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LEADING THE CONSUMER AND
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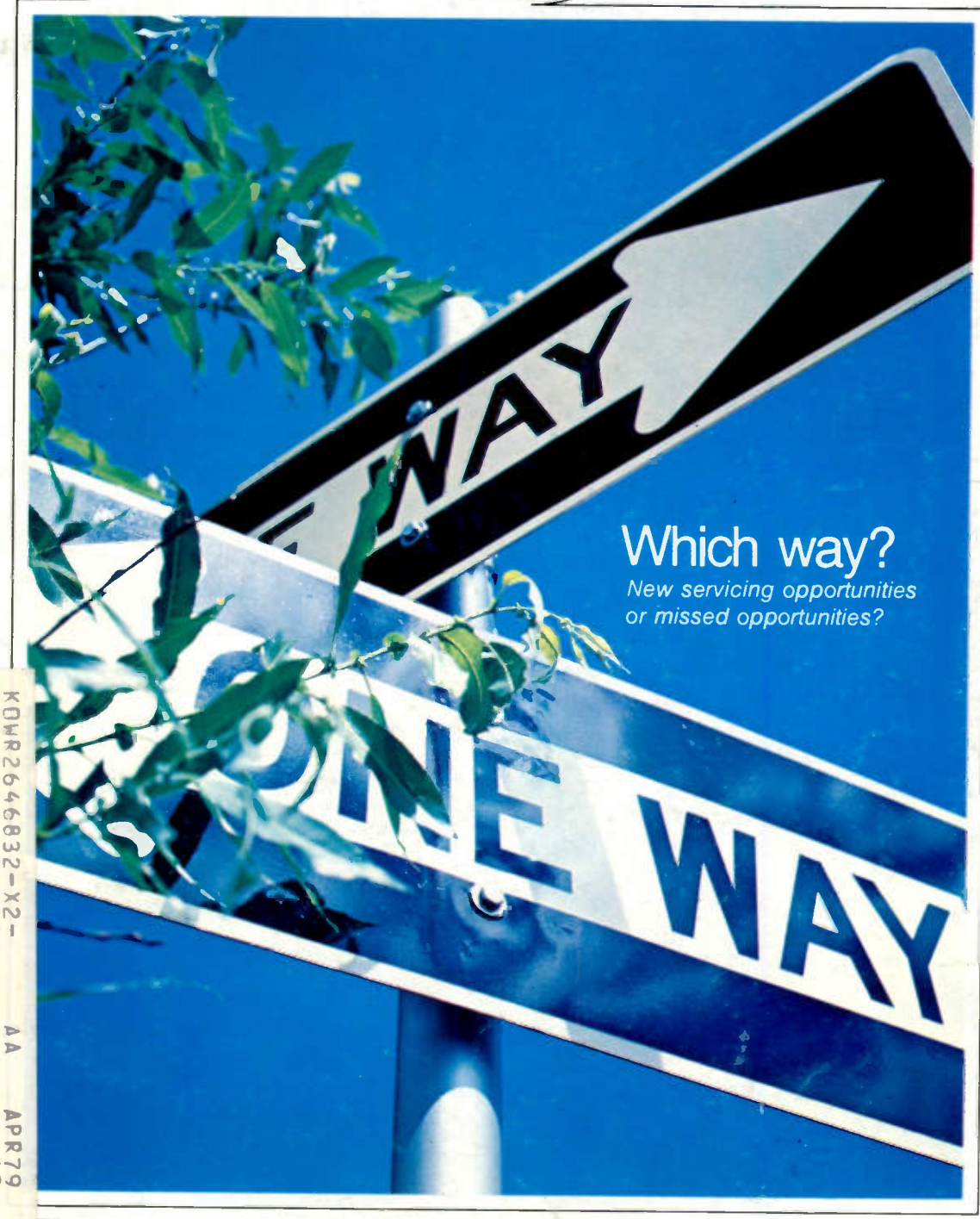

Which way?

New servicing opportunities or missed opportunities?

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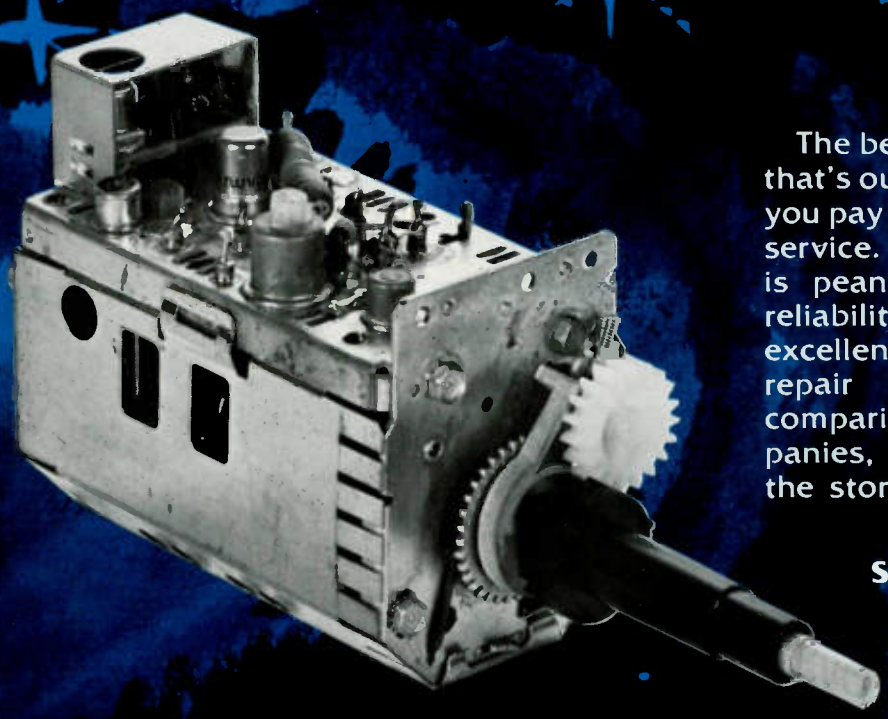

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INDUSTRY REPORT

NARDA Says Service Profits Up

The National Association of Retail Dealers of America (NARDA) reports that repair service profits rose during 1977.

Reporting on the association's annual cost of doing business survey, NARDA's John Gooley said net operating profit (measured against total sales) was 5.8 percent and after tax, profit stood at 4.7 percent.

Service operations out-paced most other segments of the industry in terms of operating profits, he said.

In addition, Gooley said that labor income continued to dominate the volume picture "with almost twice as much contribution as parts income."

Gooley stated that if there is a nagging financial statement problem, "it is the fact that inventories continue to rise." Servicers ended the year with 18.5 percent more inventory than was on hand at the start of the year, he said. While this could be the result of stocking more items, it is more likely the inventory problem stems from increases in the prices of parts.

The survey, which will run between 30 and 40 pages, is available for $25 per copy to non-members and for $10 to members, from NARDA, 2 North Riverside Plaza, Chicago, Ill., 60606.

Sharp Shows "Tubeless TV"

Without question the technological star of the entire Summer CES this year was the unveiling by Sharp Electronics Corporation of its experimental 6-inch black and yellow tubeless television set.

Displaying an amazingly sharp and clear picture, the display device consisted of a two-inch thick "electroluminescence" (EL) panel developed in Osaka. The device, shown on the floor of the show, brought such wide ranging comments as, "who wants to watch yellow television," from an uninterested retailer to "we've been trying to do this for 25 years" from a design engineer for an American television manufacturer.

Sharp Electronics "super" thin screen television.

The EL panel itself is a matrix consisting of 230 vertical and 325 horizontal electrodes. It utilizes AC picture information to alternatingly polarize and depolarize the electrodes.

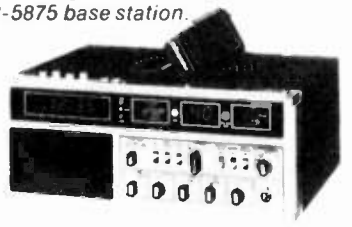
According to Sharp, the set eliminates image flickering by continuously sending pulses of opposite polarity to the electrodes so that they maintain their luminescence until the image changes.

The set, which weighs just over eight pounds, uses advanced semiconductor technology to create a DSA MOS IC that handles signal processing and switching in the EL display, Sharp said. In addition, high pressure diffusion self alignment circuitry is another feature of this first 100 percent solid state television system.

C.B. Industry is "Well"

The C.B. industry is alive and well, according to executives from two major manufacturers. Larry Jones, vice president of marketing for Motorola, told a seminar at the Summer CES show in Chicago that the C.B. marketplace "is at the same stage of development as a teenager ready to burst into adulthood."

GE's Single Sideband Model 3-5875 base station.



"The consumer is not looking for a basic 40-channel underdash today. He or she wants a single sideband set . . . or an in-dash set . . . or an in-dash set that also offers AM and FM stereo and 8-track or cassette," Jones said.

Meanwhile, G.E.'s Walter Williams said the "potential for C.B. has not yet been realized. . . . There has been some shake out in the industry this year but we expect to see some stabilization of the market by the end of 1978."

G.E. was among the manufacturers showing new C.B. products at the show. Introduced was a high end single sideband unit retailing for $470. The model 3-5875 features phase locked loop frequency control, dual meter system, and a pro-

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AUGUST 1978, VOL. 100, NO. 8

On the cover
Which way to greater service opportunities and profit? These signs symbolize the choice to be made by each serviceshop owner, and lead into this month's feature on the future of electronic servicing on page 14.

FEATURES

DEPARTMENTS

HBJ A HARCOURT BRACE JOVANOVICH PUBLICATION ABP ABC EIA

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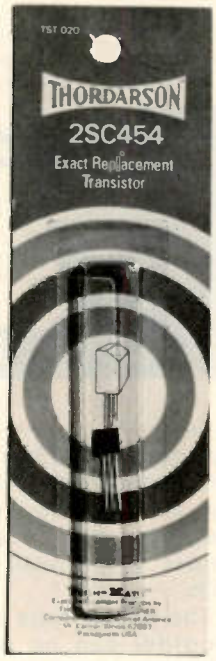

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The Electroscan 540, a new AM/SSB CB transceiver from Motorola.

grammable electronic digital clock.

Motorola also showed its System 500 Electroscan transceiver. This unit features open channel scan control, 10-channel user programmed memory, and a power microphone for use without batteries.

Magnavox Introduces Two New Chassis; High Resolution CRT Display

Magnavox introduced its new 1979 television chassis at the Summer CES. New are the 25-inch T-815 and the 19-inch T-809 which the manufacturer says contain the positive features of the T991 (19-inch) and the T995 (25-inch) chassis.

However, the most significant innovation was the introduction by Mag-

Magnavox's new T-815 chassis.

navox of its new "high resolution filter," a circuit which Magnavox claims improves picture resolution by 25 percent (look for details on this system in the September issue of ET/D).

The new system is designed for use with the 19 and 25 inch Touch Tune and STAR System and, so the manufacturer says, provides "the highest resolution television picture existing in the industry today."

According to Magnavox Product Manager William Newell, the filter increases the horizontal frame from 260 to 330 lines and this added definition eliminates the "barber pole effect" in vertical striped backgrounds such as shirts, jackets, lampshades. This effect, Newell said, is most noticeable on low color or black and white objects.

Essentially what has happened, according to the Magnavox technical department, is that the 3.58 MHz trap in the luminance channel has been eliminated, thus permitting the video frequency response to reach beyond 4MHz.

Magnavox also announced that all of its 19 and 25 inch sets will use a 100 degree in-line picture tube. This tube offers a 30 percent reduction in spot size as well as a two-inch reduction in overall tube length.

Magnavox also unveiled a new color video camera plus a programmable video cassette recorder. The color sound camera, with stepup

Zoom lens and electronic viewfinder are features of this color camera introduced by Magnavox.

features to include a six times zoom lens and electronic viewfinder, is for use with the previously introduced Magnavox VHS video cassette recorder. It will retail at a suggested $895.

The touch tune video cassette recorder can be programmed in advance for up to four different channels over a seven day period. It incorporates a 14 channel push-button electronic tuner and can be preset to record a television program at the same time each day or make up to four channel changes during a seven day period. It will be available this Fall, according to Magnavox.

WESCON Meeting Set for September in L.A.

The 1978 Western Electronic Show and Convention (WESCON) is scheduled for Sept. 10-14 at Los Angeles' Convention Center.

Focusing on the high state of electronic technology, this year's theme will be "Micro/Encounter." The main speaker will be Dr. C. Lester Hogan, vice chairman of the board of Fairchild Camera and Instrument, who will talk on challenges in the microelectronics era.

Dr. Hogan has been active in the development of the Isoplanar process in both bipolar and CMOS circuits, the first commercially available CCD imaging device, and sub-nanosecond ECL. ET/D

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GENERAL ELECTRIC

FROM THE EDITOR'S DESK

This month the two national electronic servicers organizations, the National Electronic Service Dealers Association (NESDA) and the National Association of Television and Electronic Servicers of America (NATESA), are holding their annual conventions. And, this year, perhaps more so than at any time in the recent past, these two organizations will be facing some of the most difficult problems they will ever encounter. These problems, many of them enumerated in this month's interview article (see page 14) with the executives of the two associations, stem basically from a single source, the meteoric speed with which electronic technology is moving.

Faced with a rapid dropoff in service calls associated with each successive year's new television chassis introductions, both NESDA and NATESA will be focusing attention on new avenues of service, on new approaches to service, and on the all important professional business approaches to service shop operations.

Also, these organizations must come to grips with the ever present march of technology. Seminars leading to a better understanding of digital concepts and dealing with the evolution of the microprocessor into the home entertainment and consumer electronics field will mark attempts by these two orgnizations to come to grips with reality.

It is a reality we at ET/D have long been aware of. It is the reason that, starting last November, we reintroduced for our readers a basic review series on digital logic. Now, with this groundwork laid, ET/D with this issue is beginning a basic explanatory series on the microprocessor.

