 55802

*Please add $1.50 per order to cover postage and handling. On multiple copy orders add 25¢ for each additional copy (for example, two copies would cost $1.75 for postage and handling).

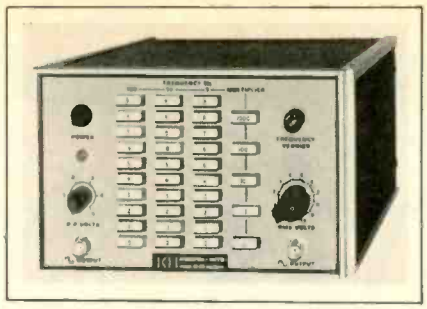
Publication Date: September 1, 1978-Orders will be fulfilled within 60 days of the publication date or within 60 days of the date of order, if received after publication date.

is resistant to the effects of high voltages and ultra violet light. It is said to bond, fill, seal, weatherproof, quiet and insulate. According to the manufacturer, Premi-Putty retains pliable consistency to −20°F and will not shrink, crack, sag or oxidize. Available in 15-square inch pieces or by the spool in larger quantities.

Sine/Square Oscillator

Circle No. 157 on Reader Inquiry Card

A new sine/square oscillator for applications where ultra-low distortion sine wave signals are needed is new from



Krohn-Hite. Designated Model 4100A, the new oscillator features a frequency range from 0.01 Hz to 1 MHz, with frequency response better than .05 dB. Distortion is typically 0.005% through the audio range. Push-button frequency controls provide rapid 3 digit resolution and 0.5% frequency accuracy. The 10 volt RMS output provides a ½ watt of power from its 50 ohm sources, and it has a calibrated amplitude control. The squarewave output is variable from 0 to 5V peak to peak. Priced at $795.

Operational Amplifiers

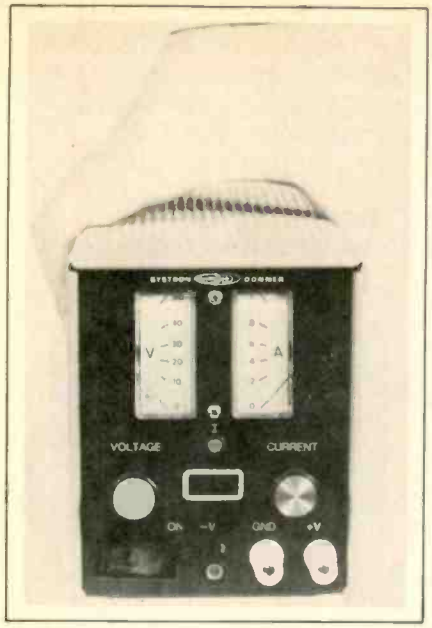
Circle No. 158 on Reader Inquiry Card

A new series of FET input operational amplifiers (op-amp) is being introduced by *Motorola Semiconductor*. Designated the LF155 series, the new devices incorporate precisely matched junction FET devices on the same substrate as bipolar IC elements, producing input characteristic enhancement of more than an order of magnitude over conventional amplifiers. Low input bias and offset currents combine with high input impedance, and characteristic low FET noise levels to make the series useful in Sample and Hold circuits, high impedance Buffers, fast D/A and A/D converters, precision high speed integrators, and wideband, low noise, low drift applications.

DC Power Supply

Circle No. 159 on Reader Inquiry Card

A new regulated DC power supply with a modular quarter-rack design is new from *Systron-Donner*. The new power supply, part of the HHB series, can be used as a single bench unit or configured in a dual bench cabinet. Four models are available in these voltage/current combinations: 6V/5A, 20V/2A, 50V/1A and



150V/0.3A. Both voltage and current are metered and a 10-turn voltage control assures excellent resolution. Each output voltage can be remotely controlled by a reference resistance or voltage. Sense terminals are provided so that the supply may deliver its specified regulation to a distant load. Priced at $375.

Cable Cleaner

Circle No. 160 on Reader Inquiry Card

A new liquid cleaner that removes semi-conductive particles and wire pulling compounds from semi-conductive jacks and insulations of electrical cable is new from *CRC Chemicals*. Called "Cable Clean," the new chemical also removes excess silicone from exposed insulation and preformed stress cones, after installation. Cable Clean is non-flammable, non-conductive, non-

corrosive, and non-staining. It can be used on neoprene, ethylene, epr, xip, pvc, butyl rubber, and thermoplastic insulations and jackets. It is available in 6 and 24 ounce aerosols, 1 pint and 1 gallon cans, 5 gallon pails and 55 gallon drums.

CB Signal Generator

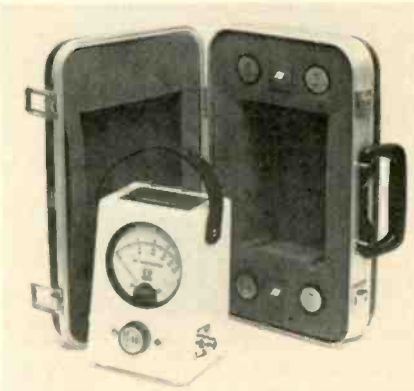
Circle No. 161 on Reader Inquiry Card

A new phase-lock-loop circuit CB signal generator, Model LSG-227, has been introduced by *Leader Instruments*. The new instrument is said to offer 5 parts per million stability for frequency positioning and includes a ±1 KHz fixed frequency shift to facilitate SSB check out. Made to sell for less than $550, the new generator has a digital channel readout

and offers an RF output calibrated to 0.3μV. Frequency range is 26.96MHz to 27.40MHz in fixed steps. Meter indication for RF output levels calibrated in V RMS and dBm is offered.

RF Measuring Kit

Circle No. 162 on Reader Inquiry Card



A series of new RF power measuring kits, called "Watt-kits," have been introduced by *Dielectric Communications*. The kits consist of the Type 1000 RF directional wattmeter and 100 watt plug-in elements that allow measurement of 100 watts full-scale from 25MHz to 1GHz. Also included is a quick-match UHF connector, two-foot patch cable

An Extraordinary Offer to introduce you to the benefits of Membership in

ELECTRONICS BOOK CLUB

take any **3** of these unique electronics books (value to $51.75) for only **99¢** each

with a Trial Membership in the Book Club that guarantees to save you 25% to 75% on a wide selection of electronics books

All two-book sets count as only one of your three Selections.

May we send you your choice of these 3 practical, time-and-money-saving books as part of an unusual offer of a Trial Membership in Electronics Book Club?

Here are quality hardbound volumes, each especially designed to help you increase your know-how, earning power, and enjoyment of electronics. Whatever your interest in electronics, you'll find Electronics Book Club offers practical, quality books that you can put to immediate use and benefit.

This extraordinary offer is intended to prove to you, through your own experience, that these very real advantages can be yours...that it *is* possible to keep up with the literature published in your areas of interest, and to save substantially while so doing. As part of your Trial Membership, you need purchase as few as four books during the coming 12 months. You would probably buy at least this many anyway...without the substantial savings offered through Club Membership.

To start your Membership on these attractive terms, simply fill out and mail the coupon today. You will receive the 3 books of your choice for 10-day inspection. YOU NEED SEND NO MONEY! If you are not delighted, return the books within 10 days and your Trial Membership will be cancelled without cost or obligation.

ELECTRONICS BOOK CLUB, P.O. Box 10, Blue Ridge Summit, Pa. 17214

Facts About Club Membership

- The 3 introductory books of your choice carry publishers' retail prices of up to $51.75. They are yours for only 99¢ each (plus postage and handling) with your Trial Membership.
- You will receive the Club News, describing the current Selection, Alternates, and other offerings, every 4 weeks (13 times a year).
- If you want the Selection, do nothing: it will be sent to you automatically. If you do not wish to receive the Selection, or if you want to order one of the many Alternates offered, you simply give instructions on the reply form (and in the envelope) provided, and return it to us by the date specified. This date allows you at least 10 days in which to return the form. If, because of late mail delivery, you do not have 10 days to make a decision and so receive an unwanted Selection, you may return it at Club expense.
- Personal service for your account—no computers used!
- To complete your Trial Membership, you need buy only four additional monthly selections or alternates during the next 12 months. You may cancel your Membership any time after you purchase these four books.
- All books—including the Introductory Offer—are fully returnable after 10 days if you're not completely satisfied.
- All books are offered at low Member prices, plus a small postage and handling charge. Prepaid orders shipped postpaid.
- **Continuing Bonus:** If you continue after this Trial Membership, you will earn a Dividend Certificate for every book you purchase. Three Certificates, plus payment of the nominal sum of $3.99, will entitle you to a valuable Book Dividend of your choice which you may choose from a list provided Members.

ELECTRONICS BOOK CLUB

P.O. Box 10
Blue Ridge Summit, Pa. 17214

Please open my Trial Membership in ELECTRONICS BOOK CLUB and send me the 3 books circled below. I understand the cost of the books I have selected is only 99¢ each, plus a small shipping charge. If not delighted, I may return the books within 10 days and owe nothing, and have my Trial Membership cancelled. I agree to purchase at least four additional books during the next 12 months, after which I may cancel my membership at any time.

101	563/636	510/628	582	743
780/790	754	785	800	841
861	905	909	913	919	1010

Name _____ Phone _____

Address _____

City _____

State _____ Zip _____

(This offer valid for new Members only. Foreign and Canada add 10%.) T-68

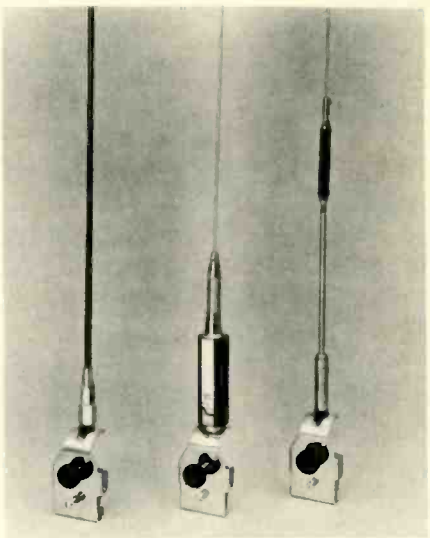
Circle No. 113 on Reader Inquiry Card

with connectors and a carrying case. There is room in the cases for storage of manuals, VSWR nomographs, and additional plug-in elements and connectors. Prices range from $280 to $465.

CB Antennas

Circle No. 163 on Reader Inquiry Card

A new series of gutter-mount CB antennas that are easily removed for theft protection is available now from *Channel Master*. Called the Perma-Quick antenna, the new models are removed with just the turn of a thumb screw. They



come with triple chrome-plated heavy duty steel mounts, 12 feet of low loss RG 58U coaxial cable with a PL 259 connector, a high capacitance stainless steel whip or tuning stub, and a weather-protected coil housing. Available in five models with prices starting at $21.95.

Instrument Probes

Circle No. 164 on Reader Inquiry Card

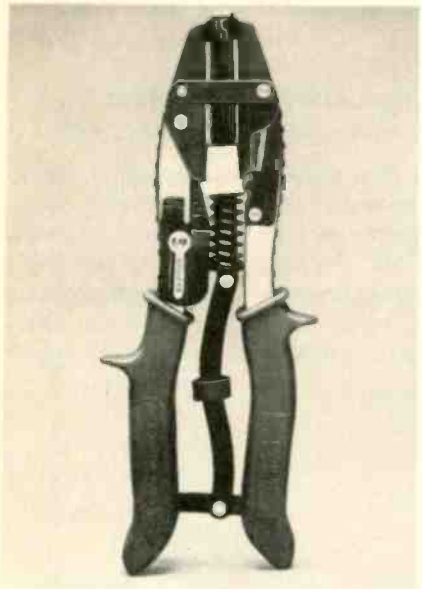
A new color-coded test instrument probe for instruments such as oscilloscopes and frequency counters to 100 MHz is new from *B&K-Precision*. Designated

Model PR-37, the new slim-body probe features a three-position switch that selects 10:1 or direct modes, or a reference position that grounds the tip through a nine-megohm resistor. The color-coding in gray or red allows the user to instantly identify the channel to which the probe is connected without tracing the cable length to the scope input jacks. Acessories included are a spring loaded retractable hooked tip, insulating tip, BNC tip-adapter, IC tip and insulated compensation capacitor adjustment tool. The two probes, which come in zippered vinyl cases, are priced at $38.50 each.

Wire Stripper

Circle No. 165 on Reader Inquiry Card

A new quadra-cut wire stripper with a built-in wire cutter and connector crimper is new from *Kemp Manufacturing*. To strip wire in a 2½ inch box or panel, insert the wire into the self centering knives on the front of the tool and

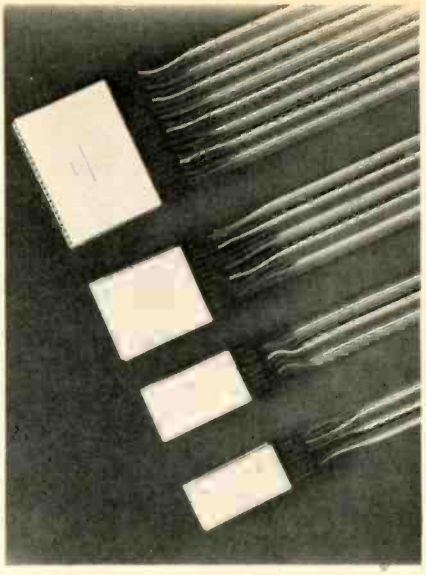


close the handles. It will handle all types of insulation including THHN, AMW, AF, TV, and THW, with O.D. of ½ inch or less. Called the Insuleater, the new tool is lightweight and fits easily into tool pouch or box.

IC Test Clips

Circle No. 166 on Reader Inquiry Card

IC test clips designed for safe handling of high-speed, low-power MOS ICs before installation have been introduced by *Continental Specialties*. The new clips, called Proto-Clips, clip gently onto DIP IC packages and bring their pin connections to the top end of the clip. Cable versions of the tool include a connecting cable preattached to the top or business



end of the clip. By attaching all leads at the far end of the cable to a good working ground, each IC pin is shorted to ground to eliminate the danger of static discharge. Available in 14-pin, 16-pin, 24-pin and 40-pin configurations. Unit quantity prices range from $7.75 to $21.75.

Frequency Synthesizer

Circle No. 167 on Reader Inquiry Card

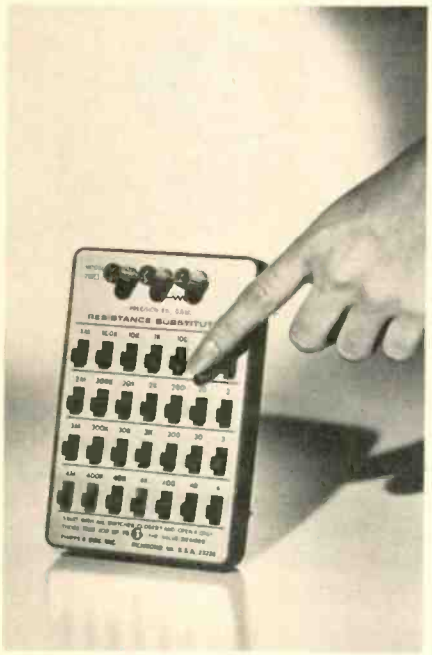
A new series of synthesized signal generators, designated Series 6000, has been introduced by *Comstron/Adret*. The series consists of two mainframes and numerous plug-ins. By interchanging plug-ins, the series can function as a frequency synthesizer, a signal

generator, or a spectrum analyzer. The frequency range, chosen from RF plug-ins, is from 300 Hz-110 MHz, 400 KHz-600 MHz, and 400 KHz-1.28 GHz. Resolution is 1 Hz, stability is ± 5 x 10-9 per day and modulation is AM-FM-PM, search and sweep.

Resistance Substitution Unit

Circle No. 168 on Reader Inquiry Card

A new slide-switch resistance substitution unit that combines pocket-size convenience with close tolerances and a range of over 11 million resistance steps is new from *Phipps & Bird*. Designated Model 236-A, the new unit features three binding posts, one to ground case. The

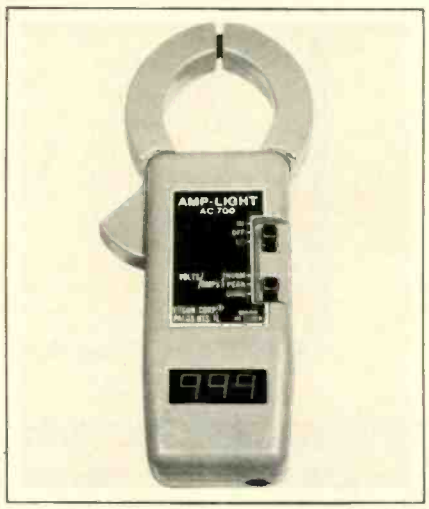


slide-switch unit uses one-half watt resistors with 1% tolerance, and gives an accurate range from 1 to 11, 111 , 110 ohms, in one-ohm steps. Size is 4 inches by 6 inches by 1-3/16 inches. Priced at $58.

Digital Volt/ohm/ammeter

Circle No. 169 on Reader Inquiry Card

A new digital clamp-on volt/ohm/ammeter designated the AC700 Amp-light, has been introduced by *ETCON Corp*. The new meter features advanced analog to digital conversion, enabling accuracy to within ± 2%, ± digit. It incorporates rectified average measuring circuitry which enables readings on half or full wave driven equipment. The instantaneous measurements of voltage and current surges is made possible with a special peak lock mode which allows the instrument to capture and hold the highest reading present. Amp-light is protected from severe overload or misapplication with a double-insulated chassis. The large jaw opening accommodates conductors up to 2 inches.



Solder/Desolder System

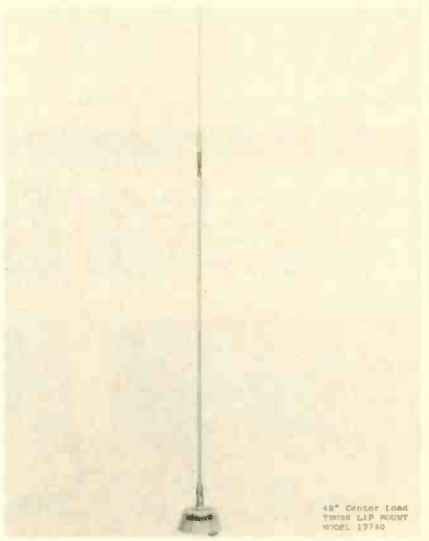
Circle No. 170 on Reader Inquiry Card

A new modular solder/desolder system, designed to place both solder and desoldering wick at the user's fingertips, has been introduced by *Chemtronics, Inc*. Designed Model SD5, the new device consists of a pound spool of MIL-spec solder with the desolder wick dispenser tool snapped into the core of the spool. The design of the desoldering tool allows it to retract or snap in or out of the solder spool. It also has a 2½ inch heat-resistant Teflon probe, permitting pinpoint wick application for densely-packed circuits. Solder provided is 16, 18 and 21 guage in the following alloys: 63/37, 60/40, 50/50, and 40/60.

CB Antennas

Circle No. 171 on Reader Inquiry Card

A complete new line of center-loaded CB mobile antennas with 48-inch masts is available from *Antenna Incorporated*. Designed to meet any application and fit any vehicle, the six new antennas feature a tuneable top whip for a VSWR of 1.5:1 or less. The line includes a trunk lip mount, a cowl mount, mirror mount, and is also available without mount. Each model features a stainless steel mast wrapped in a white vinyl jacket and weatherproofed, vinyl-clad loading coil. Included in 17 feet of RG-58/U coax cable with connectors.



Polyester Capacitors

Circle No. 172 on Reader Inquiry Card

New metallized polyester capacitors, described to be the "smallest possible size," have been introduced by *TRW Capacitors*. The new devices have capacitance values from 0.01 to 20 mfd. At 50 VDC, the company's new TYPE

X659F ranges in size from .125 inches by .230 inches by 7/16 inches for 0.47 mfd to .430 inches by .790 inches by 1½ inches for 20 mfd. The new products are suited for commercial and instrument applications where space requirements are critical. They use very thin gauges of metallized polyester. Prices start at 40 cents in production quantities. ET/D

Digital Voltmeters

continued from page 20

during a specified time interval.

We have covered the readout, so what's left in the counter? Basically the circuit consists of four flip-flops (bistable), as shown in Fig. 11. Flip flops have long been used as "divide by two circuits," or binary frequency dividers. In our case no signal processing is required, since the oscillator pulses have been shaped to the proper form, polarity, and amplitude to feed the flip flops directly. Each flip flop drives the next in the chain, giving us four output lines, representing—you guessed it—1s, 2s, 4s, and 8s!

Fig. 12 is a "Truth Table" which shows the output states of each of the four flip flops, for any number of input pulses from 0 to 9. If you think about it, we have encoded the pulses from the ADC into a four line, 1, 2, 4, 8 binary code with our flip flop "counter." And, we have done something more. If we stop feeding pulses into the flip flop, the flip flop will hold the count indefinitely, until reset. This is called "memory," and is very useful to us, since we want to hold the last voltage reading taken, until we take a new one.

Figure 13 is a block diagram of a basic DVM. At this point you should know what each block does, and why. And you should know all the strange new "buzz" words, like ADC, decoder, LCD, multiplexing, etc., which appear in non-entertainment electronics. ET/D

Troubleshooting

continued from page 33

If several gates switch on simultaneously, the current spike on the supply line is increased linearly with the number of gates. These spikes or glitches can easily trigger fast TTL circuits and then can destroy information stored in memory systems (proms, roms, rams, etc.). A glitch is an undesirable spike that is riding on a desired pulse signal.

Now, should the large filter, C2, become open, then a large spike will occur only when the pulse goes low, as shown in Fig. 23. Low is also referred to as 'Zero-0-' logic state. The correct pulse that should be found at the collector of Q2 is shown in Fig. 24. Should the small 50 pfd capacitor open up, you may see a very thin spike at the top of the pulses leading edge as shown in Fig. 25. These slim spikes are very hard to see, so you'll have to take a close look.

All of which proves the necessity of a very fast rise-time scope in working with today's electronics. ET/D

Test Instrument

continued from page 36

even though the total battery voltage drops. However, when the total battery voltage drops below the regulator voltage, the regulator will no longer be able to maintain it's proper level and the instrument will not properly perform its functions. To replace batteries, you remove the front panel.

The DBV-13 is also available in kit form for $74.95. ET/D

CLASSIFIED

RATES: 40 cents per word (minimum charge, $10). Bold face words or words in all capital letters charged at 50 cents per word. Boxed or display ads charged at $46 per column inch (one inch minimum). For ads using blind box number, add $5 to total cost of ad. Send ad copy with payment to: Dawn Anderson, ELECTRONIC TECHNICIAN/DEALER, 1 East First Street, Duluth, MN. 55802.

BOX NUMBER REPLIES: Mail box number replies to: ELECTRONIC TECHNICIAN/DEALER, Classified Ad Department, One East First Street, Duluth, MN 55802. Please include box number in address.