It is being written by an author new to ET/D, but certainly not new to microprocessor technology. Steven K. Roberts, a graduate engineer and president of his own computer/microprocessor design firm, will with successive issues present to you the basics of this increasingly important functional unit. This series is ET/D's way of helping you, the technician in the field, familiarize yourself with the reality of modern electronics applications.

I hope you find this series enlightening, certainly the subject is critical to continued survival in consumer electronics servicing.

In fact, digital and microprocessor applications is the subject of another article on the operating characteristics and troubleshooting procedures for the Omega Digital Tuning systems.

Thus, it seems we have come full circle in less than a year. The digital circuitry and logic you've been hearing about for so long, is now staring you right in the eye, in today's modern, state-of-the-art television systems.

Good luck with it.

Sincerely,

Richard W. Fay

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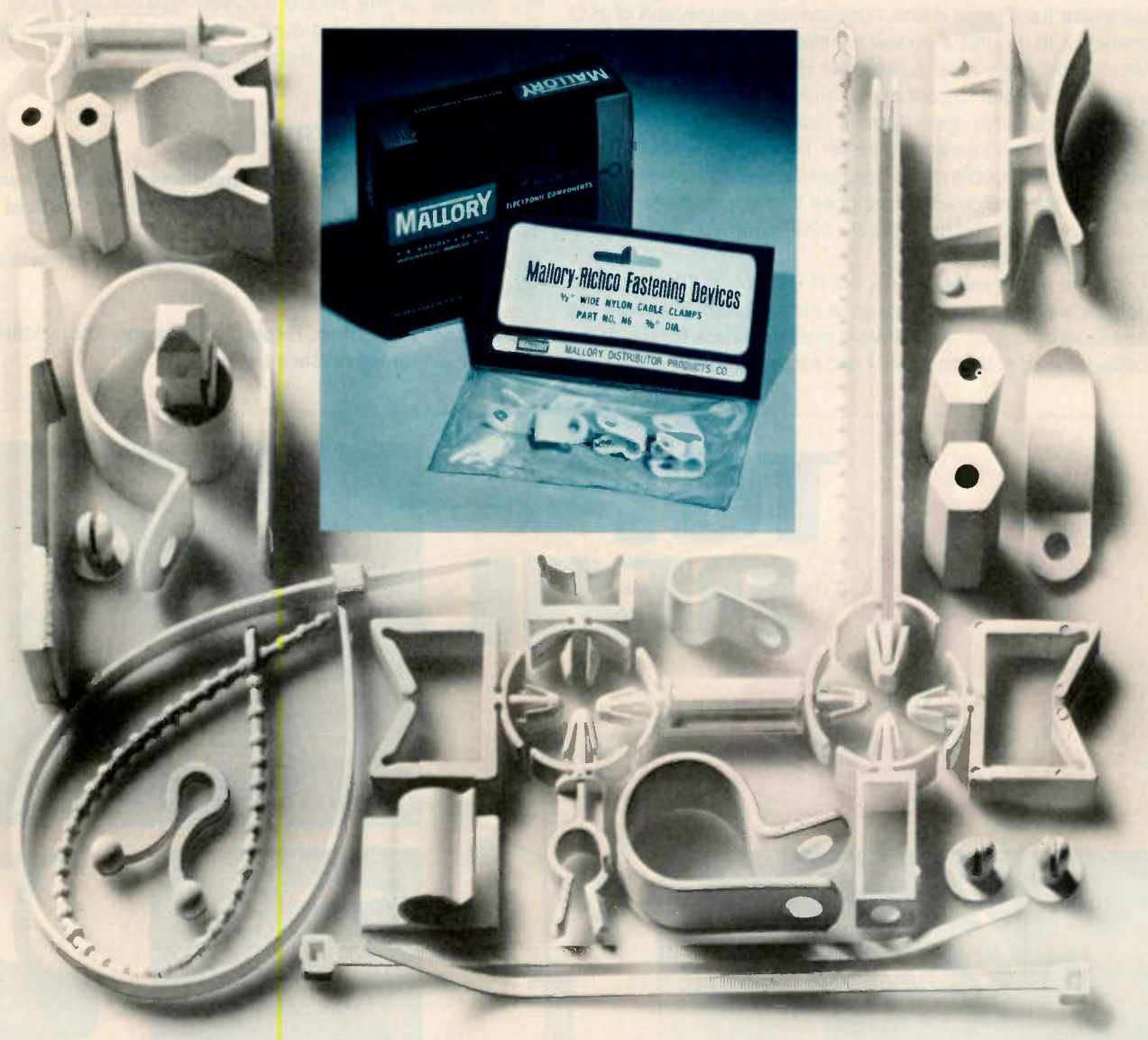

(Parts shown actual size.)

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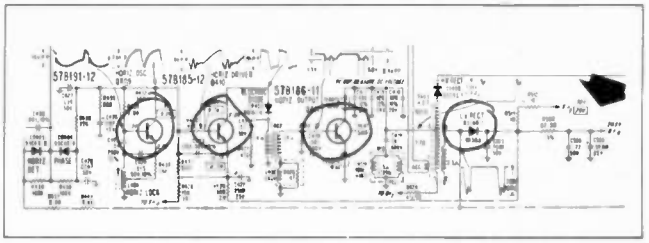


ADMIRAL

Color TV Chassis M10—Troubleshooting techniques for horizontal sweep circuit.

There are three symptom categories for horizontal output troubles:

1) A B+ supply fuse blows and/or the HV shutdown circuit goes into operation.

2) B+ supply to horizontal is OK but there is no sweep action.

3) There is horizontal sweep action but it's abnormal.

In case of *blown fuses*, check for trouble in the horizontal sweep by removing the horizontal output transistor. If the fuse no longer blows, check for shorts or low resistance in the H/O transistor itself; also check from collector connection of H/O transistor to ground. If no low resistance is present, the problem is most likely to be a defective HV tripler. Disconnect the input of the tripler to confirm. If the H/O transistor was found shorted, check for open damper diode or defective tripler.

If the fuse continues to blow after removal of the H/O transistor, check for trouble in the horizontal oscillator-driver area. If the M10 HV shutdown circuit goes into operation (with H/O transistor in circuit) check the B+120V supply. If OK, suspect the shutdown circuit itself.

If there is *no sweep action*, but B+ supply is OK, check for square wave drive at the base of the H/O transistor with the transistor removed. If the drive is present, check for B+ at the collector lead of the transistor and for proper grounding of the emitter circuit.

If there is *horizontal sweep action* but it is abnormal, check the flyback pulse at the collector of the H/O transistor for proper frequency and amplitude using a triggered scope with 10:1 or 100:1 probe. The flyback pulse must be about 12 microseconds wide at the base and more than 800V peak to peak. If the pulse width is incorrect, the trouble involves capacity or inductance in the sweep output circuitry. If only the amplitude is low, the circuit is oscillating but has insufficient B+ applied, or the trouble involves resistive loading on the horizontal output—most commonly one of the circuits that is fed from the horizontal output transformer.

GENERAL ELECTRIC

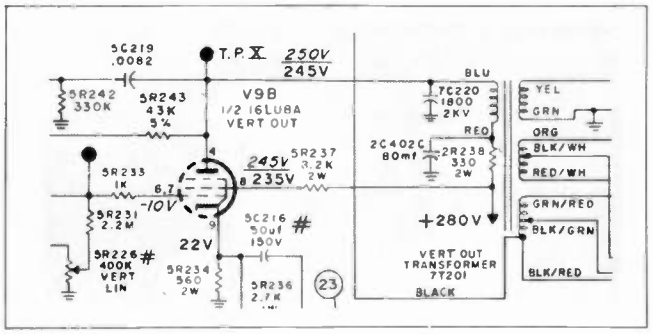
Color TV Chassis MA/MB—Insufficient vertical sweep. Top and bottom of raster are short 1 inch. Vertical collapses in about 3 minutes.

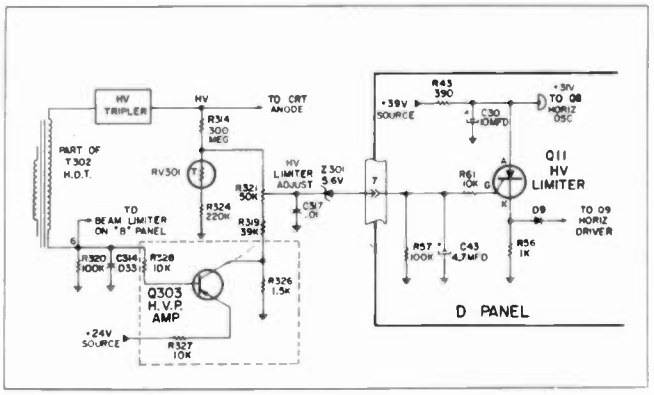
Check for a short to ground on the connections to the service switch, S1601.

No vertical deflection. Replacing any module, including vertical, does not restore deflection.

A bare wire on the sweep interconnect mother board, between W17 and W18 (about 3 inches long) is likely touching the hex head ground screw.

Color TV Chassis C1/L1—No vertical sweep, or insufficient sweep.
Check for intermittent short in 16LU8, or an open 5R234, or open 5R237, or open 2R238 (check the load side for short), or an open 5C216. (see diagram below).





of a new HV limiter Adjust, R321. If component values in the divider network change, the circuit trip point will be changed. R314 and RV301 are likely suspects. RV301 should measure approximately 750K at 25 degrees C, and approximately 225K at 55 degrees C. Z301 is also a critical circuit component. If it is too leaky, it will allow the circuit to trip prematurely. A specially screened diode must be used for Z301. To replace the diode, order kit P.N. 171383-1. The kit contains a new diode and a new R321.

MAGNAVOX

Color TV Chassis T989—Troubleshooting the High Voltage Protection circuit.
The T989 chassis uses a HV monitoring circuit to sense excessive HV. When the HV exceeds acceptable limits, the circuit kills the horizontal oscillator and shuts down the HV. (See diagram below).

The circuit is preset at the factory and R321 is sealed. Therefore, any readjustment of the circuit requires installation

ZENITH

Chassis 25FC45—No raster, loss of high voltage.
Several causes possible, (1) Open peaking coil (L212) in 24V supply to horizontal module, or (2) when changing coil, check the vertical module. It may reduce brightness and open new coil again. Substitute new module to be sure there is no loss of brightness, or coil may open again in a few hours. **ET/D**

NEWSLINE

SINGLE CHIP RADIOS IN THE WINGS? Technological advances are being applied to auto radios, which although expensive now, have the potential for reducing overall cost in the long run. That information comes from a recent study on car radio conducted for the National Association of Broadcasters by Booz, Allen Applied Research. "Single chip AM/FM radios are on the horizon, pending the resolution of certain technical problems," the study said.

IHF OPPOSED TO INTERFERENCE LEGISLATION. Representatives of the Institute of High Fidelity testified recently at federal hearings into the impact of radio frequency interference on consumer electronic products. IHF's Technical Director Leonard Feldman told the Senate's Communications Subcommittee that the Goldwater sponsored S.864 would force unnecessarily high prices on consumers. "Every purchaser of an audio component should not have to bear the cost of including multiple RFI filters and shielding in high fidelity components when a large percentage of purchasers will never experience any interference problem." Enforcing such government-sponsored legislation, Feldman continued, would unnecessarily increase the cost of manufacturing hi-fi equipment.

THE STATE OF THINGS TO COME? Fotomat Chairman Richard Irwin says he believes a portable hand held video camera with a built-in VCR will be the death of the home movie business. Quoted in a recent issue of Television Digest, Irwin said: "With this new product we see the camera business leveling off and ultimately dying. It will have a significant influence on the still area." VCR manufacturers have made a mistake in concentrating on TV instead of the photography market, he claims. "We want to let the public know their equipment can be used for photography." According to Irwin, the portable camera/VCR will be with us in five years.

MAINE SERVICERS MEET. The Maine Electronic Technicians' Association met recently in Lewiston for the last time under that name. Delegates voted to change their name to the Maine Electronic Association. The reason..."to broaden the scope of the organization." The new president is Walter J. Wheeler of Topsham and the first vice president is Richard Halle, of Waterville. Other officers elected during the meeting were James Troutman of Brewer, Marshall Turner, recording secretary, and Manley Lane, treasurer.

VIRGINIA ELECTS NEW OFFICERS. The Virginia Electronic Association wound up its recent annual state meeting and voted to meet again next year June 17-20 in Richmond. The newly elected officers for 1978/79 are: Earl Tally, president; Wayne Appleman, first vice president; Joe Jackson, second vice president; and Tom Hughey, third vice president.

DIGITAL COURSE AVAILABLE. The Philips Test and Measuring Instruments Corporation has announced the availability of the third part of its digital instrument course on voltmeters and multimeters. According to Philips, the course contains the very latest developments in instrumentation in those fields plus illustrated material on current applications-oriented techniques. It is available from Philips for $5 by writing Philips Test & Measuring Instruments, Inc., 85 McKee Drive, Mahwah, N.J. 07430.

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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 19BL	.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
VO 6B	.40
VO 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

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WINEGARD WORKS...150

Miles Offshore!

Far out in the Gulf, drilling and construction oil rigs stand like giant metal mushrooms. Crews of workers spend many days on the platforms, isolated by distance and weather from the mainland. Even with well equipped recreation rooms that include pool tables and regular movie showings, they depend on television sports and news for relaxation and information.

Getting and keeping good, watchable pictures means overcoming two major problems: distance from tv transmitters—as much as 150 miles or more—and the ravages of salt spray and gale winds on antennas.

Clifton Giroir, Winegard Dealer Associated with Houma Avionics.

Houma Avionics and Winegard dealer Clifton "Pookie" Giroir (Antenna Service Company), have become specialists in tv antenna installations on oil rigs, both drilling and production types. Giroir's early efforts on jobs contracted by Houma Avionics, were as a "troubleshooter" for antenna installations which were not working properly.