BUSINESS OPPORTUNITIES

OWN YOUR OWN SHOP. For as little as one month's house payment you can set up your own shop on Main Street. Let me show you how. Send $4.00 to: Bill's T.V., 1101 S. Main, Springfield, TN 37172. 6/78

TV sales and service shop, eastern New York, excellent ski country. 53 year old, one owner business. Owner must retire. Well stocked inventory, latest test equipment. FCC licensed technician will remain. Practically no competition. Appliance business adjoining available. Write ET/D Box 121. 7/78

T.V. Business for sale. 20 years in large shopping center in So. Fla. Zenith-Sony-RCA sales and rental service. Year round. Over $100,000 gross. Excellent opportunity. Write to Jeff Cohen, 19B Madeira Ave., Coral Gables, Fla. 33134. TF

TV AND STEREO SALES AND SERVICE BUSINESS FOR SALE. Authorized Zenith Warranty Service Center. Established over 20 years in major suburb of southern New Jersey. Includes all stock, merchandise, new modern equipment and customers. Three man shop with 2 trucks. Grosses $75,000 to $100,000 a year. Cherry Hill TV Service, 11 West Main Street, Maple Shade, NJ 08052. (609) 667-8881. 7/78

COMPUTER FUTURE—We are looking for qualified radio-television and electronic shops to handle our sales, service and supplies. We provide training and a protected area. S/D COMPUTER TECHNOLOGY, P.O. Box 1283, Albany, N.Y. 12201. 9/78

TV and appliance store and TV repair in beautiful foothill town in the California Sierra Nevada Mountains. Major brand franchises, great lease, fantastic opportunity. Call evenings (209) 736-4421. 6/78

MECHANICALLY INCLINED INDIVIDUALS—BUILD ELECTRONIC DEVICES IN YOUR HOME. GET STARTED IN YOUR SPARE TIME. $300 TO $600/WK POSSIBLE. EXPERIENCE NOT NECESSARY. WRITE FOR FREE LITERATURE. ELECTRONIC DEVELOPMENT LAB., BOX 1535 (B), PINELLAS PARK, FLA., 33565. TF

TV SALES & SERVICE—In same southern Oregon location for 19 years. Bldg. 1200 sq. ft. with full basement on 1 acre of land. Zenith dealership. Bldg, land, truck, and inventory $55,000.00. Write ETD, Box 117. 6/78

ELECTRONICS/AVIONICS EMPLOYMENT OPPORTUNITIES. Report on jobs now open. Details **FREE.** Aviation Employment Information Service, Box 240Y, Northport, New York 11768. 8/78

For sale: TV & electronics sales & service business. Retiring after 30 years serving Heart o' Lakes area. Top dealer lines. Building on main street with two bedroom apartment over. Write 609 N. Washington Ave., Detroit Lakes, MN. Phone (218) 847-9841. 6/78

ORLANDO, FLORIDA—T.V. Sales & Service Business, best location, $27,500. Excellent opportunity! Write Dorothy Phillips, Realtor-Associate, One Hundred Percent Real Estate, Inc. Realtor, 1881 Lee Road, Winter Park, Florida 32789. 6/78

BROADCAST STATION. Start your own, any type! Unique cable FM station requires no investment/experience. Receive free tapes, records. Learn how. Free details. "Broadcasting," Box 5516-ET6, Walnut Creek, CA 94596 8/78

HELP WANTED

TECHNICAL WRITER

Technical writer with strong managerial capabilities needed immediately. You must possess a strong background in state-of-the-art home entertainment and consumer electronics service areas. Location is a sportsman's paradise. Write ET/D Box 123. 6/78

INDUSTRIAL ELECTRONICS INSTRUCTOR. Teach theory and laboratory work. B.S. degree in Electrical Engineering. Master's degree preferable. Current industrial experience required. Teaching experience desirable. Position available September 1978. John C. Vander Molen, Acting Department Head, Ferris State College, Big Rapids, MI 49307. AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER. 8/78

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. 6/78

FOR SALE

LINEAR AMPLIFIER, 2-30 MHz, 150 watt solid state. **FREQUENCY COUNTER,** 300 MHz, 7 digit portable/mobile. **OMNIPOLARIZED BASE ANTENNAS** (CB-6M-2M). Construction plans $3.00 each. $7.50/all. Others! Catalog with order. **PANAXIS** Productions, Box 5516-ET6. Walnut Creek, CA 94596 8/78

THERE'S NO NEED TO BUY ORIGINAL JAPANESE TRANSISTORS WHEN OUR REPLACEMENTS WILL DO THE JOB of many original types. Phyltron's LX123A replaces over 50 Japanese types in our catalog. Don't tie yourself up with excessive inventory, buy Phyltron Electronics replacement transistors and save.

Write for free catalog. One year unconditional guarantee. Phyltron Electronics, 487 Springfield Ave., Summit, NJ 07901. TF

Save hundreds: dependable, quality Head-Ends, V/V, U/V Converters, Camera Modulators. Factory prices. Send $5.00 (or business card). "Information," Box 809, Boynton Beach, FL 33435. 12/78

WHY PAY MORE? Now buy an original part # (Japanese or American type) for your **ECG, SK, GE, WORKMAN or HEP** transistor needs for 35% to 55% off regular dealer net price. Contact us with your needs and quantities used now and we will quote you immediately. Discounts vary with quantities used.

Bescor, 547 S. Broadway, Hicksville, NY 11801 (516) 822-3988 7/78

DIRECT ECG REPLACEMENTS

AR Semiconductors replace all ECG transistors and IC's at 50% below regular cost. One year unconditional guarantee. These are all top of the line solid state devices. To order, send in the ECG number and your AR replacement will be promptly shipped. Minimum order $15.00, add $1.00 UPS.

AR SEMICONDUCTORS
P. O. BOX 976
UNION, NJ 07083 TF

Selling early Sams' Photofacts; Rider radio and television manuals. Rider's Volume 1 through 5 (abridged), $39. Supreme and various factory manuals. Write: Lawrence Beitman, Box 46, Highland Park, IL. 60035. 6/78

TV-117 NPN same as ECG-196 90 V 7 Amp 50 watt better repl for SK-3054 GE-66 .75—TV-116 PNP complement .75—AC-100 NPN TO-3 case same as ECG-283 excellent vert defl repl 800 V 15 Amp 100 watt 2.95—2SC1172 Hor output same as ECG-165 ECG-238 121-831 121-1015 SK3115 GE-38 3.99—2SC685A NPN TO-66 repl ECG-124 GE-12 SK-3021 .75—Varo tripler-excellent repl for 221-128 32-33057-4 14.95—Zenith tripler 212-139 8.95. David Sims Enterprises, Inc., 665 E. Jericho Turnpike, Huntington Station, NY 11746. 8/78

TUBES—Receiving, Industrial and Semiconductors, factory boxed. Free price list. Low, low prices. **TRANSLETERONIC INC.** 1365-39th Street, Brooklyn, N.Y. 11218E 800-221-5802, 212-633-2800. 4/79

BUGGING & WIRETAPPING is a growing public concern. Are you equipped to answer your customers' questions—and get your share of the 'de-bugging' profits? 'ELECTRONIC SPYING' is the most simplified and comprehensive book ever written on the subject of electronic surveillance, and will tell you all you need to know. Order direct from publisher for only $7.95: MENTOR PUBLICATIONS, Dept. 120, 135-53 No. Blvd., Flushing, N.Y. 11354. 7/78

FREE MONTHLY LISTING of IC's, transistors, regulators, opamps at super savings e.g. SN7400-.08, 2N2222A-.08, LM309K-.50, LM709C-.13. Many, many more great buys. Write us to be put on our monthly m/l. Industrial Semiconductors Inc., 97 Rantoul St., Beverly, MA 01915. 9/78

ELECTRONIC BARGAINS, CLOSEOUTS, SURPLUS! Parts, equipment, stereo, industrial, educational. Amazing values! Fascinating items unavailable in stores or catalogs anywhere. Unusual FREE catalog. ETCO-013, Box 762, Plattsburgh, NY 12901. TF

GENUINE SONY SEMICONDUCTORS—CHECK THESE PRICES!!
EG. 1-9/ 10-24—SG613-8.50/7.30-SID 30-15 2.60/2.30, -2SC867A 5.10/4.90-2SC1114 5.50/4.80-2SC1358 6.50/5.70, -2SC1124 1.50/1.30-2SC634A 0.45/0.41. Contact us for complete list of Japanese semiconductors and pricing information. Bescor, 547 S. Broadway, Hickville, NY 11801 (516) 822-3988 7/78

TV AND RADIO TUBES .36¢ EA!! Send for free color parts catalog. Your order free if not shipped in 24 hours. Cornell Electronics 4215-17 University San Diego California 92105. TF

Who's buying mixed older OEM parts? Older test equipment? Sams? Older tubes? We are liquidating a $100,000 cost parts inventory. List available. Write Box 122, ET/D. 6/78

REPLACEMENT COLOR YOKES-DEALERS ONLY. Zenith 95-2501-2532-2638-2667-S89633 etc. $16.95. Magnavox 361380-1 $18.95 etc. Sylvania, G.E. etc. $14.95 to $19.95. Request for price list on your letterhead. David Sims Enterprises, Inc., 665 Jerricho Turnpike, Huntington Station, N.Y. 11746 TF

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¢ P&H. Century American Instruments, Dept. 616 Box 1014, Placentia, CA 92670. 6/78

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, TX 79105. 7/78

TRANSISTOR REPLACEMENT. PHYLTRON ELECTRONICS LX REPLACEMENT LINE REPLACES THE MOST POPULAR REPLACEMENT TYPES AT OR BELOW DISTRIBUTOR COST. One year unconditional guarantee. Buy direct and save. Write for free catalog. Phyltron Electronics, 487 Springfield Ave., Summit, N.J. 07901. TF

REPAIR TV TUNERS-High earnings, Complete Course Details, 12 Repair Tricks, Many Plans, Two lessons, all for $2. Refundable. Frank Bocek, Box 3236, Ent., Redding, CA 96001. T/F

SEEKING ORIGINAL JAPANESE TRANSISTORS, IC, FET AND DIOES FOR CB AND STEREO REPAIR? See our full page ad in this issue. ORDER TOLL FREE. Write or call for our complete price list and compare prices. FUJI-SVEA ENTERPRISE, Dept. ET, P.O. Box 40325, Cincinnati, OH 45240. 6/78

WANTED

PICTURE TUBE MACHINE
We buy and sell NEW AND USED CRT rebuilding machinery. COMPLETE TRAINING. Buy with CONFIDENCE from the ORIGINAL MFGR. For complete details, send name, address and zip code to:

LAKESIDE INDUSTRIES
3520 W. Fullerton Ave., Chicago, IL 60647
Phone: 312-342-3399

ALARM SYSTEMS

DON'T PURCHASE any burglar-fire alarm equipment before getting our free value packed catalog. Super savings on Dialers, master controls, infrared detectors, wireless Automatic panic buttons and much more. No shipping charges. Sasco, 5619-E. St. John, Kansas City, MO 64123. (816) 483-4612. 6/78

send a message...
...write here.

1. Number of insertions: (circle) 1 2 3 6 12
2. Start with (month) _____ issue (Copy must be in by 1st of month preceding)
3. Amount enclosed: $_____.

PAYMENT MUST ACCOMPANY ORDER. WE'LL BILL RATED FIRMS.

NAME_____ COMPANY_____

STREET_____

CITY_____ STATE_____ ZIP_____

MAIL AD COPY TO: DAWN ANDERSON, ELECTRONIC TECHNICIAN/DEALER, 1 EAST FIRST STREET, DULUTH, MN. 55802.

RATES: 40 cents per word(minimum charge, $10). Bold face words or words in all capital letters charged at 50 cents per word. Boxed or display ads charged at $46 per column inch (one inch minimum). For ads using blind box number, add $5 to total cost of ad.

ET/D Classified

READER SERVICE INDEX

ADVERTISER'S INDEX

This index is furnished for the readers' convenience. However, the publisher can not guarantee its accuracy due to circumstances beyond our control.