As he states it, "We replaced unsatisfactory equipment with complete Winegard systems, from antenna to the tv outlets. While models vary by distance from shore and specific installation problems, we use Chromstar antennas, Chromstar high gain—low noise preamplifiers, and other Winegard electronic components. This may include a distribution amplifier, cartridge filters, and up to 8 or 10 outlets. With drilling rigs, the antenna is mounted on the derrick crown, 150-200 feet high. On production rigs, the antenna is mounted on the communications tower, with cable run to the crew's home base platform.

We prefer Winegard products for these oil rig installations. Winegard has everything we need in their line, components are compatible and reliable. The antennas are anodized and very ruggedly constructed."

Giroir, in working with Houma Avionics, has developed many techniques for dealing with unusual installations, particularly in assuring longer life for oil rig antennas which face destructive conditions constantly. He adds to his knowledge by attending Winegard technical seminars, and by tackling, for Houma Avionics, the very toughest oil rig antenna installation problems in the Gulf of Mexico.

LETTERS

IN NEED OF HELP

I live in a rural area and have a 30 foot antenna tower which works alright during early morning and afternoon hours. But in the evening I lose a quality picture and color.

I have about 4 or 5 neighbors who are close to me, and I know at least two of them have CBs. When they key their mike, I lose all color and picture quality. What can I do about this problem?

Also–I would like to rig up a good outside FM antenna and try to receive stations that are further away and with more clarity.

Now–here's the monkey wrench in the whole thing. I live in a metal box–like mobile home. Is there anything I can do without going to the cost of a new house?
Keith Lanolis

EDITOR: Keith didn't include his address or city—so if any ET/D readers have any answers or suggestions, we'll publish them in this column for Keith to read.

We would like to know if anyone can tell us where parts can be purchased for Model 107B geiger counter, manufactured by Precision Radiation Instruments, Inc. We've lost track of the firm. They used to be at 2235 S. LaBrea Avenue, Los Angeles, California.

Thanks for any help we can get.
Joe Vezabal
Lyle's Service Center
Hettinger, N.D. 58639

We would appreciate help in finding out which type of connector is used on the yoke for the following sets: Sanyo–91C30/53/54/63/75; Sanyo–91C50/60/61/70; GE–25YM; Sylvania–E21; E22; Electrohome–C12/14/16/17.
Thank you.
Jerry McKouen
534 Pacific Avenue
Lansing, Michigan 48910

I recently acquired a CRT Tester/rejuvenator made by Amphenol, known as Model 855 CRT-Commander. However, the manual and schematic is missing. Can anyone tell me how to obtain this information?
J.I. Cepero
141 Maryland Ave.
Paterson, N.J. 07503

Independent electronic service

At the crossroads

ET/D chats with the executives of the two national consumer electronics service associations.

By Richard W. Lay

For those independent TV shop owners and technicians who so choose, the pathway to survival is in diversification of business, educational upgrading of skills to keep pace with the technological explosion, the sharpening of key business and financial skills, and the assimilation and merger of the smaller inefficient service operations into larger and more critically managed shops.

These were some of the ideas placed forth on the eve of the conventions of the two national electronic servicers' associations by the leaders of the two groups in a discussion of future industry trends with Electronic Technician/Dealer magazine.

Interviewed were Frank J. Moch, executive director of the National Association of Television and Electronic Servicers of America, and Charles L. Porter, executive vice president of the National Electronic Service Dealers Association.

"Technology is going to raise hell with the service people," Moch told ET/D. "We've been trying to forewarn them, we've been nagging them they had better do three things. They've got to diversify their service lines; they've got to advertise and stay in contact with their customers, and they've got to acquire the necessary skills in digital and microprocessor technology."

Fig. 1 — Porter "There is more and more evidence that the televisions and radios on the market are becoming throw-a-way items."

Fig. 3 — Moch "I believe what we are heading for now is the absolute planned obsolescence of television and radio sets."

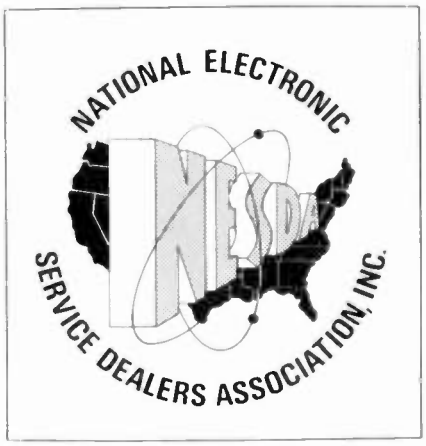

Fig. 2 — (NESDA logo)

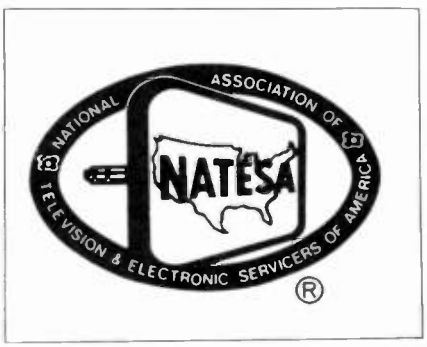

Fig. 4 — (NATESA logo)

The reason?

TV service declines

"The incidence of service has been dropping at an accelerated pace since the beginning of the solid state era," Moch said. "After looking at some of the new chassis which have just been introduced, I would say we are going to see a greater reduction. The incidence of service right now is at .5 calls per year and I would expect

with some of this new LSI circuitry that it will drop below that."

Porter, in a telephone conversation with ET/D, warned that if individual servicers insist on television and radio only servicing they're going to find themselves lost to the world of the future.

"It's just like the radio servicer of 40 years back," Porter said. "He didn't have too much trouble in adding to his knowledge and learning to fix this complicated radio that had a picture with it. Then the breakthrough of the transistor, and then the modules, and now we're coming up with something new. If he continues advancing his knowledge he should be able to survive," Porter said.

As an example of the type of attitude that is going to leave the unmotivated service organizations in the lurch very shortly, Porter related the story of a small business and home computer company which called NESDA headquarters to inquire as to the availability of service technicians. "This particular company happened to be involved in just computer terminals. They would offer something like $25 per hour — portal to portal," Porter said. "We called some people in the area where these terminals would be located and we found out that the TV business was really bad and you had to be humping — working something like 70 or 80 hours a week trying to make ends meet.

"Yet, these people turned down the offer of this company needing the service on computer terminals because it was out of their field."

Microprocessors are here

Frankly, Porter told ET/D, microprocessors are "going to be the up and coming thing, through the home computer eventually. And, he said, "the home entertainment and consumer electronics technician, the same who now services the radios, TVs and stereos, is the logical choice if he understands the technology of the equipment he is working on. So when the consumer gets these more advanced pieces of equipment, the small computers, the VTRs, the VCRs, who is going to service it but the local electronic technician?"

For a comparison of where technology is now taking us, Porter said, just take a glance back 10 years and look at the innovations. In 1968, technicians were still primarily engaged in tube television servicing. Then came the transistor, the modules, the integrated circuits, now LSI and digital. "You go back another 10 years to 1958 and you find you were still in black and white television."

With the "explosion" of electronics into virtually every endeavor, there is money to be made in the service industry, Porter said. "A lot of the larger dealers who are really making money have already expanded into these other fields like VTR, VCR, and even now are taking on the microprocessor/computer and this type of business in order to subsidize the drop off in other lines of service."

According to Moch, the "electronics explosion" has provided today's capable technicians with a wide range of electronics service to pick from. There are smoke and security alarms, MATV, CATV, auto electronics, and appliance electronics, such as washing machines and microwave ovens.

Key is advertising

The key to gaining access to this business is advertising, Moch said. "Years ago every successful service business did quite a bit of advertising. The problem came when the service business became so great, and the need for technicians was so intense because of the work load, that most simply stopped advertising because they didn't want the extra business.

"Thus they broke contact with the customer," Moch said. "But today if you are going to stay in business you better make sure you stay in contact with your customer, you must get more business per customer since you're going to have fewer calls per product."

Moch said continuing education in technical skills is one of the key goals NATESA will push during the coming year. "We started to push our people for the serious study of digital electronics about two years ago, before it really hit hard. One of the real problems in our industry, so far as the technicians are concerned, is that we 'jump' in technology," Moch said. "While a technician may have more than enough work to do in today's technology, all of a sudden

continued on page 51

Omega digital tuning systems

Transition in the TV industry

Here's an overview of the modern Omega system including a look at the pulse width modulation techniques plus set up procedures.

By Paul Shih

Changing over from mechanical to digital tuning of television receivers is an ongoing event in the television industry. There have been a number of electronic tuning systems already in use, and most of them basically employ the varactor tuner in one way or another. The basic principle of the varactor tuners along with a simple analog electronic tuning system employing mainly discrete components was described in an article in February issue of ET/D. This article deals with the digital tuning systems that incorporate a voltage synthesizer in developing necessary tuning data. For a review of tuning voltage and band switching functions, please refer to that previous article.

The analog electronic tuning system containing a potentiometer assembly for picking out different tuning voltages has many advantages over any mechanical tuning system. However, there are drawbacks associated with the potentiometer assembly which must be recognized. First of all, DC stability is always a problem; as a result, tuning tends to drift or lacks precision. Other drawbacks are the high cost of the precision potentiometers and the inconvenience in tuning and retuning the potentiometers for optimum reception of desired channels.

A rather different approach in deriving the tuning voltage was used by General Instrument Corporation in developing the Omega tuning system. Instead of using the mechanical position of the potentiometer as a means to retain the necessary tuning voltage, the Omega system uses an electrically alterable read only memory (EAROM) to store digital equivalents of tuning voltages. With proper control functions, this vital tuning data can be retrieved from the EAROM, processed and sent to the varactor tuner. The data stored in the EAROM can also be altered, updated or rewritten any time the viewer adjusts the coarse and/or fine tuning of the set.

Omega tuning systems

The original Omega tuning system was first introduced in 1975. There are now three systems available for use. These systems are compatible with many available varactor tuners, push-button selection and display devices, and of course remote control systems. With their low production cost due to the use of low-speed MOS-LSI technology and their capability of accommodating many different television channel allocations found all over the world, the Omega systems will be accepted by the television industry not only in the United States but also in many major foreign countries.

The three Omega digital tuning systems, namely, Omega/82 Channel System, Economega I/16 Channel System and Economega II/20 Channel System, will now be described.

The 82-channel system is built around primarily 4 custom LSI chips, an N-channel MOS control chip, an MNOS memory chip, a CMOS D-to-A converter chip and an N-channel MOS display chip (Fig. 1). The system accepts 2-digit keyboard entries and generates the required tuning and band switching voltages for the varactor tuner. In addition, it also provides a two-digit seven-segment channel number display for the selected channel.

Switches or controls are provided for channel stepping by units or tens, coarse-tune, fine-tune and active channel searching. By adding another interface chip to the standard 4-chip system as a design option, each of the favorite television stations up to 20 channels may be selected with a single digit keyboard entry.

The "10 year" memory

The use of an electrically alterable read only memory array, ER1400, in the Omega system is a rather unique feature in electronic tuning. The ER1400 is a semiconductor MOS memory which is made of 1400 memory transistors. Each transistor can store one bit of data. A "word" may be represented by one or several bits of data. The ER1400 has 100-word capacity, and each word is to be represented by 14 bits. These 100 words are arranged in the 10-by-10 two-dimensional matrix, and there are 14 such matrixes stacked one on the top of the other to give each word a capacity of 14 bits.

The ER1400 is fabricated with the MOS technology using metal-nitride-oxide silicon as interface for the aluminum gate insulator. Data is stored by internal negative writing pulses which are selectively applied to the 1400 MNOS memory transistors. The applied pulses cause charges to tunnel through the 2-angstrom-thick gate oxide of the MOS transistors. These charges are trapped at the oxide interfaces when the writing pulses are removed. The result is that the gate threshold voltages of the selected memory transistors are shifted toward a negative direction. This negative shift in

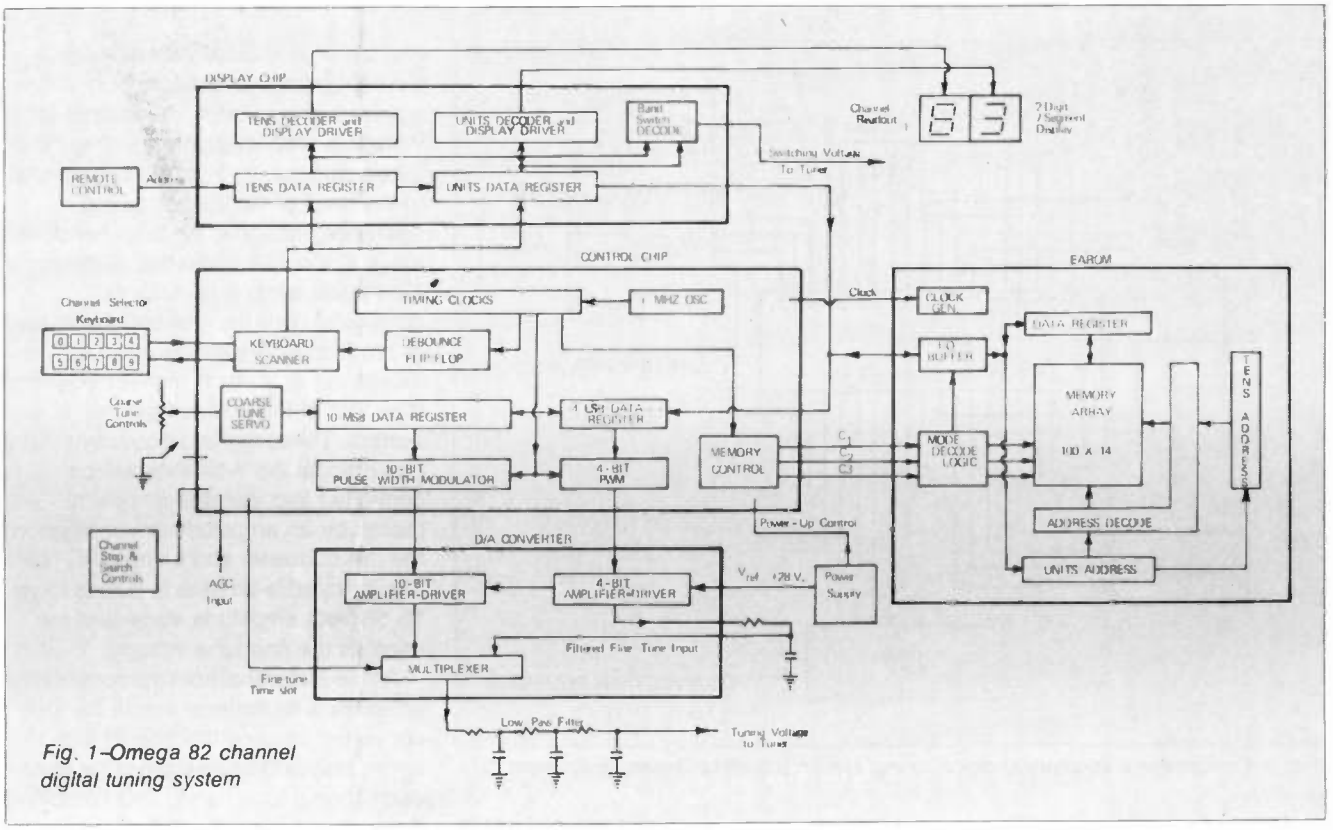

Fig. 1–Omega 82 channel digital tuning system

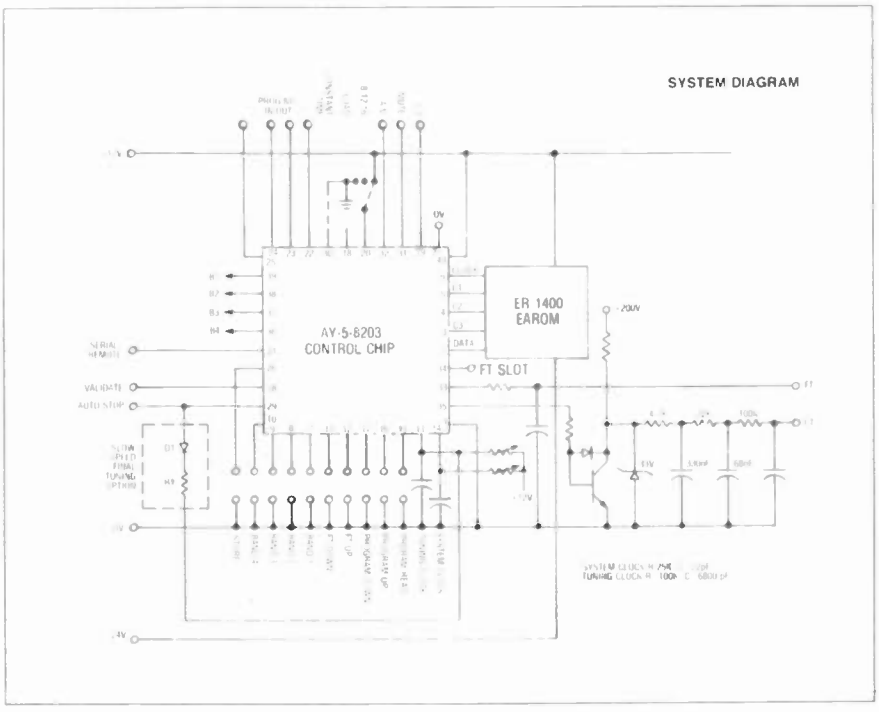

Fig. 2–Economega I 16-channel digital tuning system (courtesy General Instrument Co.)

the threshold voltage, as an indication of data stored, will remain even if the DC supply is removed. Thus, nonvolatile data retention is realized. The ER1400 is capable of storing data for 10 years without any stand-by power.

The ER1400 is used in the Omega system to store binary equivalents of the analog tuning voltages for 82 channels as well as the two-digit channel number of the last channel being viewed. An additional 16 memory locations may be used to accommodate optional services such as closed circuit or cable television.

In comparison to many computer memories, the ER1400 is a rather slow memory system that requires 20 milliseconds to write or to erase each word. However, this long memory-access time is not a detrimental factor in television tuning. In fact, this slow speed feature together with simple timing requirements permits serial transfer of both address and data to and from the memory by a one-pin bidirectional bus. As a result, the need for multiple-terminal connections for addressing or writing as required in a faster parallel data transfer system is eliminated. The only parallel terminals used are pins 6, 7, & 8 (C_1, C_2 & C_3). These pins are coupled to the control chip by 3 wires to receive a 3-bit parallel code for commanding the memory into one of its seven operating modes—input address, input data, erase, write, read, data out and stand-by. This economy of interconnects for the memory results in lower production costs.

The 4-chip system

Channel selection is performed with push-button entry of two digits on a keyboard connected to the keyboard entry pins on the 40-pin control chip. A keyboard scanner (essentially a counter) in the control chip scans the keyboard switches at a 14-KHz rate constantly for a switch closure. Once a closure is sensed from the first digit entered, the scanning is stopped. The closure is reconfirmed 15 msec later by a "debounce" flip-flop circuit in the control chip to insure smooth and accurate keyboard operation. After confirmation of the switch closure, the scanner turns itself into a shift register which then passes the data (created by the closure) contained in it to a data

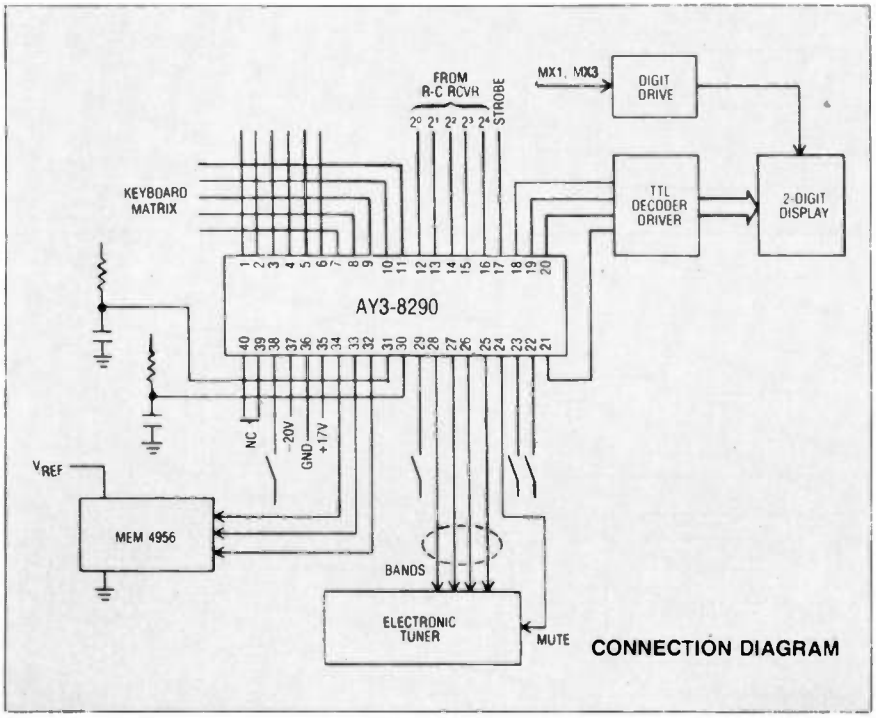

Fig. 3–Economega II 20-channel digital tuning system (courtesy General Instrument Co.)

register in the display chip. This same process will repeat for the second digit entered. After the two-digit channel number is stored in the two data registers of the display chip, the following 3 operations take place:

(1) storing the last channel number being viewed in the ER1400,
(2) developing the required tuning voltage for the channel selected, and
(3) decoding the channel number to develop the corresponding band switching voltage and also displaying the channel number.

The last channel number

Upon the completion of storing the channel number in the display chip, the control chip will begin to send a 20bit code to address memory line 99 in the 100 line main memory (lines 0 thru 99) for the first digit channel number through the EAROM address register. The same first digit stored previously in the display data register is now shifted to the data register of the EAROM via the control chip. Upon reception of a "write" command by the 3-bit parallel code from the control chip, this piece of data temporarily held in the EAROM data register is then shifted into the EAROM memory through line 99. The second digit channel number is next written into the memory through line 98 in the same manner.

The combination of the two digits in the memory locations 99 and 98 represents the channel number of the channel being viewed at the moment. If the system is switched to another channel by new keyboard entry, the channel number previously held in the memory locations 99 and 98 will be erased, and the new channel number is written into the same memory locations. When the power is turned off, this last channel number viewed will be retained in the memory. When the power is turned on again later, the last channel number will reappear in the display, and of course the receiver is tuned to that channel.

Developing tuning voltage

After the two digit channel number is stored in the EAROM, the same channel number also temporarily stored in the data registers of the display chip is now sent to the address registers of the EAROM via the control chip through the single I/O bus. When the "read" command, coming from the control chip through the three parallel wires, arrives at the EAROM, the channel number information held in the EAROM's address registers will help to locate the correct memory lines and cause the tuning data to be read into the EAROM's data register. This tuning data is then shifted out via the same single bidirectional I/O bus to the 14-bit data register in the control chip.

The 14-bit data register consists of two polynominal counters of 10 MSB (most significant bit) and 4 LSB (least significant bit). With the input from the 10bit counter, a 10-bit *pulse width modulator* (essentially a set/reset flip-flop) produces *variable duty cycle square wave pulses*. The coarse tune voltage is produced by amplifying these 10-bit data pulses from the control chip to the level of the 28-volt tuning reference voltage in an amplifier-driver stage in the D/A converter. Similarly, a 4-bit pulse width modulator in conjunction with the 4-bit counter is used to produce variable duty cycle square pulses but at a much higher frequency than that of the pulses from the 10-bit system. These higher frequency pulses proportional the 4-bit data will be converted into variable-amplitude pulses by an amplitude-driver stage in the D/A converter and a single RC filter. These variable-amplitude pulses have 15 discrete amplitude steps and are used as the fine tune voltage.

A time-slot signal from the control chip activates a multiplexer inside the D/A converter, causing the filtered fine tuning pulses to be inserted at the end of each coarse tune pulse. This combined output pulse from the D/A converter is smoothed out by a low-pass filter. The resulting tuning voltage for the selected channel is then sent to the varactor tuner.

Display & band switching

The display chip decodes the channel number information received from the control chip to provide channel band switching and channel number display. The switching voltage for UHG or VHG Hi/Lo channel is developed in a band-switch decoder. At the same time display decoders interpret the channel number information. The decoded channel number is sent to a 2-digit 7-segment channel readout through display drivers. The system is also made available for a character generator type of display in BCD format.

Coarse/fine tuning

The Omega 82-channel system has preset tuning done at the factory. Under normal condition, it requires no customer set-up or adjustments. However, there are occasions when the fine tune needs to be slightly readjusted for optimizing channel reception. Simply push the Fine-Tune Up or Down button until the best picture and sound are obtained. What has been done is that the control chip increases or decreases the fine-tune output by stepping (15 possible steps) until the correct value is reached. On release of the fine tune button, the new fine tune data in digital form (4 bits) is rewritten into the

EAROM's 4 memory locations. Thus, the fine-tune data is updated.

Any time when the varactor turner has been modified, repaired or replaced, the readjustments of the coarse and fine tune controls or switches should be carried out. First, press the Coarse-Tune switch and then rotate the Coarse-Tune potentiometer until the desired channel is tuned in. The adjustment varies the coarse tune voltage and actually changes the most significant 10 bits of the data word to be rewritten into the EAROM's memory. After the coarse tuning is completed, next press the Fine-Tune buttons to optimize the reception as described previously. The new coarse and fine tune data will be used each time the same channel is called on again.

"Last channel" operation

As the power is turned on, a master reset pulse generated in the control chip resets all timing clocks. All the clocks in the system are now set to be referenced to the 1 MHZ OSC in the control chip. A two-digit 20bit address signal generated in the control chip is then sent to the EAROM to address memory lines 99 and 98 in sequence. This causes the channel number of the last channel viewed, stored in those two memory locations, to be read into the EAROM's data register and then sent out to the display chip registers. Once this channel number is stored in the display registers, the whole sequence of channel selection operation as previously described will start, just as if this two-digit channel number came from the control chip keyboard.

The 5-chip system

Addition of an interface chip, T-1201, to the 4chip system does not change the basic operation as described above, but it enables the viewer to select up to 20 favorite channels each with just single digit entry. The interface chip contains 20 non-volatile memory lines and necessary logic circuitry for addressing the memory locations and interfacing with the rest of the Omega system through the control chip input terminals.

Controls or buttons have been provided for the initial entry of the two-digit channel number ("zero" before a single digit channel number) via tens and ones inputs. Each digit of the channel number entered is converted into a 12-bit code. By pressing a store button, the encoded channel number is then stored in the interface memory.

When a single button on the input keyboard connected to the interface chip is pushed, the corresponding two-digit channel number stored in the interface memory lines is picked. This two-digit information is sent to two corresponding keyboard terminals on the control chip, just as if this channel selection came from a two-digit input originating at the control chip keyboard. From this point on, the channel selection operation is the same as what has been described for the 4-chip system.

KB_1	KB_2	KB_3	KB_4	KB_5	KB_6	
1	2	3	4	5	6	MX_1
7	8	9	10	11	12	MX_2
13	14	15	16	17	18	MX_3
19	20	Pr ↑	Pr ↓	Ch ↑	Ch ↓	MX_4
Tune ↑	Tune ↓	Store		KEYBOARD MATRIX		MX_5

Fig. 4–Keyboard matrix used in economega II system (courtesy General Instrument Co.)