ET/D TEKFAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

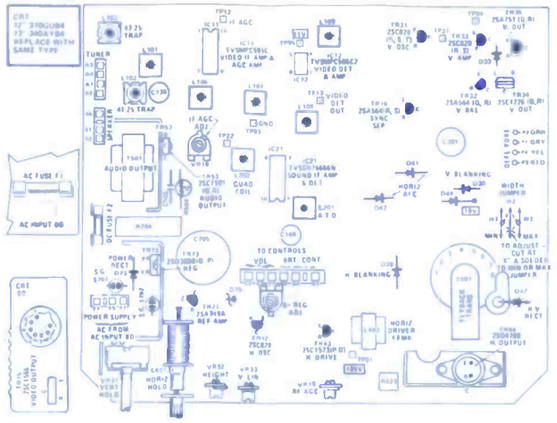
	SCHEMATIC NUMBER		SCHEMATIC NUMBER
GENERAL ELECTRIC Color TV Chassis CQB7400 WD	1747	QUASAR Color TV Chassis TS-961	1748
QUASAR B/W Chassis 12, 13TS-484	1745	ZENITH Color TV Chassis 17HC55	1746

1745

QUASAR

B/W Chassis
12,13TS-484

JUNE • 1978



Transistor and Control Locations

NOTES:
UNLESS OTHERWISE SPECIFIED; CAPACITOR VALUES LESS THAN 1 ARE MF, ALL OTHERS ARE PF. RESISTORS ARE 1/4, 1/2W UNLESS SPECIFIED.

VOLTAGE MEASUREMENTS
1. TAKEN FROM POINT INDICATED TO CHASSIS WITH A VTVM. +20%.
2. LINE VOLTAGE MAINTAINED AT 122V AC.
3. TAKEN WITH ALL CONTROLS AT NORMAL OPERATION.
4. WHERE TWO VOLTAGES SHOWN
AIR SIGNAL (tuner in strong channel)
NO SIGNAL (tuner in between channels)
ant. term. shorted, mid. noise)

WAVEFORM MEASUREMENTS
1. TAKEN FROM POINT INDICATED TO CHASSIS WITH A WIDE-BAND OSCILLOSCOPE.
2. OSCILLOSCOPE SYNCED NEAR SWEEP RATE INDICATED.
3. TAKEN WITH AIR SIGNAL. ALL CONTROLS AT NORMAL OPERATION.

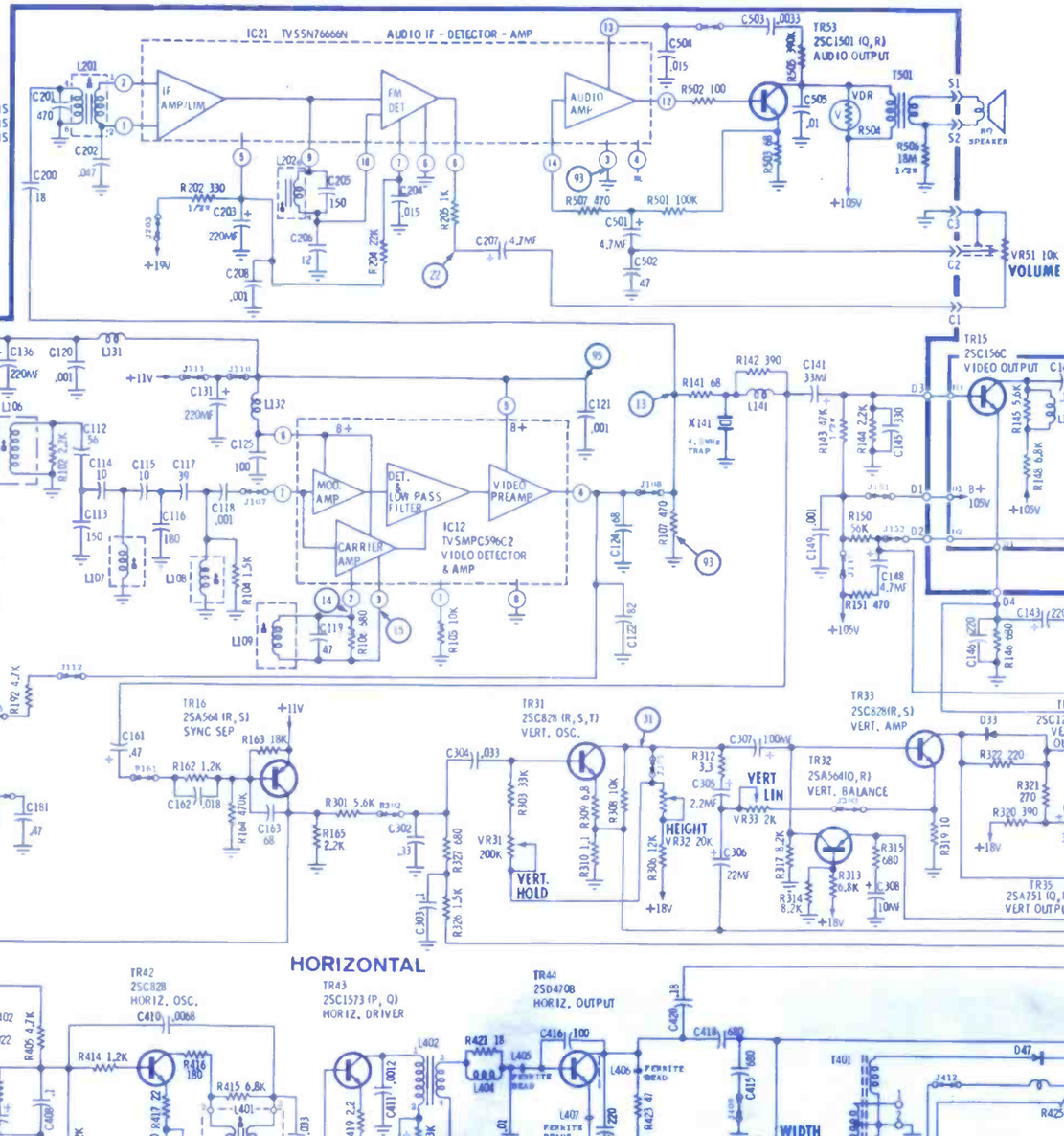
INDICATES ON PANEL JUMPER.
INDICATES PANEL TEST POINT.

SERVICE TECHNICIAN: IMPORTANT NOTE

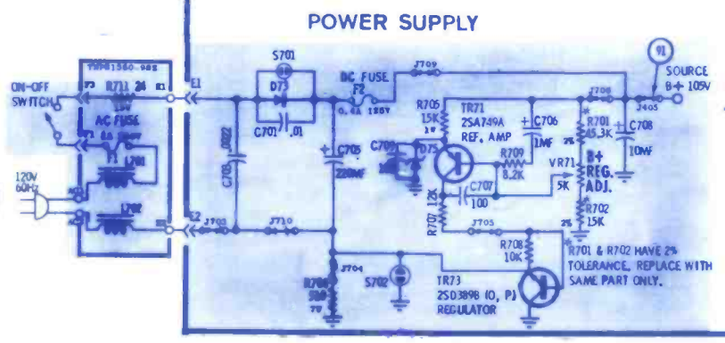
THIS RECEIVER HAS BEEN DESIGNED TO MEET OR EXCEED APPLICABLE SAFETY AND X-RADIATION PROTECTION AS SPECIFIED BY GOVERNMENT AGENCIES AND INDEPENDENT TESTING LABORATORIES.

TO MAINTAIN ORIGINAL PRODUCT SAFETY DESIGN STANDARDS, RELATIVE TO X-RADIATION, SHOCK AND FIRE HAZARD, THE PARTS SHOWN IN THE SHADED AREAS OF THIS SCHEMATIC MUST BE REPLACED WITH IDENTICAL REPLACEMENT PART NUMBERS SHOWN IN THE REPLACEMENT PARTS LIST OF THE SERVICE MANUAL.

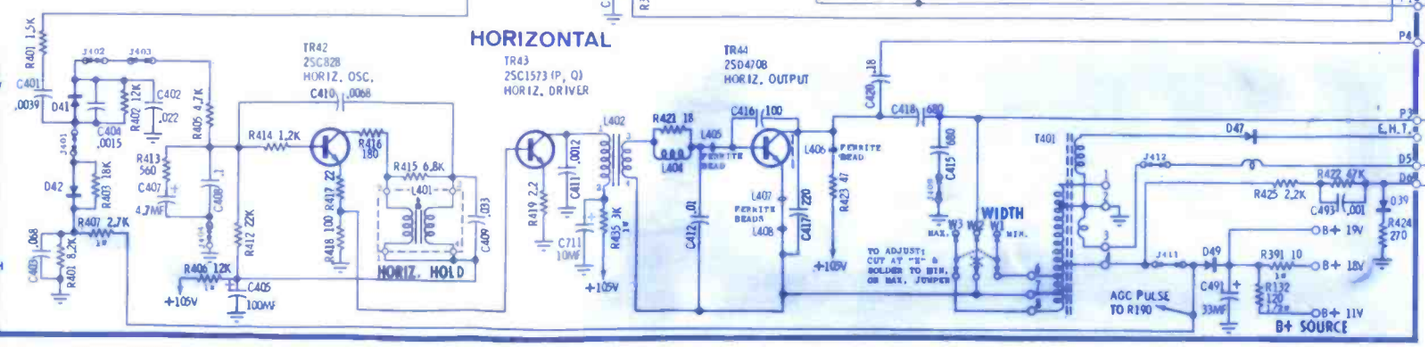
FOR OPTIMUM PERFORMANCE AND RELIABILITY, ALL OTHER PARTS SHOULD BE REPLACED WITH COMPONENTS HAVING IDENTICAL SPECIFICATIONS.