Economega I/16 system

The Economega I system has many of the tuning features that the Omega 82 channel system has, and yet it costs considerably less. Basically, it consists of two chips, an N-channel control chip and an EAROM (fig. 2). The EAROM stores the tuning and band information for 16 television programs. Both the coarse and fine tuning information stored have the same bits resolution as the standard Omega system (10 bits for coarse tune and 4 bits for fine tune). In addition to receiving binary program number inputs and functional command from the control keyboard, the control chip interfaces with the EAROM, a D/A converter and possibly a display unit.

Push-buttons or switches are provided for band selection, program stepping by units, fine tuning and input storing. A program select input (pin 20) terminal on the control chip, when connected to 3 different DC potentials, allows selection of 8, 12 or 16 television programs during the initial setup for the system.

Pins 22, 23, 24 and 25 (2^0, 2^1, 2^2, 2^3) on the control chip have the dual function of either receiving binary program input commands from an encoder or providing outputs to a TTL and an appropriate display unit. When the Input/Output Select pin 19 is connected to ground, the input mode for those pins is selected.

With a remote control system in operation, the Serial Remote Input pin 21 on the control chip receives a 0.5 msec negative pulse train from the remote receiver. The number of pulses received determines the program number to be selected.

A muting operation is incorporated into the system. From the time a program scan is initiated, the muting operation starts and continues until the ValidateAuto Stop function stops the scanning at a selected television program. Actually, muting is activated for 256 msec each time a program change is made.

The additional features that may be made available include sequential tuning through all 16 memory lines and introduction of a skip code to bypass any memory line which does not store a channel. This sequential tuning operation lends itself very well to a simple remote control system that does not have too many different ultrasonic frequencies to be encoded and decoded.

Economega I system may incorporate one more chip, MEM 4956, a D/A converter, as an option. In this 3-chip

system, the Fine Time Slot pins on the control chip and on the D/A converter are connected together to provide operation for combining coarse and fine tune data as was performed in the standard Omega system.

Tuning procedure

To tune in a desired television channel, first select a corresponding program number (1 to 16) and then press the required band button. Program scanning commences within the selected band until a valid, desired program is located. At that time, the Validate (pin 28) and Auto Stop (pin 29) operation stops the scan. The validation of a selected program is carried out within 256 msec by a positive going pulse originating at the Validate pin. If the selected program is not validated in this time period, the scanning will restart and continue to sweep toward the upper end of the selected band. If the desired program has not been located, the tuning voltage drops back to zero, and the scanning restarts from the lower end of the band after a delay of 256 msec.

The automatic scanning in locating the desired channel may be defeated by linking the Validate and Auto Stop pins to the band input terminals. In doing so, full manual control of the tuning operation is restored.

Economega II/20

The heart of the Economega II system is a voltage synthesizer, AY-5-8290, which contains both p-channel control logic and non-volatile memory in its single package. The memory stores channel numbers and tuning voltages for 20 television programs. The peripheral components interfacing with this single-chip voltage synthesizer include a TTL decoder driver for the 2-digit display, a D/A converter, a remote decoder, a local keyboard and the tuners (Fig. 3).

Channel selection is carried out by pressing one of the 20 single push-button program selectors or by pushing down the Program UP (Pr) or Program Down (Pr) button (Fig. 4). Upon receiving program selection commands from the local keyboard or from the remote control receiver, the control logic retrieves channel information from the memory and produces 3 different signal voltages. The signal corresponding to the channel number (or desired program number) is sent to the TTL decoder driver for application to a 2-digit readout, while an appropriate DC switching voltage is coupled to the tuner to provide band switching. Another signal, variable duty factor modulated pulse train, is coupled to the D/A converter for developing the final tuning voltage.

When the Program Up button is pressed, the program selection is incremented upwards; program "I" is selected after program "20." Pressing the Program Down button switches the program downwards; program "20" is selected after program "I." If the No Skip terminal (pin 22) is set at a logic "0," unused programs which have previously been set to channel "0,0" will be skipped during the downwards or upwards sequential program selection.

The system programming, as described below, allows any television channel from 01 to 99 to be assigned to any one of the 20 system programs. A display mode switch provided permits display of either the two-digit television channel number or the system program number on the same two-digit readout. The channel number is displayed when the mode switch sets a logic "1" for Display Mode pin 23; a logic "0" displays the program number.

System programming

To have the tuning system operate properly, an initial setup for up to 20 television channels must be performed. The steps involved in the programming are:

(1) turn on the Program switch,
(2) turn the rotary switch to Channel,
(3) press the desired single program button,
(4) press the Channel Up or Channel Down button until the desired TV channel number appears in the display,
(5) press the Tune Up or Tune Down button until the desired TV program appears in the screen,
(6) press the Store button,
(7) repeat steps 3 through 6 for tuning each of the desired programs,
(8) turn the Program switch off.

Empty or unused programs may be all set to channel number "0,0." They will be skipped rapidly during program selection.

The Economega II system just like the previous two Omega systems also has muting operation which blanks out the tuner during program changes. However, one unique feature that previous systems do not have is the VHF Lock. When pin 29 of the voltage synthesizer is set at a logic "1" or at the "Lock" position, the tuning data stored in the first 12 VHF programs can not be erased or altered by the user. ET/D

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Electronic voltage regulators

Getting to know them

The author takes you on a familiarization tour of today's modern "invisible" IC voltage regulators, with troubleshooting hints and a list of the basic IC families.

By Bernard B. Daien

For decades electronic voltage regulators have been used in test equipment, industrial electronics, medical and scientific apparatus, and commercial power supplies. Recently various forms of electronic voltage regulation have been incorporated into color TV's, high fidelity phono turntables and tape decks, and video tape systems, But the biggest single incentive towards electronic voltage regulator progress has come from the computer field, where many regulators are used in a large system, and consequently have a significant impact on size, weight and price.

The computer people have been concerned with regulator efficiency, since inefficiency means heat, and heat means blowers and coolers, which translates again into size, weight and price. It also translates into higher power consumption, and rising electrical energy costs have made users very efficiency conscious. Together, these factors have influenced a revolution in voltage regulator design, which is now being felt even in consumer electronics, and has been felt in industrial electronics for some time.

The voltage regulator revolution dictates that the technician update his knowledge in the field of electronic voltage regulators, which, like most modern circuitry, is now largely available in integrated circuit form.

Critical parameters

It is generally accepted today that electronic equipment must operate over the range of 105 to 130 volts on the AC line. Brown outs often reduce this still further and momentary drops occur when air conditioners and other heavy loads come on the line. With digital circuitry, momentary undervoltage can cause loss of information, with consequent erroneous results. (And some logic families operate only over very narrow supply voltage ranges.)

But there are other considerations, other functions, performed by voltage regulators which are less apparent. For example, since many different signal circuits may be powered from the same supply, some means must be employed to prevent interaction. A TV set is a good example of this, where the video amplifier, the vertical, and the horizontal deflection circuits often are derived from the same source. Thus we have signals from 30 Hz up to 4 MHz on the same supply line, and the way we handled it in the old days was to use plenty of "decoupling filters," big electrolytic capacitors. When the vertical amplifier decoupling capacitor opened, there was 60 Hz sawtooth feeding back into the horizontal (and thus the keyed AGC line into the IF), and the video and other circuits. Symptoms appeared everywhere.

Now let's suppose that the circuit used a 100 mfd decoupling capacitor ... that turns out to have an impedance of about 30 ohms at 60 Hz, not very low for a bypass capacitor. If we use a good voltage regulator in the power supply, the output impedance of the regulator would be about 3 milliohms, or the equivalent of a capacitor of one farad! In case you are curious as to how we arrive at the output impedance of the regulator, here it is: We place an electronic load on the supply, such as an audio amplifier. We vary the output current drawn from the supply, and measure the resulting change in voltage. Thus if we change the current one ampere, at a 60 Hz rate, and the voltage changes one volt, then, by ohms law, $Z_{out} = \frac{\text{change in voltage}}{\text{change in current}} = 1$ ohm.

Since the output change in a modern regulator is in millivolts, the output impedance is in milliohms. What we are really saying is that a voltage regulator is also inherently a very good decoupling filter. By using a modern IC voltage regulator we not only get regulation, we also eliminate the need for big, heavy, costly, electrolytic capacitors.

The multiple regulators

But we go even further. Instead of using one large, hot, high power central regulator, the trend is toward using several small IC regulators, mounted on the modules (PC plug-in boards). This means we are using low powered, cool, inexpensive regulators, right where they are needed. We thus avoid even the impedance of wiring between the regulator and the load, which can be appreciable at video frequencies. And we do not need heavy heat sinks. These are called "on-board" regulators, for obvious reasons.

Once we go to several small on-board regulators, we get a free bonus ... each regulator can be at a different voltage if needs be, to obtain optimum performance from the particular module.

Now we get another bonus. Have you ever seen what happens to a system when the regulator fails? If the series type regulator fails shorted, or the shunt type (zener) regulator opens, the output

voltage goes high, and all semiconductors on that line are zapped! With several regulators, only the components using that particular regulator are damaged. That is a BIG bonus to the service technician.

A different approach

Now how do we solve the efficiency problem previously mentioned? There is a whole new family of commercial IC "Switching Type" regulators, which work on a different principle than the series, or shunt type of circuit. Look at Figure 1. In some ways it is similar to the pulsating relay type voltage regulator that was used for so many years with automobile battery charging systems.

With 20 volts unregulated, applied to the input, current flows through inductor "L," and charges capacitor "C." When the output voltage across C rises to over 10 volts, the relay is activated, pulling the armature down and interrupting the flow of current through L. C stops charging and the output voltage stops rising.

The magnetic field in the core of L collapses, creating a counter flow (discharge current). Like any collapsing field (auto ignition coil), a high voltage would be generated by the counter emf, but in this case we have placed a "catch diode" with reverse polarity at the input to the coil, across the switch contact to ground. This functions just like a TV damper diode, it "catches" the discharge of L and dumps it into C, just the way the damper rectifier dumps the charge into the boost capacitor. So the energy stored in L winds up charging C, and C sees a fairly continuous current charge.

Now L also performs another function. When the switch closes again, as the output voltage fails due to the load discharging C, L prevents a heavy inrush current as C charges. This inrush not only is hard on the switch contacts, it also takes short, heavy, current pulses from the power source, and causes radio frequency interference over a wide band of frequencies. Since an inductor opposes a sudden change of current, L forces the current to rise gradually. The result is a *small*, ever changing, output voltage change, usually a millivolt or so. (Of course, in actual practice, the relay switch is replaced by a solid state device.)

No voltage drop

This circuit is very efficient, since there is no "voltage drop" across the regulator, in the usual meaning of the words. Instead, we use a switch which opens and closes as needed, to charge a capacitor to the desired voltage. If the load changes and tends to drain the voltage on C more quickly, the switch closes. If the line voltage rises, and tends to charge C more quickly, the switch opens. The output voltage depends on the ratio of the switch open time to the switch closed time. The voltage drop across the regulator, which includes the switch, is high when the switch is open (but the current is zero with the switch open) thus the power dissipated in the regulator is I X E at this instant, which is zero! When the switch is closed power is stored in the inductor, and the capacitor ... but if you remember your basic electronic theory, losses in a high quality (high "Q") inductor or capacitor, are very low ... (reactance, not resistance). By inspection, and intuition, you know that the losses must be far less than if we attempted to drop the voltage by means of a resistor, or a semiconductor acting like a resistor.

At this point you may be wondering why we haven't replaced all voltage regulators with switching type regulators. In order to make a switching regulator small and light and inexpensive, we use a small ferrite cored coil, and the small resulting inductance means a high switching frequency in order to prevent core saturation. At high frequencies we can also use a small capacitor. But, at high frequencies we run into the previously mentioned radio frequency interference, which requires shielding and filtering.

And at high frequencies we need power diodes and transistors which are fairly expensive. You know that in the TV sets which rectify some of the horizontal sweep (scan rectified) for power for the low voltage transistor circuitry, special diodes with fast recovery time are required, and the horizontal output transistors, running at 16 KHz, are quite costly too. We can get inexpensive signal diodes to run at high frequencies, but when you try to run appreciable current through a junction, it takes time to clear the charges out of the depletion zone in order to establish an "open circuit" condition again. Thus *power* semiconductors that run at high frequencies cost money. Switching supplies cost money for shielding, filtering, and semiconductors ... and when something costs more it is adopted with reluctance by the manufacturer. Rising energy costs have made these switch type regulators more

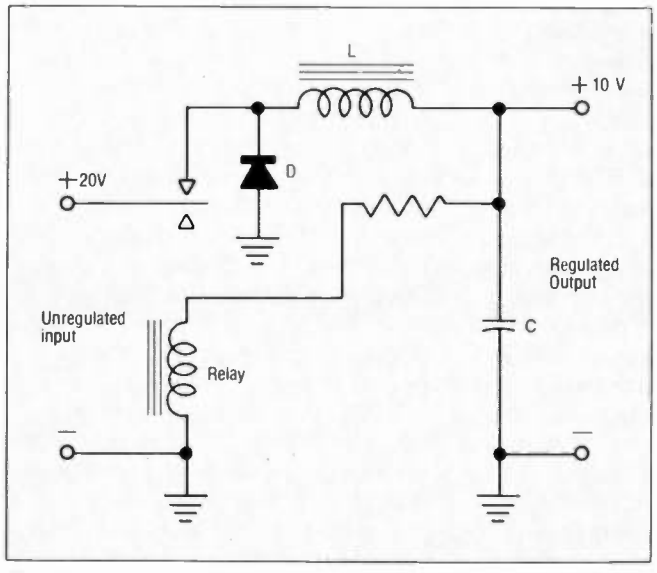

Fig. 1–A basic switching regulator circuit, in many respects similar to the pulsating relay type used in auto battery charging systems.