POWER SUPPLY



HORIZONTAL



1746

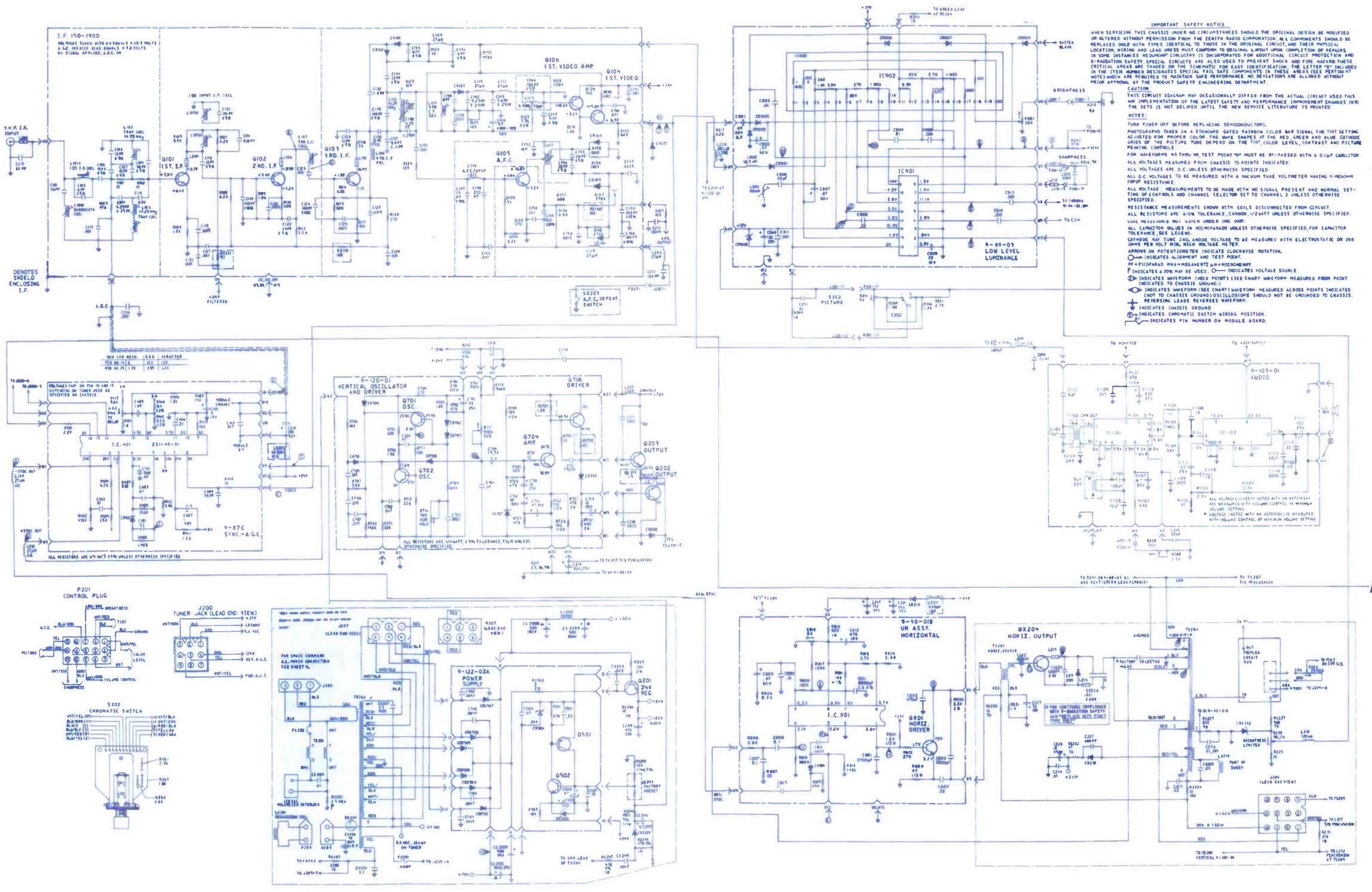
ZENITH

Color TV Chassis
17HC55

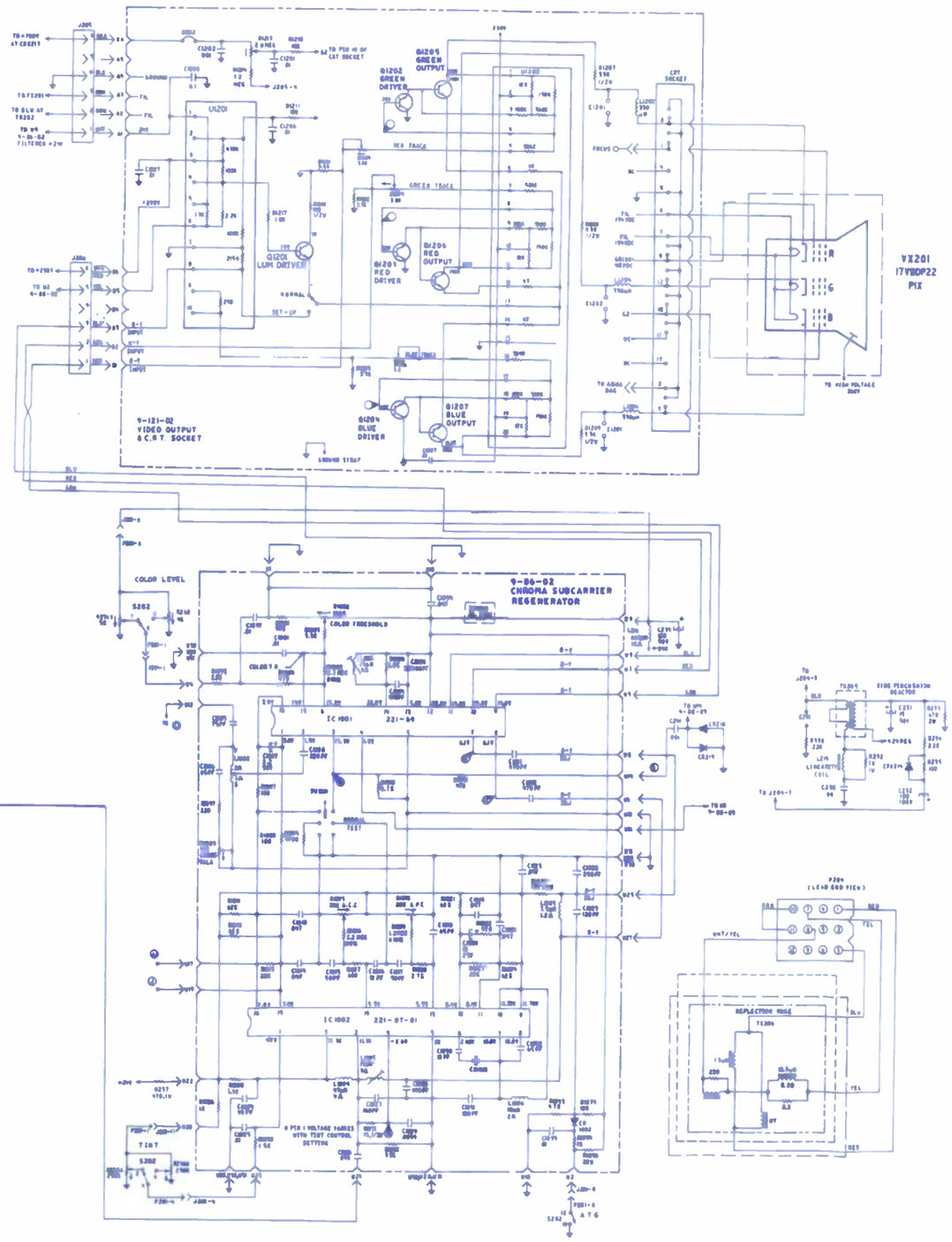
ET/D TEKFAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