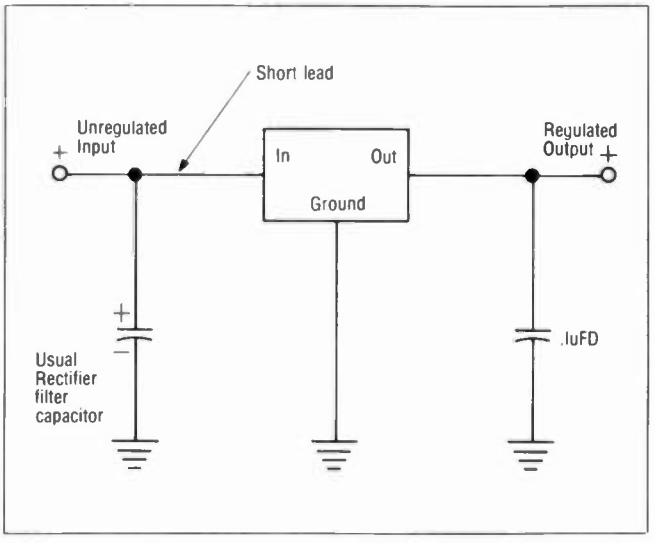

Fig. 2–The three terminal plug-in regulator is the closest thing we have today to a "universal" regulator. Virtually impossible to destroy, these compact devices automatically limit current and shut down when overheated.

attractive, and even the cost conscious TV industry is now using them, and making an advertising point out of their use.

Computer terminals have been using switch regulators for some time, and the technician entering the industrial field will certainly encounter them quite frequently. Many pocket calculators use some form of switching regulator to establish the different voltages required by the read-out, logic circuits, etc.

Three terminal regulators

Until a few years ago power supplies were big business. People either designed their own, which employed engineers and technicians, or they bought supplies from one of the many power supply manufacturers. Of course with such a big market, the integrated circuit manufacturers jumped in and filled the need, as they have in so many other areas. At first the regulators required several external components to set the voltage to the required level, to prevent oscillation, to limit the current, etc. More recently the "three terminal" regulator has become available, and is popular because it is exactly what its name implies ... a three terminal plug in device that is a self contained fixed regulator. It is used as in Figure 2. The only precautions are that the lead between the usual rectifier filter capacitor and the input to the regulator be short, and that a small capacitor be placed across the output terminal to ground close to the regulator. (These precautions prevent oscillation of the internal high gain wideband amplifier.)

Three terminal regulators come in a wide variety of *fixed* voltages, in both positive and negative polarity. If you need a five volt regulator for TTL logic circuitry, you simply buy one, and plug it in. They also come in a variety of packages, from small plastic low current, to metal cased high current for use with a heat sink.

Don't be deceived by the apparent simplicity of these devices, because they do some pretty sophisticated things ... they shut down when overheated (thermal shutdown) due to the combination of voltage across them and current through them. They also limit the current through them to a value which cannot destroy the regulator. In short, they are virtually blow-out and burn-out proof. About the only way to destroy them is to apply an input voltage in excess of the voltage capability of the regulator ... such as a lightning hit on the line, or some other unusual occurence. Even a dead short circuit on the output will not phase them. Simple, and rugged.

Voltage Regulator Guide

Positive fixed three terminals regulators.
7800 Series. Available in various packages with output currents from 100 ma to 3 amperes, in voltages from 5 volts to 24 volts. Temperature drift 1 millivolt per degree centigrade. Ripple reduction 5000 typical. Load and line regulation about 100 millivolts each. Thermal and overcurrent protection internal.

Negative fixed three terminal regulators.
7900 Series. Available from 3 volts to 24 volts, with somewhat better performance specifications than the positive regulators above, otherwise similar.

Adustable three terminal regulators.
LM 117 and LM 317. Positive only. Adjustable 1.2 to 37 volts. Output current capability over 1.5 amperes. Internal thermal and overcurrent protection. Similar performance specs to fixed 3 terminal regulators. New devices are scheduled for this family.

Dual tracking regulators.
These devices come in the following voltages, depending upon the manufacturer, +5 and -5, +12 and -12, +15 and -15, +18 and -18, +12 and -6, +5 and -9, +5 and -12. It is advisable to consult the various manufacturers data sheets as these specifications are variable, depending on the source.

The "Universal" regulator

Not long ago, a new 3 terminal regulator was announced that is adjustable from a little over a volt, to almost 40 volts, at 1.5 amperes ... this is a positive regulator, and by the time this is in print someone will be working on a negative polarity counterpart. As you will see later, it is easy to raise the current level of any regulator by adding power transistors to handle the extra current, so we have an almost-univeral regulator now. There is now very little reason for any one to design, or buy a regulated power source, when for most applications, we can plug in a three terminal regulator and do the job adequately.

These 3 terminal regulators are series type devices. In the past it was difficult to use low voltage series regulators because the internal reference was some form of zener device, in the 6 volt range in order to achieve a low temperature coefficient. With a 6 volt reference it required different circuitry to obtain voltages over 6 volts, and under 6 volts, regulated output. Voltages over 6 demanded an amplifier with gain, since the output exceeded the reference ... while voltages under 6 demanded circuitry that ran at less than unity gain (a loss). One circuit could not do both well. The new adjustable 3 terminal regulators solved this problem by means of a precise reference under a volt, which does not depend upon zener diode action, but instead is based upon the forward conduction of a junction.

Since much has been written about the internal circuitry of ICs in the past, this article will not be concerned with that aspect. Rather the space is spent upon the characteristics, applications, and troubleshooting of the regulators ... the practicalities of the devices required by a technician. The writer feels that it is no more necessary to understand the construction of an IC now, than it was to know how a vacuum tube was made in the tube days, in order to use and troubleshoot vacuum tube equipment.

Dual tracking regulators

Some types of operational amplifiers require both a positive and a negative supply, so that the output can swing positive or negative with reference to ground. Certain configurations of transformerless power output stages similarly require dual power supplies. In digital logic we have a parallel situation, with some logic families requiring dual power sources. All of these dual power supplies have one thing in common, both the positive and the negative supply are supposed to be equal. If they are not closely equal, the circuitry being powered becomes "unbalanced," i.e., there tends to be an output signal when no input signal is present, or, as the power supplies fluctuate a similar fluctuation appears in the output. If the power sources are balanced and the circuitry is performing properly, we achieve "common mode rejection," which means that, among other things, variations in the power supply voltage do not appear in the output.

In order to meet these needs, dual tracking regulators have been developed, which consist of two regulators on one chip, so configured

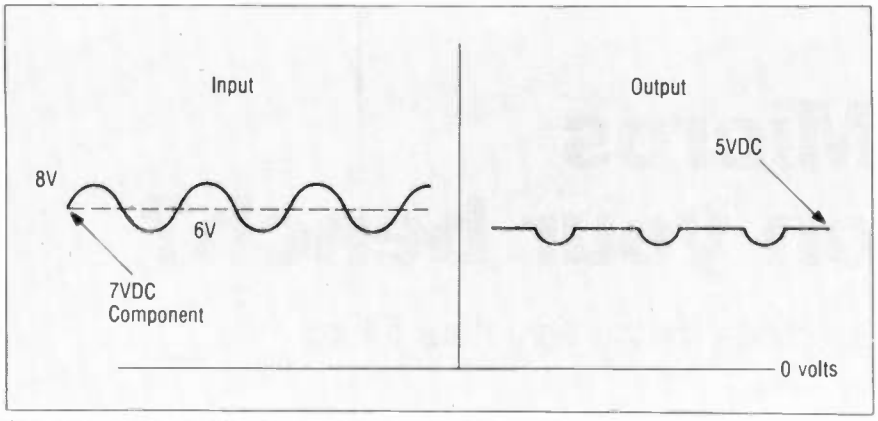

Fig. 4–Input versus Output voltage for a +5 volt regulator.

that one tracks the other. If one shifts, the other shifts by the same amount, so that, for example, the outputs are +15 volts, and -15 volts with respect to ground. If the +15 volts shifts to 15.1 volts, the negative will also shift to -15.1 volts.

Dual tracking regulators usually have one or two external resistors which are selected to tighten up the tracking. In addition, there are the usual precautions that apply for bypassing, short leads, etc. These regulators are of the series type.

Figure 3 is a table listing the different types of popular IC regulators, and their characteristics, to aid in selecting, using, identifying, and troubleshooting these devices. (You can use these device numbers to locate substitutes with service type identification in the Sylvania ECG, Motorola HEP, RCA, SK and similar series.) They are generally in stock in electronic industrial supply houses.

Troubleshooting

Troubleshooting these regulators requires an oscilloscope in order to look at the output, in the event of loss of regulation, or ripple in the output. (A properly operating regulator has so little ripple in its output that it takes a high gain scope to look at it.) In the event that the regulator is oscillating, due to long leads, poor contacts, or inadequate or defective bypass capacitors, the output regulation may suffer. Oscillation is readily detectable with a scope.

Figure 4 illustrates the most common cause of regulator problems. The specifications for the 7800 series of positive 3 terminal regulators calls for an input voltage 2 volts higher than the rated output voltage. This allows a 2 volt internal drop in the series circuitry. But we must ask what the input voltage looks like ... because if it is rectified and filtered 60 Hz it is going to look like the input voltage of Figure 4, which is a 7 volt D.C. component (as measured on a VOM), *with 2 volts of peak to peak ripple*. You may wonder why the ripple is so high ... well, we may be using an electrolytic filter capacitor in a cold environment, in which case the capacity becomes quite low ... or we may have an aging filter cap which has lost much of its original capacity.

The regulator is a 7805 ... a 5 volt regulator commonly used for TTL digital logic power supplies. The output is supposed to be a nice clean 5 volts ... but look at the "down" pulses. Of course the ripple on the input drives the instantaneous input voltage down to 6 volts, which is only one volt higher than the output ... and we need a two volt difference to be safe. There is not enough voltage available for the series element to function when the line voltage is down to 105 volts, at full load, and with all that ripple. The scope will tell the story. A simple problem, but it has been diagnosed too often as a faulty regulator because of the output ripple.

Thermal shutdown

Now assume we have a regulator that appears to be intermittent, because the output goes to zero after a short period of operation. Cooling the regulator with a freon coolant spray restores normal operation, in the customary test for intermittent semiconductors. But, the regulator is OK, and substituting another results in the same symptoms. Remember ... these devices have thermal shutdown in their design ... when they overheat they turn themselves off. What can cause overheating? Inadequate heat sinking, heating by nearby hot equipment, overloading. A defective load which places extra current drain on the regulator can cause it to overheat. A dirty air filter in an air cooled instrument can result in thermal shutdown. Excessive input voltage causes higher internal drop in the regulator, increasing power dissipation. How to detect it? A thermometer on the IC case ... or the old finger test ... can give a pretty fair indication of the trouble.

Another cause for shutdown is just plain excessive current, beyond the regulator's current rating. Every time the load overloads the regulator, it limits the current to a safe value, and in consequence, the output voltage falls off.

The regulator can also fail to regulate at very light loads, since some current is required for normal operation. If all the loads tend to reduce sharply under certain circumstances, it may be necessary to add a bleeder on the regulators output in order to insure a minimum current of a milliampere or so.

There is another potential problem that can occur, and is often not anticipated. Suppose the input voltage source drops to zero momentarily (AC line drop out). If the various loads on the output of the regulator incorporate capacitors, and if the load current is light, it will take an appreciable time for the capacitors to discharge. Thus the output voltage may still be near normal, while the input voltage is quite low. The result is a reverse bias placed across the regulator. With some devices this can cause internal damage to the regulator.

What are the symptoms of a defective voltage regulator? If the input voltage is several volts higher than the desired output, current is within specs, the device is not very hot, there is no oscillation evident, and the input ripple does not push the input voltage down too far for proper operation, then the device should be replaced when regulation is poor, or the output voltage is out of limits, or there is excessive ripple in the output.

Miscellaneous regulators

There is a family of fairly complex regulators which are really variations of the operational amplifier, with an internal zener voltage reference. The op amp is programmed, via external feedback resistor networks, for any desired gain. The result is an output which is the reference voltage multiplied by the gain (or loss) programmed. Since op amps can be made to respond at fairly high speed, they can have the output change very quickly when that is required. By using thumbwheel switches with ten positions, resistor decades can be used in the feedback network to "digitally" program the desired output voltage with very high accuracy. Thus with 3 thumbwheels we can, for example,

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Micros on your bench?

Directions for the very near future

Mr. Roberts believes it is no longer feasible for the electronic servicing community to consider computers as part of another technological reality.

By Steven K. Roberts*

One of the most popular predictions for the future made by writers of recent decades has been that computers will find their way into our homes—not only as data processing machines, but as the "brains" of appliances as well. The anticipated date of this event was usually assumed to be somewhere in the 1990's but here the accuracy of the predictions fails. One must take into account the noncontinuous nature of technological development: every now and then a single major advance is made whose consequences alter all future growth.

Such an advance was the development of the microprocessor. By this time, micros need little introduction ... they are popping into our lives with ever-increasing frequency, almost uncannily heralding a day when even the average house in suburbia is an intelligent system, responsive to the varying needs of its occupants and host to scores of so-called "smart" appliances.

It is no longer excusable for members of the electronic service community to consider computers as part of another technological reality. They are cheap, easy to design with, and effective in a wide range of products, and no manufacturer with an eye turned toward profits can afford to ignore situations in which the microprocessor is an appropriate design solution. In this article we will open with a discussion of this appropriateness, looking at some of the problems encountered in the design of a "typical" appliance, and at the areas in which it is wise to use the new smart hardware. A good understanding of this philosophical background is the best place for the service technician to start in learning about the nature of his or her future work. If it is allowed to become a surprise, the agony of technical obsolescence will soon follow.

Mr. Roberts is president of Cybertronics, Inc., a microprocessor engineering firm in Louisville, KY. The firm designs custom control systems with an emphasis on serviceability.

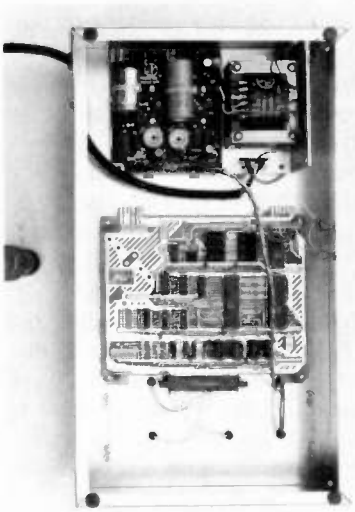

Fig. 1–Single Board Microprocessor Systems. Industrial-grade unit from Intel (SBC 80/40) is shown mounted along with a power supply. The large IC near the edge is the processor; the other large IC contains a programmable timer, 256 8-bit words of scratchpad memory, and three ports for communications with the outside world. The two empty sockets await the program memory devices. This unit is used in the author's development system to simulate industrial control computers.

Why a microprocessor?

Designers of consumer products have, in addition to the primary requirements of low cost and good reliability, a number of secondary design criteria that govern many of the choices they make in the product development stages. They need to be concerned with a future repairability, and with keeping at a minimum the number of different parts necessary for factory support. Additionally, if parts can be shared between different models of a given product, or even between different products, the massive costs of inventory can be held to a reasonable level. As anyone who has to maintain a repair parts inventory knows, a lot of rapidly devaluing dollars can wither away on the shelf in the form of components that further worsen the problem by slowly becoming obsolete. Manufacturers face the same problem, but on a larger scale.

As a result, various techniques have been developed over the years to allow as much component interchangeability as possible. Sometimes the consumer is scalped anyway, by giving identical parts different numbers corresponding to the product involved, but the more a manufacturer can reduce inventory levels, the happier he is.

It is thus natural that the development of a device which allows a wide range of functions to be performed by identical hardware, with changes only in the programming, would be greeted by appliance manufacturers and others with considerable enthusiasm. Using one standard microprocessor card, a designer can handle the timing of a dishwasher, the control of a stereo tape deck, the "intelligence" of a color television, or the processing functions of a piece of test gear. The differences between the applications lie in the software, stored permanently in solid state memories, and once written and debugged, it never fails. Ninety-five percent (95%) of the design is intangible, leaving only a few standard components to be swapped if the

Fig. 2–Microprocessors form the basis for this Video-Brain (TM) Family Computer System which is compatible with any home television set. Shown here is basic unit, retail about $500, a data storage unit, retail about $150, and a typical program, retail about $70, such as the Video-Brain Money Manager program for home income, expense and credit calculations.

system breaks down.

The modular concept

It may be seen, then, that these complex devices actually simplify the service task. A few basic concepts will enable the technician to localize the source of a problem to one of a few specialized subsystems, which are then merely swapped. From a service viewpoint, this amounts to an extension of the modular concept (like Zenith) to include a wide range of products, but with the modules themselves sometimes being merely large integrated circuits.

Chip-level replacement may at first sound disturbing to anyone who has ever had the opportunity to poke around on a board full of IC's, but it must be kept in mind that the arrival of the microprocessor has completely changed the structure of hardware logic. The old way is called "Random Logic" and its complexity arises from the fact that functions are performed by a very large number of very dumb devices which, although far more compact than discrete transistors, still require a technician to understand device timing, loading conditions, Boolean Algebra, and other troublesome topics that can scare away all but the most ambitious of service personnel. As the technology matured, more and more functions found their way inside the IC's, reducing the number of devices necessary and generally simplifying their interconnection. With the microprocessor, we have reached a major plateau: all of the "smarts" are in a chip or two, and the rest of the circuit merely interfaces the intelligent devices with the hardware being controlled. This clean functional division has revolutionized the field of digital logic troubleshooting.

It is worth noting at this point that digital logic is taking on far more importance than ever before. Not only is it being used for the obvious applications of control, decision making, and switching, but it is in the process of replacing almost all traditional forms of analog signal processing. The tricky circuits of tuners, filters, discriminators and the like, fraught with thermal sensitivity, critical components, and the need for adjustment, can be replaced far more efficiently with digital circuitry. Once a signal is converted from a voltage variation in the time domain into a stream of data, it is insensitive to noise, drift, and similar problems, and it can even be merged with error-correcting codes to guarantee perfect processing. It has become evident in the last few years that the world of electronics is in for some very significant changes.

Computerized time

As an introductory example of the appropriateness of a micro, let's look at the design of a fancy alarm clock. The marketing department of our clock company has told us to allow the user to select the snooze alarm time delay, and the number of times it repeats before it becomes persistent. Also, we want to allow a choice between three different alarm sounds and the radio.

Now, this is not a particularly

outlandish set of requirements, but if we approach the problem with old-fashioned alarm clock mechanics, it quickly becomes absurd. So we move on to digital circuitry, perhaps even using one of the "clock chips" that incorporate all the timing and display logic. We build the clock chip onto a board, along with enough custom logic to handle all of the specified options. Expensive, but nice.

Then marketing comes along and requests a model that not only does what the last one did, but also allows the user to preset different wake-up times for weekdays and weekends. Suddenly we have to make the clock remember which of seven possible days it is, and act accordingly. Depending upon the extent to which the circuitry is different, we either design a complete new circuit board, or tear into the last one and make additions. The net effect is a lot of costly engineering time, inventory requirements for two similar boards with different features, and a total lack of flexibility to accommodate marketing's next whim.

The solution is the use of a microprocessor. The redesign is still necessary between models, but it is only a programming change which, once accomplished, costs essentially nothing to duplicate. The program chips for the different models are merely plugged into identical circuit boards as product demand warrants. When marketing requests display of two time zones, we merely generate a third version of the code. Net cost: design time only. No production changes are required.

Now let's take a look inside the clock. In our next article, we will treat a typical application in detail, but the basic idea is easily expressed.

The basis of decision-making

The microprocessor is nothing more than a very unimaginative device that does exactly what it's told, step by step. The instructions that it is given are each very simple, and are stored in the form of binary codes in the program memory (ROM, or Read Only Memory). Each instruction directs the processor to perform a single logical operation, such as add two numbers, fetch a piece of data from a certain location in its "scratchpad" memory, or start performing the instructions in another area of program memory. This last one is a key point—forming the basis of the machine's decision-making capability. Normal program execution proceeds in a simple sequential fashion (the first instruction is at location 0, then 1, then 2 ...) until the processor encounters an instruction that says, "Jump to Location XXXX." An important class of these instructions is in the Conditional Jump Group, where the transfer of execution is made only if a certain condition exists.

Follow instructions

For example, the instruction at location 145 may be "Subtract one from the value of A." Then, at location 146, there may be a statement that says, "If A is equal to zero, jump to location 267." The processor will check the value of A (from which 1 was just taken), and if it has reached zero, off it goes to 267—but if not, it merely proceeds to the next location, which is 147. It may be seen that this concept allows logical decisions on the basis of the value of the data, and there are no restrictions on the combinations of these simple steps.

In the design of the clock, we can even take advantage of the timing predictability of the microprocessor to eliminate more hardware. Each instruction takes a very precise amount of time, which is a function of the crystal clock that runs the system. By building software timing loops, and by having the processor "read" the positions of the various switches and controls on the clock, a clever programmer can completely eliminate all hardware from the design except for the processor and its memory, the controls, and the output devices (display, alarm, radio). The resulting unit is such a general design that only trivial changes are necessary to make it into a different model.

Instruction execution theory

If that went by a little fast, don't panic. In the next article we will take it step by step. Once the single basic idea of instruction execution is grasped, along with a feel for what types of instructions are possible and how the thing is interconnected with the outside world, the technology of the microprocessor is yours.

From a service standpoint, our computerized clock is a dream. All we need to stock for replacement parts, in addition to the usual items like the display and switches, is a single processor board and a ROM chip for each model the company produces, containing the code that makes that particular model unique. The cost of these memories is less than $5 each, and that of the processor board is around $20.

Where to now?

Based upon the foregoing, perhaps the most significant single comment we can make is that there is nothing to fear. This may sound patronizing, but the greatest single human opponent to technology is the lack of understanding that results from fear of the unknown. It is the force that makes many engineers become obsolete, that creates anti-technology political factions, that limits federal spending on new energy research, and that so often freezes an individual's personal growth at the peak of his career. Fear.

Perhaps the major source of that fear is concern over the possibility of failure, or of getting "stuck." In this business, we are closely integrated with technology, yet too often we can find ourselves treating hardware as something to be conquered—something external—and we thus fall into an "ego trap" in which we cannot be comfortable until the challenge is met. This type of psychological approach to equipment services does indeed provide a motivation to succeed, but the personal price paid is a stiff one.

Consider instead a type of psychology in which the work being done is always treated as a growth experience. The TV on the bench is not a frustrating object to be beaten into cooperating submission, but is instead a theater of interaction with the world, an opportunity to express your creativity and technological awareness by working *with* it, in harmony. If the business of service is approached in this light, new technologies like that of the microprocessor are rich opportunities indeed to broaden your intellectual horizons and put your understanding of electronics to rewarding use.

The observation that this psychological discussion leads up to is that it is time for some personal decision making. We are just seeing the beginning of a major technological era, one which is being more and more frequently described as "yesterday's science fiction come true." Everything is in for major evolutionary changes: direct satellite transmission to homes, personal computers for everyone, whole new fields of entertainment electronics, high-technology hobbies, wide bandwidth communications ... the list

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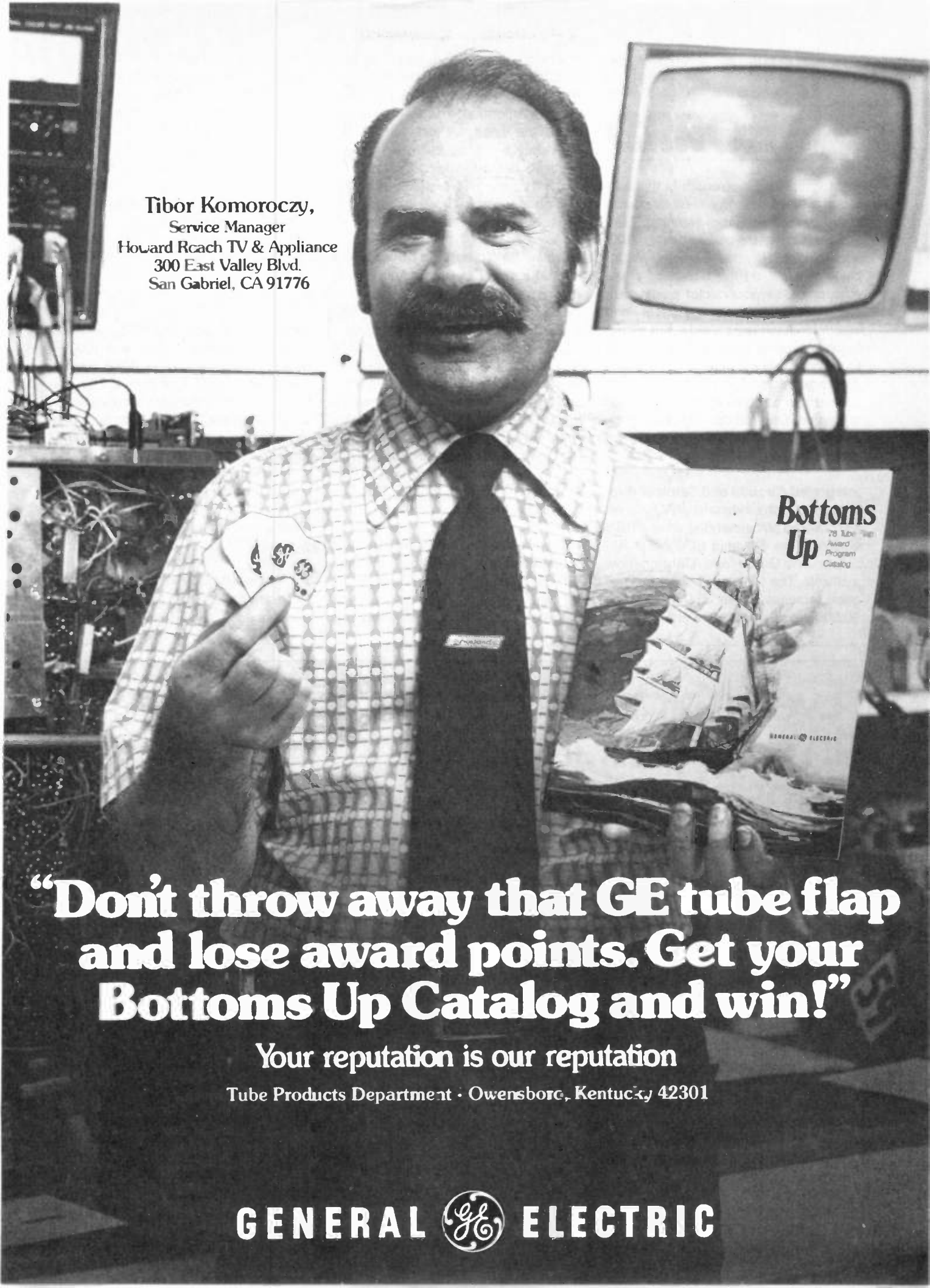
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GENERAL ELECTRIC

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Photographic Electronics is the subject of a new 8-lesson self-study course currently available from National Camera, Inc. Cost of the course, under $100, according to National Camera, will include lessons on the basics of photo electronics, semiconductor electronics, electronically controlled shutters, and electronic flash units. Audio visual materials covering specific cameras and techniques are optional portions of the program. Information on the self-study course may be obtained by writing *Photographic Electronics, National Camera, Inc.*, 2000 West Union Avenue, Englewood, Colo., 80110.