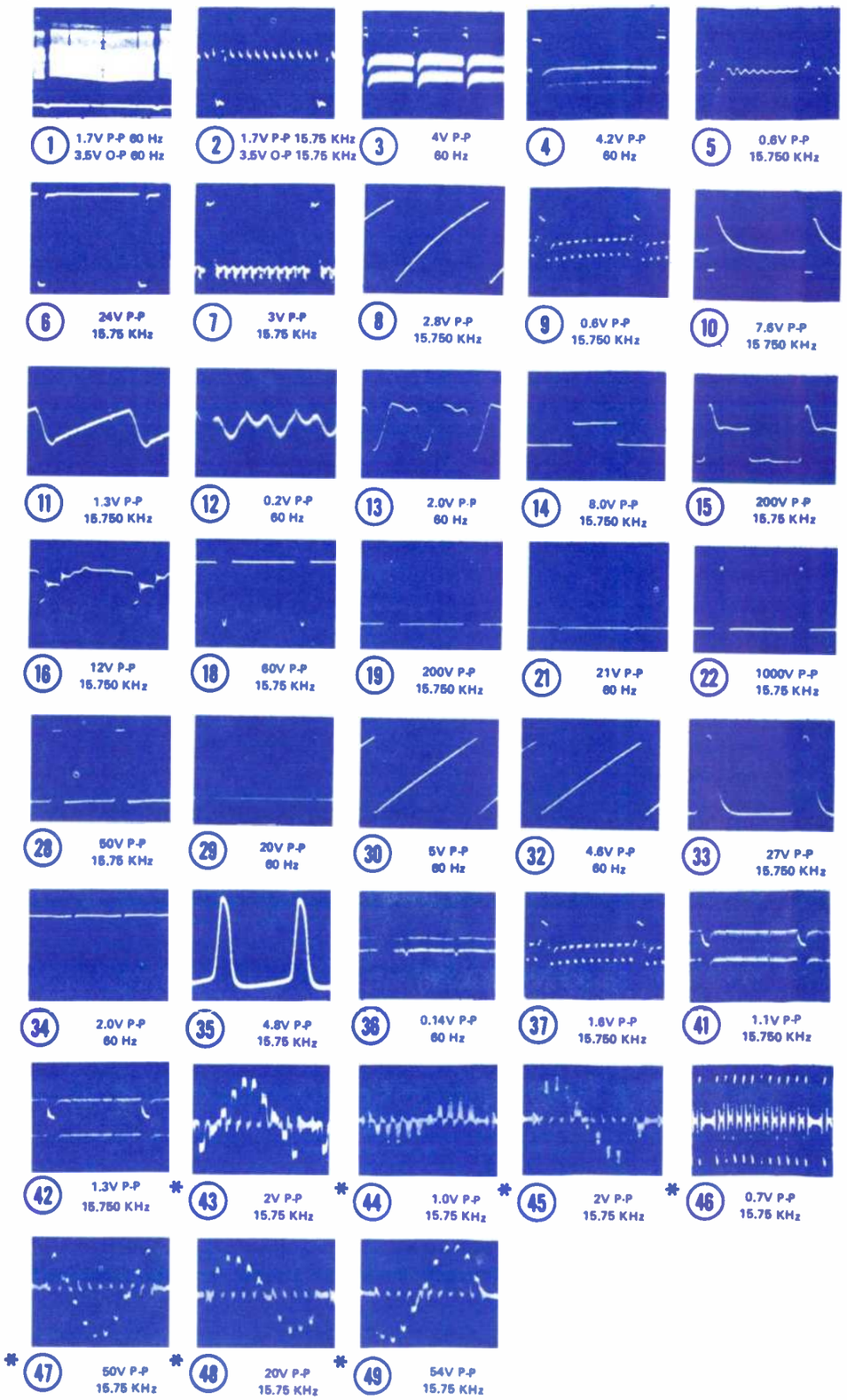
JUNE • 1978



ZENITH
Color TV Chassis
17HC55



*** FOR WAVEFORMS 43 THROUGH 49, BYPASS TEST POINT "D" WITH 1.0 MF CAPACITOR.**



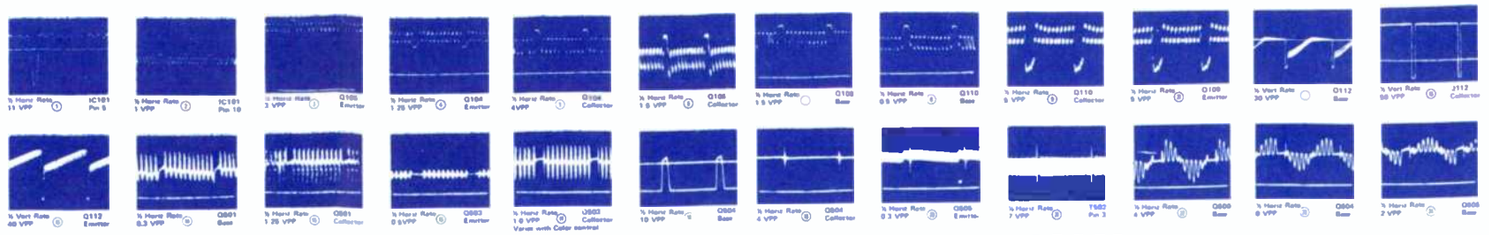
1747

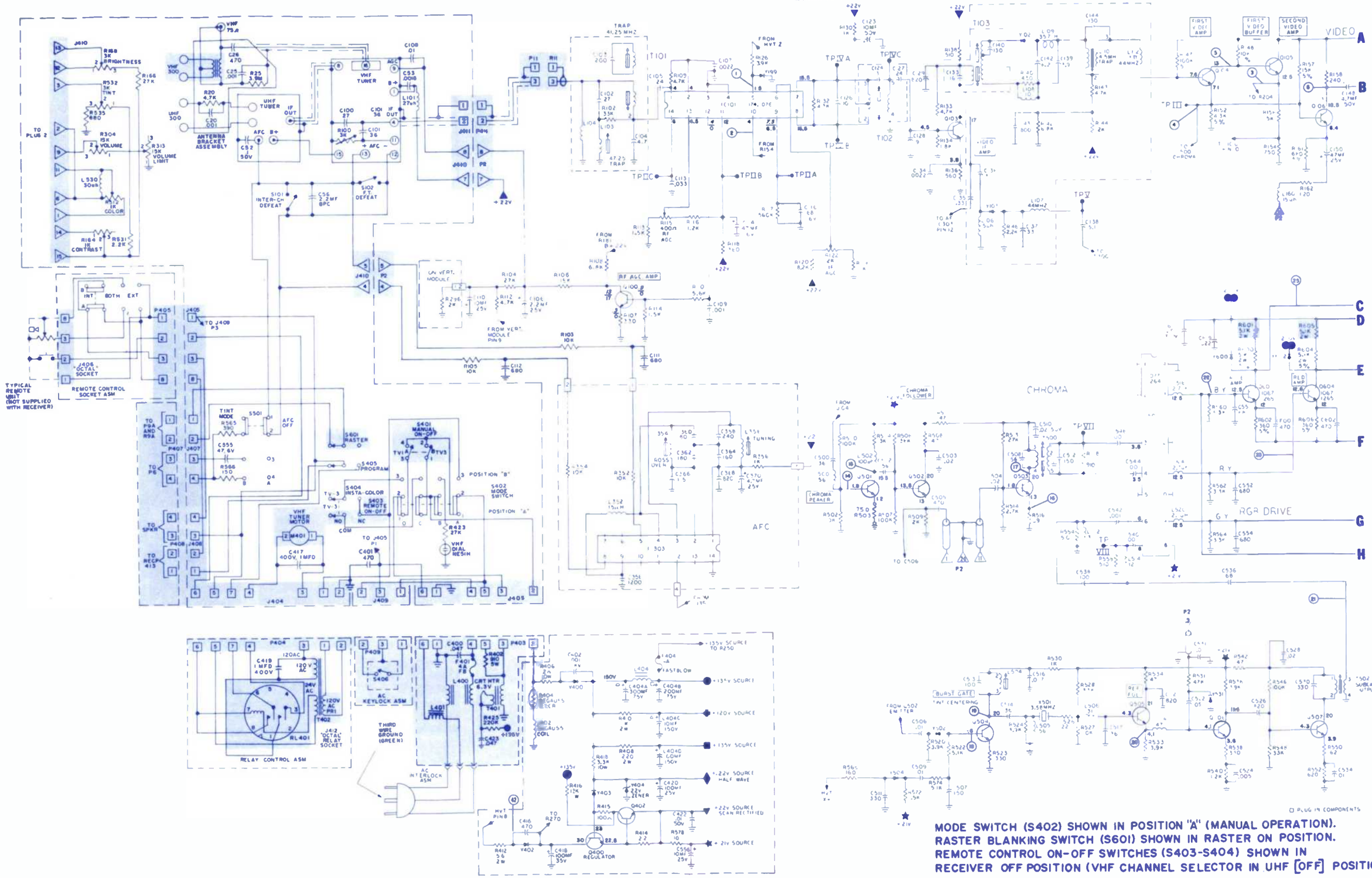
G.E.
Color TV Chassis
CQB-7400-WD

JUNE • 1978

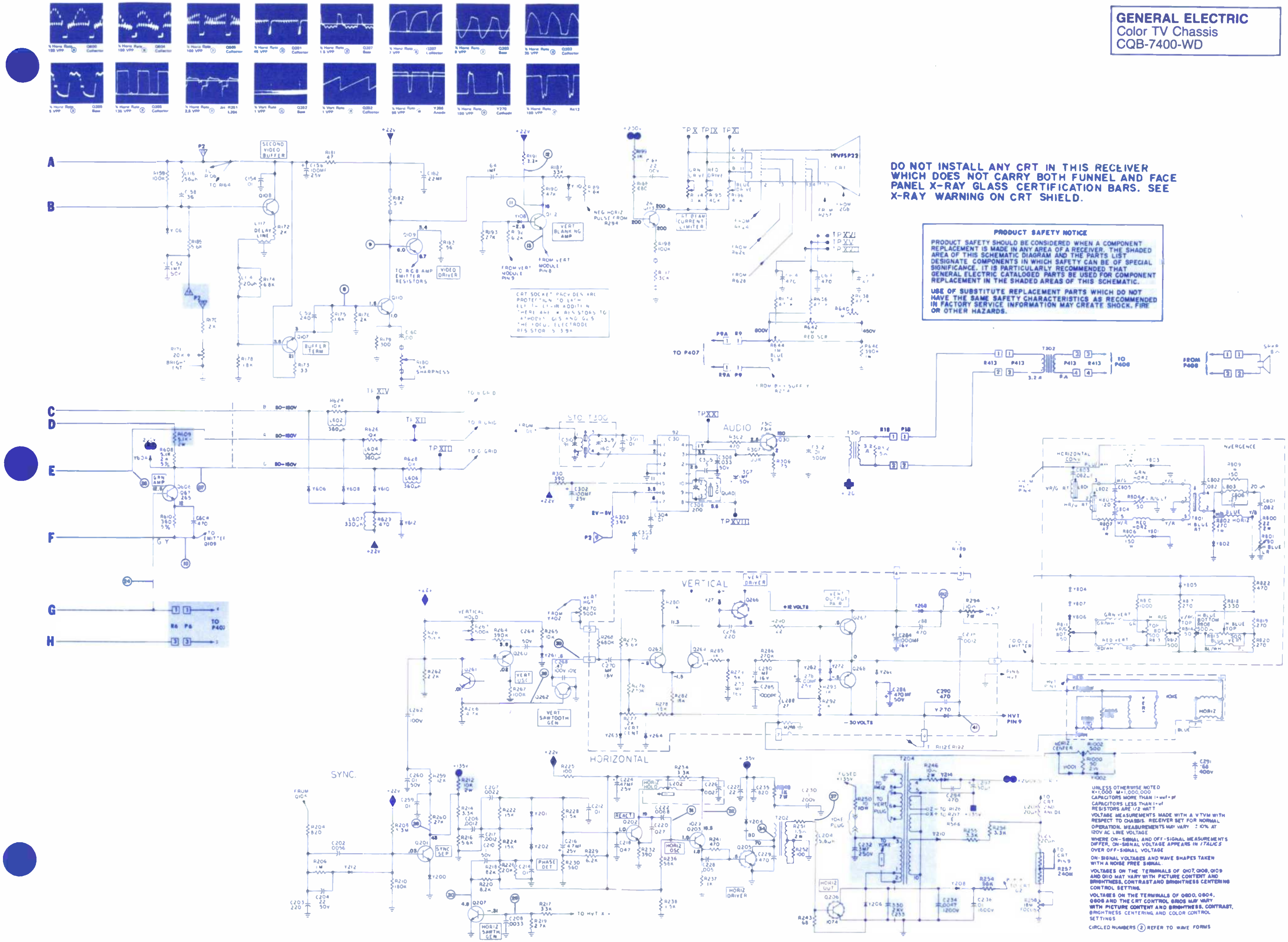
ET/D TEKFAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS





GENERAL ELECTRIC
Color TV Chassis
CQB-7400-WD



DO NOT INSTALL ANY CRT IN THIS RECEIVER WHICH DOES NOT CARRY BOTH FUNNEL AND FACE PANEL X-RAY GLASS CERTIFICATION BARS. SEE X-RAY WARNING ON CRT SHIELD.

PRODUCT SAFETY NOTICE

PRODUCT SAFETY SHOULD BE CONSIDERED WHEN A COMPONENT REPLACEMENT IS MADE IN ANY AREA OF A RECEIVER. THE SHADED AREA OF THIS SCHEMATIC DIAGRAM AND THE PARTS LIST DESIGNATE COMPONENTS IN WHICH SAFETY CAN BE OF SPECIAL SIGNIFICANCE. IT IS PARTICULARLY RECOMMENDED THAT GENERAL ELECTRIC CATALOGED PARTS BE USED FOR COMPONENT REPLACEMENT IN THE SHADED AREAS OF THIS SCHEMATIC.

USE OF SUBSTITUTE REPLACEMENT PARTS WHICH DO NOT HAVE THE SAME SAFETY CHARACTERISTICS AS RECOMMENDED IN FACTORY SERVICE INFORMATION MAY CREATE SHOCK, FIRE OR OTHER HAZARDS.

UNLESS OTHERWISE NOTED
K=1,000 M=1,000,000
CAPACITORS MORE THAN 1=uuf=pf
CAPACITORS LESS THAN 1=uf
RESISTORS ARE 1/2 WATT

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

WHERE ON-SIGNAL AND OFF-SIGNAL MEASUREMENTS DIFFER, ON-SIGNAL VOLTAGE APPEARS IN *ITALICS* OVER OFF-SIGNAL VOLTAGE

ON-SIGNAL VOLTAGES AND WAVE SHAPES TAKEN WITH A NOISE FREE SIGNAL.

VOLTAGES ON THE TERMINALS OF Q107, Q108, Q109 AND Q110 MAY VARY WITH PICTURE CONTENT AND BRIGHTNESS, CONTRAST AND BRIGHTNESS CENTERING CONTROL SETTING.

VOLTAGES ON THE TERMINALS OF Q600, Q604, Q606 AND THE CRT CONTROL GRIDS MAY VARY WITH PICTURE CONTENT AND BRIGHTNESS, CONTRAST, BRIGHTNESS CENTERING AND COLOR CONTROL SETTINGS

CIRCLED NUMBERS (2) REFER TO WAVE FORMS

1748

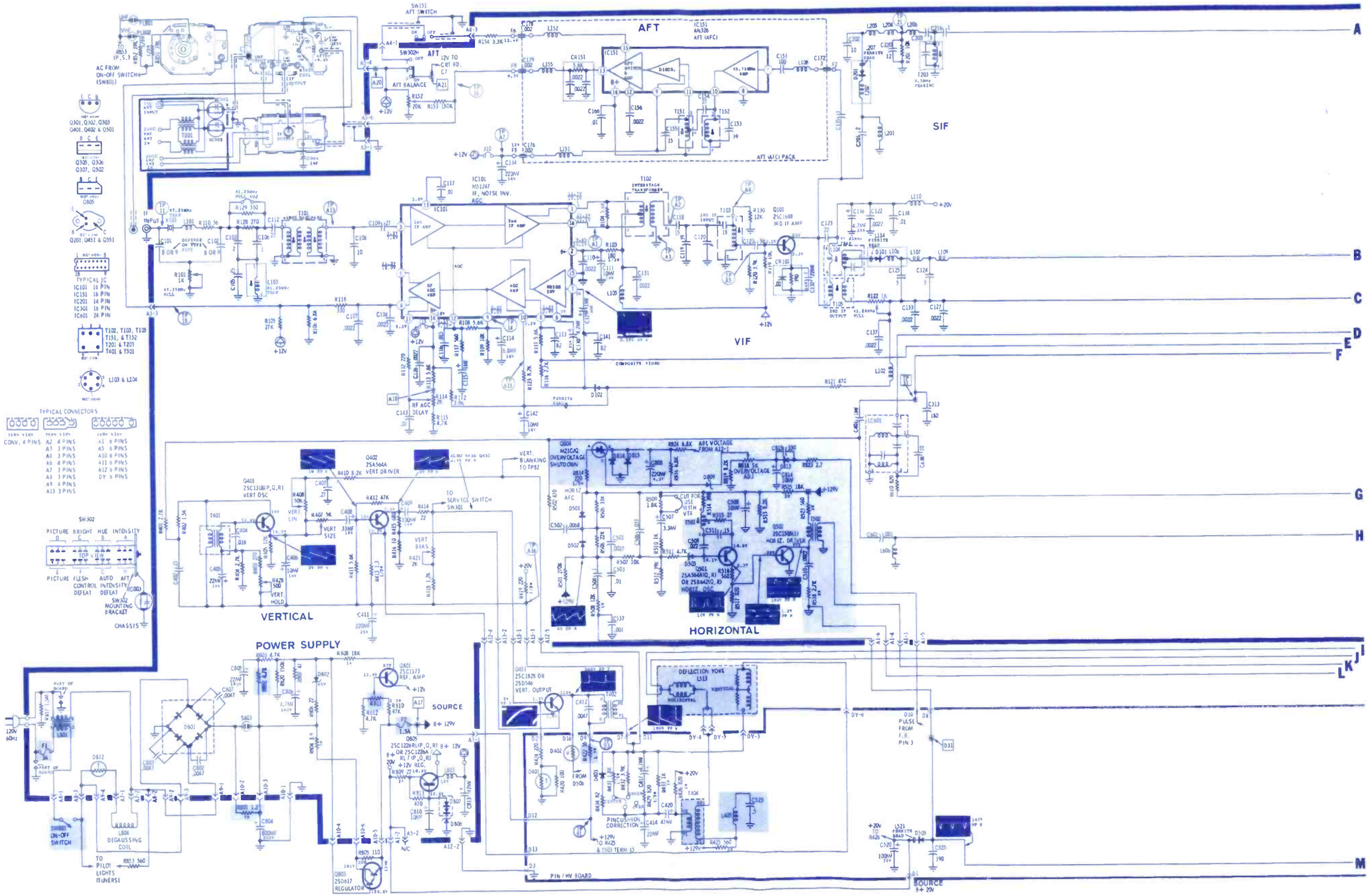
QUASAR

Color TV Chassis
TS-961

ET/D TEKFAX

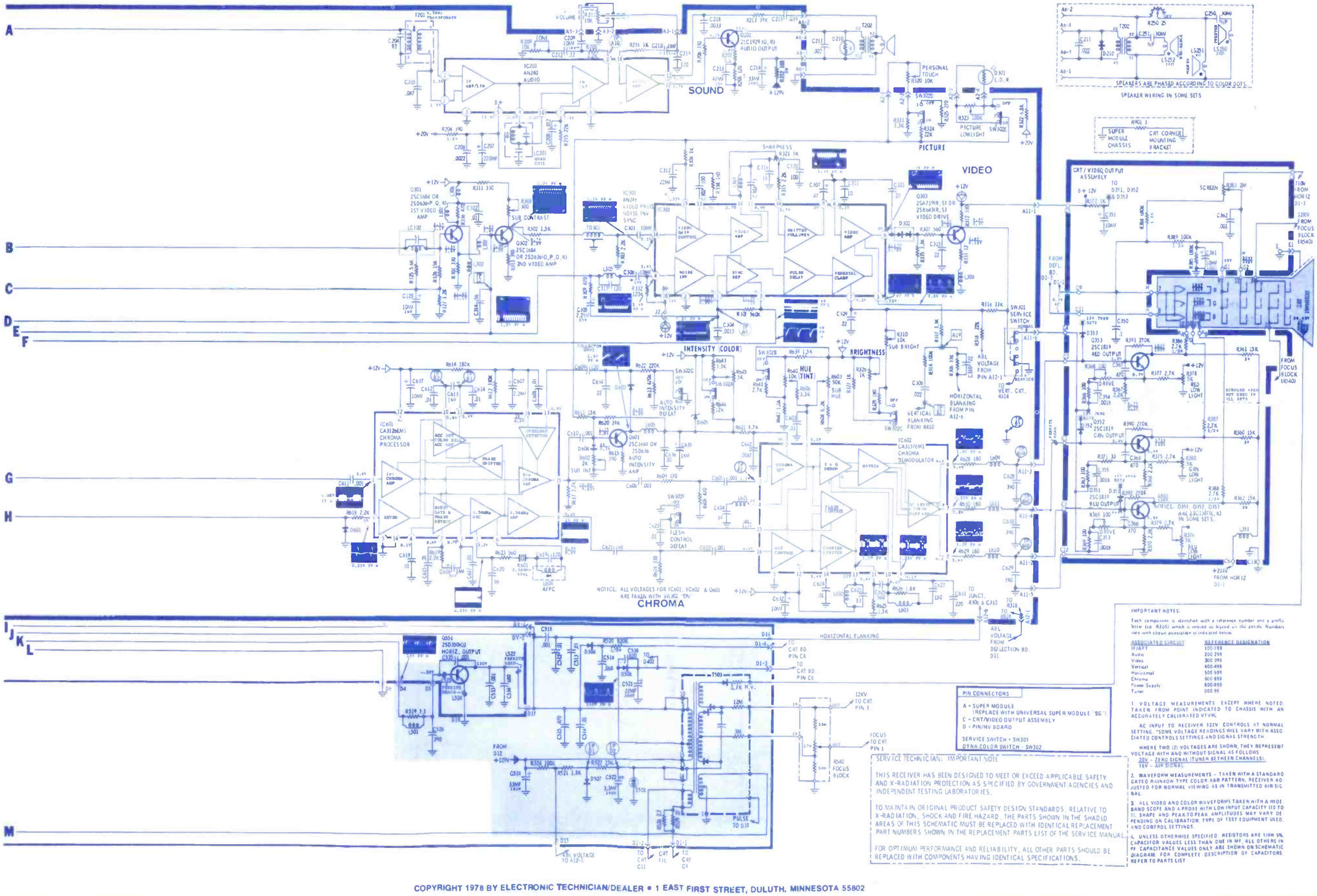
COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

JUNE • 1978



ADDITIONAL INFORMATION
NEXT PAGE

QUASAR
Color TV Chassis
TS-961



SERVICE TECHNICIAN: IMPORTANT NOTE

THIS RECEIVER HAS BEEN DESIGNED TO MEET OR EXCEED APPLICABLE SAFETY AND X-RADIATION PROTECTION AS SPECIFIED BY GOVERNMENT AGENCIES AND INDEPENDENT TESTING LABORATORIES.

TO MAINTAIN ORIGINAL PRODUCT SAFETY DESIGN STANDARDS RELATIVE TO X-RADIATION, SHOCK AND FIRE HAZARD, THE PARTS SHOWN IN THE SHADED AREAS OF THIS SCHEMATIC MUST BE REPLACED WITH IDENTICAL REPLACEMENT PART NUMBERS SHOWN IN THE REPLACEMENT PARTS LIST OF THE SERVICE MANUAL.

FOR OPTIMUM PERFORMANCE AND RELIABILITY, ALL OTHER PARTS SHOULD BE REPLACED WITH COMPONENTS HAVING IDENTICAL SPECIFICATIONS.

IMPORTANT NOTES:

Each component is identified with a reference number and a prefix letter (e.g. R201) which is related to board on the parts. Numbers vary with circuit association as indicated below:

ASSOCIATED CIRCUIT	REFERENCE DESIGNATION
IF/AFT	100-199
Audio	200-299
Video	300-399
Vertical	400-499
Horizontal	500-599
Chroma	600-699
Power Supply	800-899
Tuner	000-99

1. VOLTAGE MEASUREMENTS EXCEPT WHERE NOTED TAKEN FROM POINT INDICATED TO CHASSIS WITH AN ACCURATELY CALIBRATED VTVM.

AC INPUT TO RECEIVER 122V. CONTROLS AT NORMAL SETTING. *SOME VOLTAGE READINGS WILL VARY WITH ASSOCIATED CONTROLS SETTINGS AND SIGNAL STRENGTH.

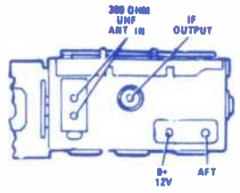
WHERE TWO (2) VOLTAGES ARE SHOWN, THEY REPRESENT VOLTAGE WITH AND WITHOUT SIGNAL AS FOLLOWS
20V - ZERO SIGNAL (TUNER BETWEEN CHANNELS).
16V - AIR SIGNAL

2. WAVEFORM MEASUREMENTS - TAKEN WITH A STANDARD GATED RAINBOW TYPE COLOR BAR PATTERN. RECEIVER ADJUSTED FOR NORMAL VIEWING AS IN TRANSMITTED AIR SIGNAL.

3. ALL VIDEO AND COLOR WAVEFORMS TAKEN WITH A WIDE BAND SCOPE AND A PROBE WITH LOW INPUT CAPACITY (10 TO 1). SHAPE AND PEAK-TO-PEAK AMPLITUDES MAY VARY DEPENDING ON CALIBRATION, TYPE OF TEST EQUIPMENT USED, AND CONTROL SETTINGS.

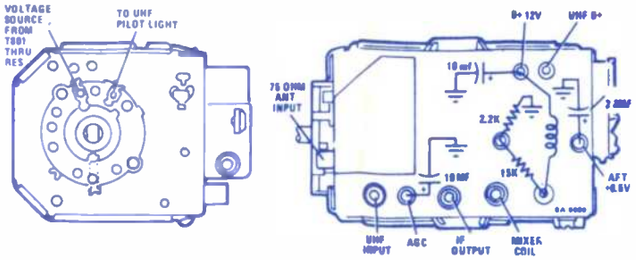
4. UNLESS OTHERWISE SPECIFIED: RESISTORS ARE 1/4W 5%. CAPACITOR VALUES LESS THAN ONE IN MF, ALL OTHERS IN PF. CAPACITANCE VALUES ONLY ARE SHOWN ON SCHEMATIC DIAGRAM. FOR COMPLETE DESCRIPTION OF CAPACITORS, REFER TO PARTS LIST.

QUASAR
Color TV Chassis
TS-961

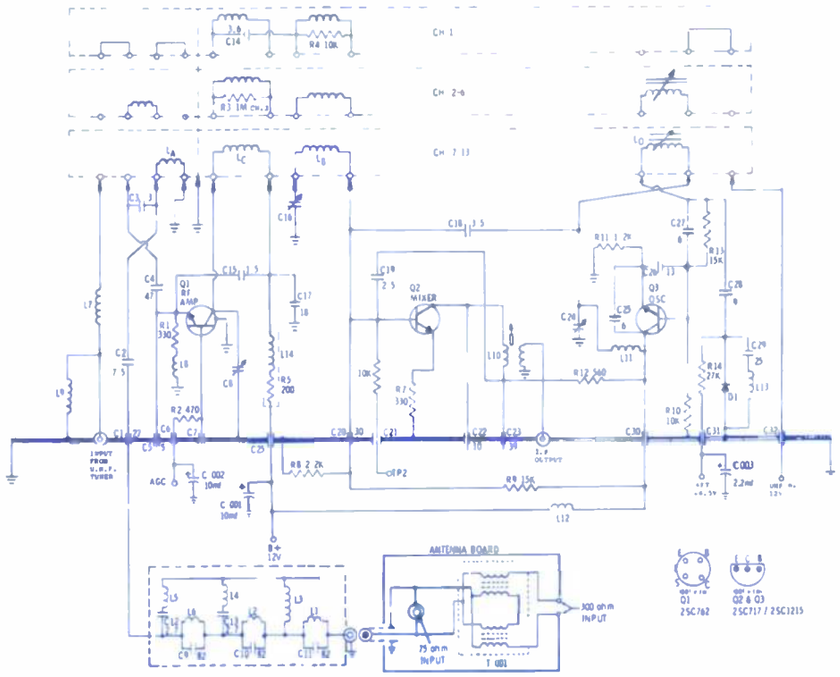


UHF Tuner Terminal Detail FTT-680

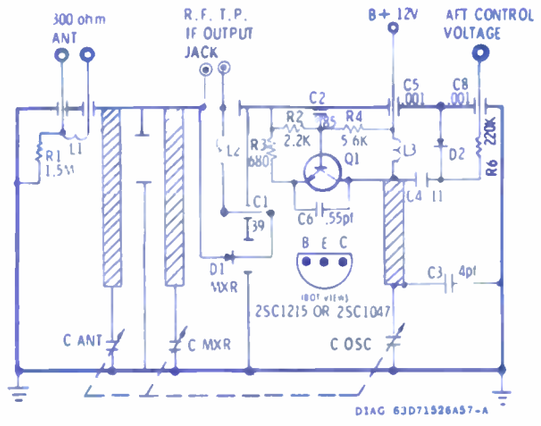
TUNER SERVICE INFORMATION



VHF Tuner Terminal Detail MCPTT-479

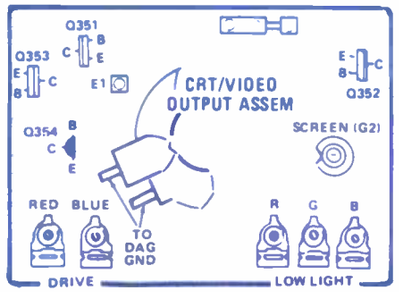


VHF Tuner MCPTT-479 – Schematic Diagram



UHF Tuner FTT-680 – Schematic Diagram

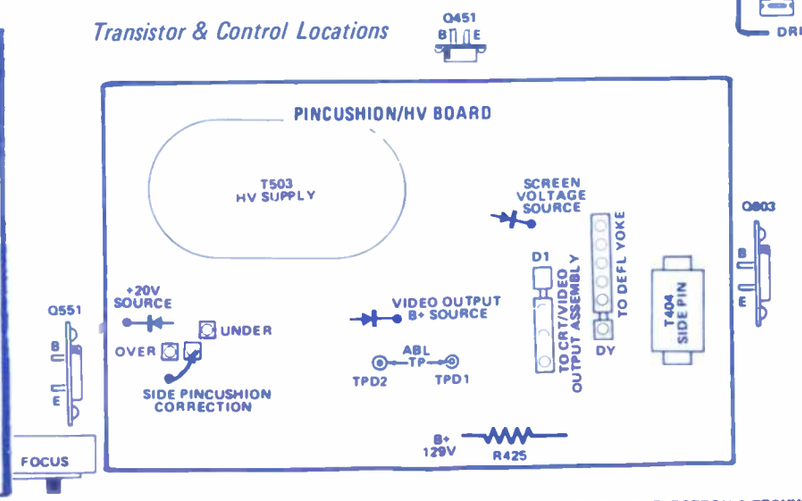
PIN CONNECTOR LEGEND
A = MAIN PANEL
C = CRT/VIDEO OUTPUT ASSEM
D = PIN/HV BOARD



PINCUSHION/HV BOARD

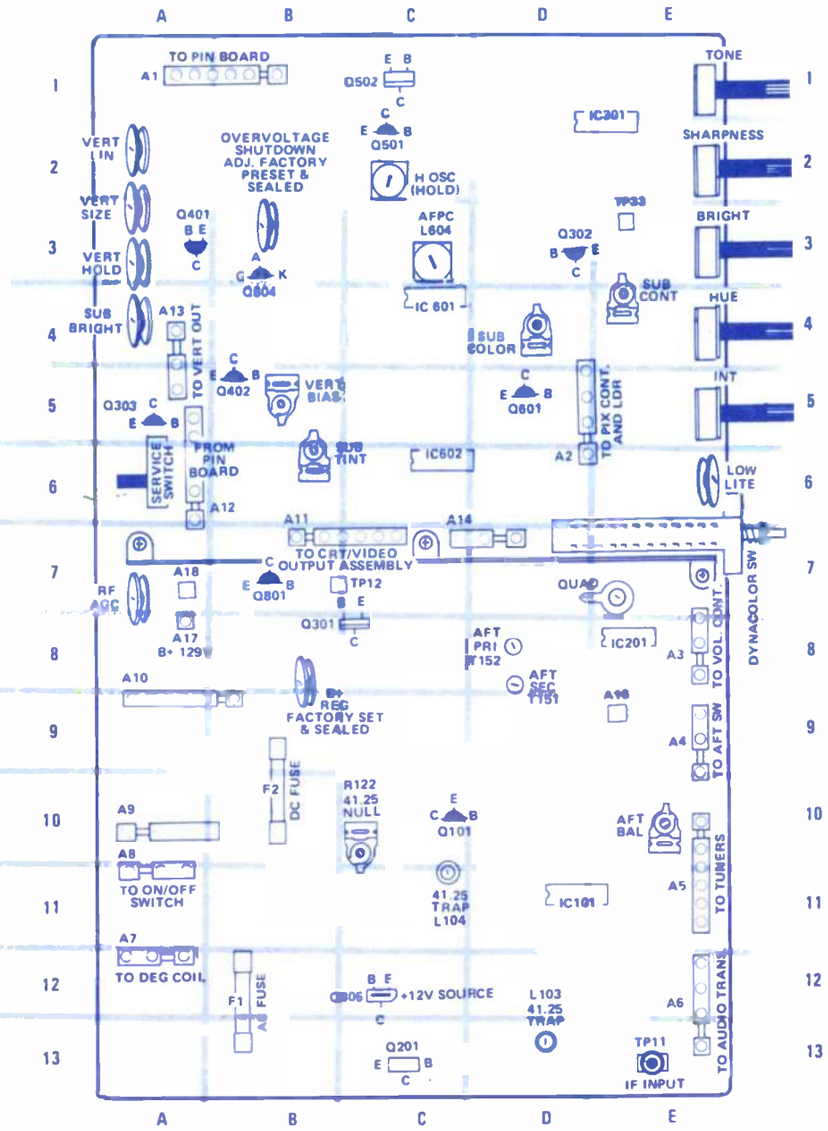
POINT	CONNECTS TO
D1 (single pin)	A1-2
D1 (multipin)	CRT Board
D2	Q451-B, A13-1
D3	A12-2 (Gnd)
D4	A1-3
D5	Q551-B
D6	A1-4 (Gnd)
D7	T402-D1
D8	A1-6
D9	T402-B
D10	A1-5
D11	A12-5
D12	A1-1
D13	A12-4
D14	A12-6
D15	A12-1
D16	Q451-C, T402-P
D17	Q551-C
D18	N/C
D19	Q551-E

Transistor & Control Locations



Test points are not shown, but can be found in the coordinates as listed in this chart.

TEST POINTS	LOCATION
TPB2	C-4
TPB3	C-5
TP82	B-5
TPA18	A-7
TPA21	E-7
TP14	E-10
TPA20	E-6
A17	A-8
TP11	E-13
TP12	B-7
TP13	A6/7
TP15	E-11
TP16	E-10
TP21	D-9
TP33	E-3
TP41	D-4
TP42	C-6
TP46B	C-7
TP46G	B-6
TP46R	B-6
TPA1	D-11
TPA2	D-11
TPA3	D-10
TPA4	D-10
TPA5	C-10
TPA6	D-9
TPA7	D-10
TPA9	D-3
TPA10	E-8
TPA13	D-12
TPA16	A/5
TPB5	D-5
F1	B-12/13
F2	B-9/10
AFC Pack	C/D-7/8/9
Interlock	A-12/13
Serv. Sw.	A-6
Dynacolor Sw.	D/E-6/7
TPA19	B-6



Shape up your shop with fingertip control of your current technical and cross-reference material

Now's the time and here's the way to end forever the costly nuisance of searching for current technical data, trying to find cross-reference material, and looking for the oldest and newest schematics.

With Zenith's new CRSP* Manual Organizer, you keep everything neat, clean, orderly...right at your fingertips.

Housed in a beautiful, durable "organizer" is a 3-ring binder with 4½ inches of catalog capacity...a "want" book... space for your most often used phone numbers...separate wells for note paper and pencils...and even a chain-attached towel to reduce catalog-page soilage.

It's just what the doctor ordered for your service shop. Comes completely assembled, ready to use.

Call your Zenith distributor now and find out how you can put the Zenith CRSP Manual Organizer to work for you!

*Cross-Reference Sales Program

For your own reputation and in your customers' best interest, always specify Zenith exact replacement parts and accessories.

Circle No. 103 on Reader Inquiry Card

ZENITH®

The quality goes in before the name goes on®

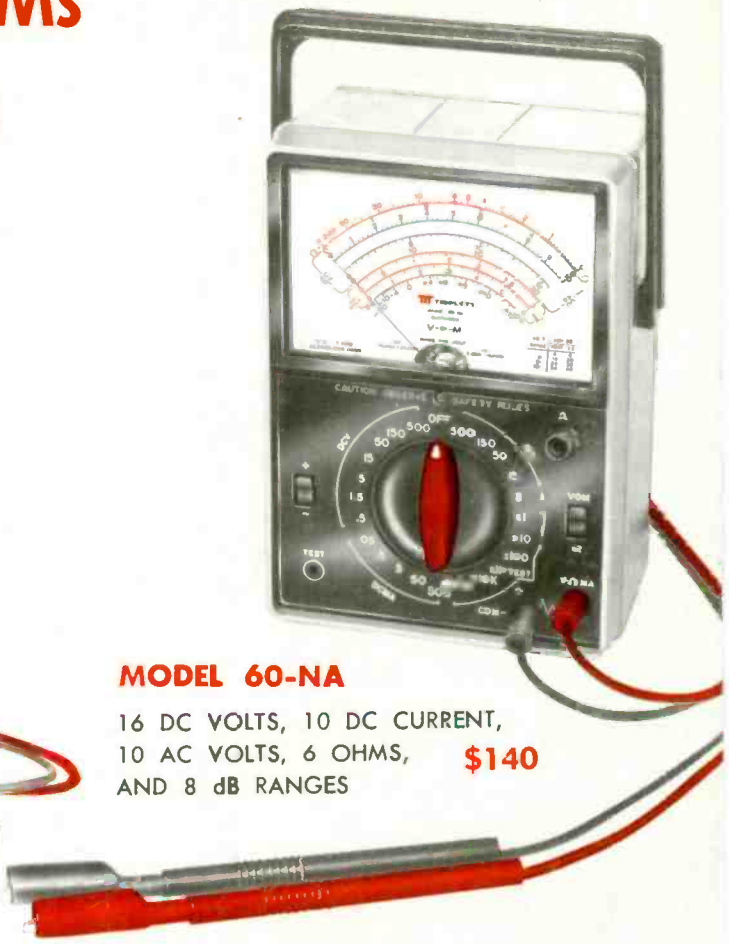
Zenith Radio Corporation / Service, Parts & Accessories Division
11000 Seymour Avenue / Franklin Park, Illinois 60131

a New Family of VOMs
The Model 60 Series

MODEL 60

RANGES
8 DC VOLTS
4 DC CURRENT
6 AC VOLTS
5 OHMS
5dB

$102



MODEL 60-NA

16 DC VOLTS, 10 DC CURRENT,
10 AC VOLTS, 6 OHMS,
AND 8 dB RANGES

$140

X'TRA™ RUGGED
OVERLOAD PROTECTED
SAFETY DESIGNED FOR YOU

The new 60 Series has been designed for the value conscious users in industrial production and maintenance, communications, vocational training and hobbyists, airconditioning, appliance and automotive service, R & D and application engineering . . . anyone who wants to be more productive with the latest in V-O-M technology. The large, "simplified" 4½" scale is an "easy reader". This combined with a single range selector switch minimizes the possibilities of error. Detented handle position, only 2 recessed input jacks and 48" safety engineered test leads are just a few of the many other user benefits of the 60 Series. Compare them with other V-O-Ms and you'll know why the new Triplett family of V-O-M's eliminate over 90% of the costly repairs from V-O-M misuses. Cultivate a profitable habit for selecting Triplett designed products.

For more technical data and a demonstration of the Model 60 Series, see your local Triplett distributor or a Triplett sales representative. Triplett Corp., Bluffton, Ohio 45817, (419) 358-5015.

MODEL 64

RANGES
8 DC VOLTS
8 AC VOLTS
7 OHMS
6 Low Power
JUNCTION
TEST

$140

TRIPLETT®
BLUFFTON, OHIO 45817

Triplett. The easy readers.

...for more details circle 104 on Reader Service Card
...For FREE demonstration circle 105 on Reader Service Card