Integrated Circuits and Semiconductors used in the industrial MRO market are covered completely in the new 1978 edition of the Sylvania ECG MRO Replacement Guide and Catalog now available. The 164-page publication has been increased from 35,000 to some 60,000 industry part numbers. The new catalog also contains 72 pages of technical data for listed types, including logic diagrams, pinouts and package drawings, plus information on devices added to the line since the last edition. The expanded digital integrated circuit section describes 340 types of CMOS, TTL, DTL, HTL, and RTL logic modes. Now available from *Authorized Sylvania Electronic Component distributors*.

A Japanese Transistor Substitution Manual is now available in its first edition from Fuji-Svea, Inc. The catalog covers the 2SA, 2SB, 2SC, and 2SD series of semiconductors. It contains the most up to date substitution information from Japan. The material is presented in clear, easy-to-read format and in introduction provides the basic information needed to understand what is available in the way of Japanese semiconductors. The new manual retails for $5.90. Write *Fuji-Svea Enterprise*, a division of Fuji-Svea, Inc. Dept. P.O. Box 40325, Cincinnati, Ohio 45240.

A New Tuner Replacement Guide & Parts Directory is available now from PTS Electronics. With a list price of $5, the new 182-page directory contains technical information on TV tuners and modules, tuner blow-ups of all makes, diagrams and comprehensive descriptions of PTS products and services. Also included is a section on module repair, a list of all modules rebuilt and exchanged, a module cross reference guide, troubleshooting information, a section on PTS instruments, tools and chemicals, and list of exact tuner replacements. The catalog is available from any of the 43 PTS-owned servicecenters located in the United States, or from *PTS headquarters*, P.O. Box 272, Bloomington, Ind., 47401.

Replacement Antennas and Accessories for television, FM, and mobile two-way radio are featured in the newest catalog from RMS Electronics. The 36-page publication illustrates and describes all of the products handled by the firm, including, in addition to antennas and accessories, filters, cables, adaptors, connectors, speakers, matching transformers, and MATV systems equipment. Available free from *RMS Electronics, Inc.*, 50 Antin Place, Bronx, N.Y. 10462.

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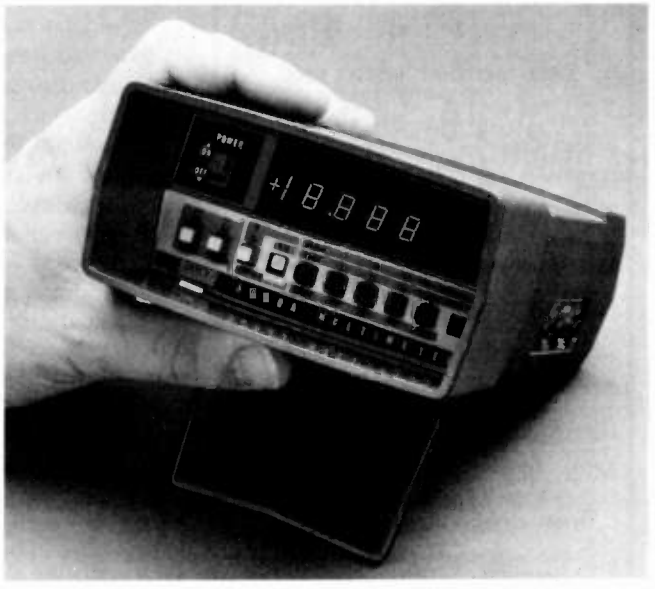

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Special Products Division. Although similar to past RCA 3-package programs, the new QT program includes a single package of 150 of the most-needed parts. As described by RCA Parts Management Director D.R. Weisenstein, "The new program also includes a Direct Information Service (subscription) for dealers, and drop-shipping of parts to keep dealers' basic inventory up to date." The package of 'most-needed parts' is a basic selection of fastest-moving color and black-and-white TV parts. Color modules are available in separate kits. For further information, contact Rhys Samuel, *Parts Merchandising Manager, RCA D&SP*, Deptford, N.J. 08096.

A new RF Selector Guide and Cross Reference from Motorola provides a thumbnail description of RF power transistors, RF power hybrid modules, linear RF amplifier hybrid modules, and small-signal, high frequency transistors. Power transistors and modules are categorized by frequency range and application extending from 1.5 MHz HF/SSB to 900 MHz FM mobile radio. Linear hybrid amplifier modules are highlighted for CATV and general purpose wideband applications. The guide is available free at *Motorola sales offices and distributors*.

A Microfiche Parts File is now available to Sony dealers and authorized servicers with comprehensive price and substitution information on all parts for the firm's consumer, business, industrial video and hi-fi products. With the new service, parts information is compiled on 4 inch by 6 inch microfiche cards. And, an entire packet of 18 fiches—which easily fits into a medium-sized envelope—will replace the equivalent of 3,726 pages of printed material. The service is on a subscription basis at $4 per month. Fiche packets are mailed to subscribers monthly. For more information, write *Sony National Parts Dept.*, 47-47 Van Dam St., Long Island City, N.Y. 11101.

The Latest Instruments Catalog has now been published by Heath/Schlumberger. The new publication features the firm's line of fully assembled and tested computers and peripherals and gives complete descriptions and specifications for their line of electronic test instruments, including oscilloscopes, laboratory grade strip and X-Y recorders, power supplies, various signal and function generators, counters, a full line of multimeters from analog to digital, and a complete selection of associated accessories such as probes and interconnecting cables. Available free from *Heath/Schlumberger*, Dept. 570-030, Benton Harbor, Michigan 49022.

Marine Antennas and Accessories are featured in a new catalog produced by Shakespeare Electronics. The full-color catalog features the complete selection of Shakespeare CB, VHF-FM, SSB and Loran Marine antennas. Included are the 36 inch Little Giant CB antenna designed for bass boats to the 35 foot heavy-duty SSB and high frequency antennas for the largest ocean-going ships. Shakespeare antennas are made of fiberglass with conductors embedded in the fiberglass. Catalog is free from *Shakespeare Co.*, P.O. Box 246, Columbia, S.C. 29202.

A Guide to Profitable Rental of Sound Equipment is the subject of a new brochure, "Sounding Off About Rentals," available now from Perma Power. The eight-page brochure is designed for two distinct categories of reader, the operator of a rental company, who needs advice about sound equipment; and a distributor or dealer in sound equipment, who needs advice about rentals. The publication covers the market for rented sound equipment, the basic considerations for being in the business, setting rates, selecting equipment, training personnel, handling rental transactions, maintenance, advertising and promotion. It is free from *Perma Power Electronics, Inc.*, 5615 West Howard St., Chicago, IL 60648.

A new Video A/D Converter is described in a new 12-page data sheet from TRW Products. The literature describes the firm's 30 MHz, 8-bit analog-to-digital converter which is packaged in a 64-pin DIP and is said to be suited for commercial TV and other digital signal processing applications. Included in the data sheet is detailed information on an optional, edge-connected, printed circuit card that hosts the 2-watt device. Free from *TRW LSI Products*, P.O. Box 1125, Redondo Beach, CA 90278.

A New Linear and Interface Circuits Master Selection Guide is available now from Texas Instruments. The publication, CL-329, is a product selection guide and catalog designed to provide engineers a convenient reference to the firm's line of linear and interface circuits. Included is a cross reference guide with package and temperature designations.

Available free from *Texas Instruments, Inc.*, Inquiry Answering Service, P.O. Box 5012, M/S 308, Dallas, Texas 75222.

Power Transistors are described in the latest catalog from Kertron, Inc. The 28-page catalog covers more than 1000 types of transistors. Included are: NPN-PNP Planar Power transistors from 2 amps to 60 amps, fast-switching power transistors, triple diffused—low and high voltages, power darlingtons--monolithic and discrete, diodes—fast recovery, hybrids and chips—standard and custom types. Available free from *Kertron, Inc.*, 7516 Central Industrial Dr., Riviera Beach, Fl. 33404.

Electronic Servicing Aids, including various chemicals, solders, and a line of servicer's business aids such as service forms and pricing guides are included in the latest catalog from Tech Spray. Designated Catalog FB-10, the new literature is available free from *Tech Spray*, P.O. Box 949, Amarillo, Texas 79105.

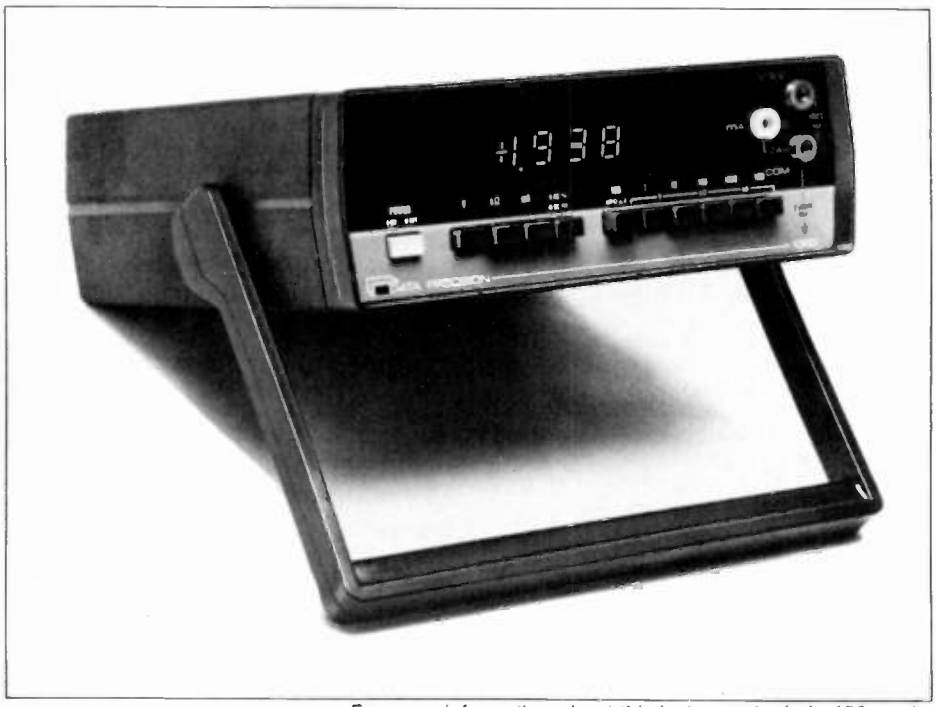
Audio Accessories are the subject of a new 20-page catalog offered by EV-Game, Inc. The catalog covers a newly introduced line of audio accessories, including shielded and unshielded cables, flexible "Y" adaptors, solid shielded adaptors, audio plugs and connectors. It also contains sections on record and tape care accessories. Available free from EV-Game, Inc., 186 Buffalo Avenue, Freeport, N.Y. 11520.

Television Servicing Aids, such as yoke adaptors, convergence plugs, yoke matching systems, CRT adaptors and extension cables are listed, priced and described in the latest literature from R.J. Dowd. Included in the literature is an adaptor reference for solid state chassis and a reference for tube chassis. Also included is information of the CC-14 and CC-19 test jigs. Available free from *R.J. Dowd Enterprises*, Box 315, Media, PA 19063.

General Electric Company has announced the addition of 35 new devices to its expanding line of replacement semiconductors. The additions include two transistors, six industrial rectifiers and 27 TTL logic integrated circuits. All of the new devices are immediately available to GE electronic components distributors. GE reports that *GE Tube Products Department district sales managers* can supply complete details on the new entertainment semiconductors. **ETD**

Circle No. 136 on Reader Inquiry Card

TEST INSTRUMENT REPORT



For more information about this instrument, circle 150 on the Reader Service Card in this issue.

The Model 1350 DMM from Data Precision

Designed to eliminate error

Data Precision's 3½ digit Model 1350 Digital Multimeter is an extremely functional and relatively low cost ($169) unit whose pushbutton design and large LED "direct" readout go a long way toward eliminating user error.

In the AC volts mode, the 1350 has good frequency response. In fact, Data Precision states the unit will take a continuous input of 100V RMS up to 2KHz without loss of calibration and in the DC mode will handle plus or minus 1,200 continuously without calibration loss. The unit carries a basic 1 per cent accuracy factor, plus or minus two least significant digits, in the 100VRM/1000KHz range and, a 1.5 per cent factor in the 1000VRMS mode.

With its state-of-the-art LSI technology, the 1350, of course, automatically displays DC polarity. It seems the unit has been designed to eliminate user error. Four function selection pushbuttons and six range buttons (plus the on/off) are all the user need be concerned with. In fact, out-of-range indications don't even show. An out-of-range measurement automatically blanks the 3, 7-segment LED displays, leaving only the "1" LED (plus the polarity sign when used in the DC mode) to indicate an operable meter.

Overall, the 1350 provides 27 measuring function/range capabilities. These are DCV, ACV, DCmA, ACmA, and Hi and Lo ohms. This AC operated, 3¼-pound meter measures DC volts from plus or minus 100 microvolts to plus or minus 1,200 volts, AC volts from 100 micros to a full 1,000 VRMS (calibrated to the Sinewave), resistance independently in both the high 2.8 volts and low 300 Millevolt modes from 100 milliohms to 20Megs, plus both DC and AC current from .1 nanoamps to two amps.

One of the real joys of using the 1350 is that it eliminates need for the operator to recall any kind of display multipliers because of the floating decimal. Readings are taken directly from the .43-inch LEDs in the units selected by the range buttons. For instance, if the operator selected the "1" range, and he was reading a DC voltage of +1.6789, the display would show +1.679; in the "10" range the reading would be +1.68; in the "100" range the display would show +1.7; and in the "1000" range it would show +2. Reverting to the fifth range button (the ohm, microvolt and nanoamp range), this same display would read +167.9.

The 1350 is housed in an injection molded (3 by 8 by 8 inch) case and has a built-in carrying case handle and tilt stand. Standard equipment includes test leads, spare fuse, a one-year warranty, plus a certificate of conformance in relation to National Bureau of Standards standards.

The manufacturer claims recalibration is necessary at one year intervals. **ETD**

Specifications

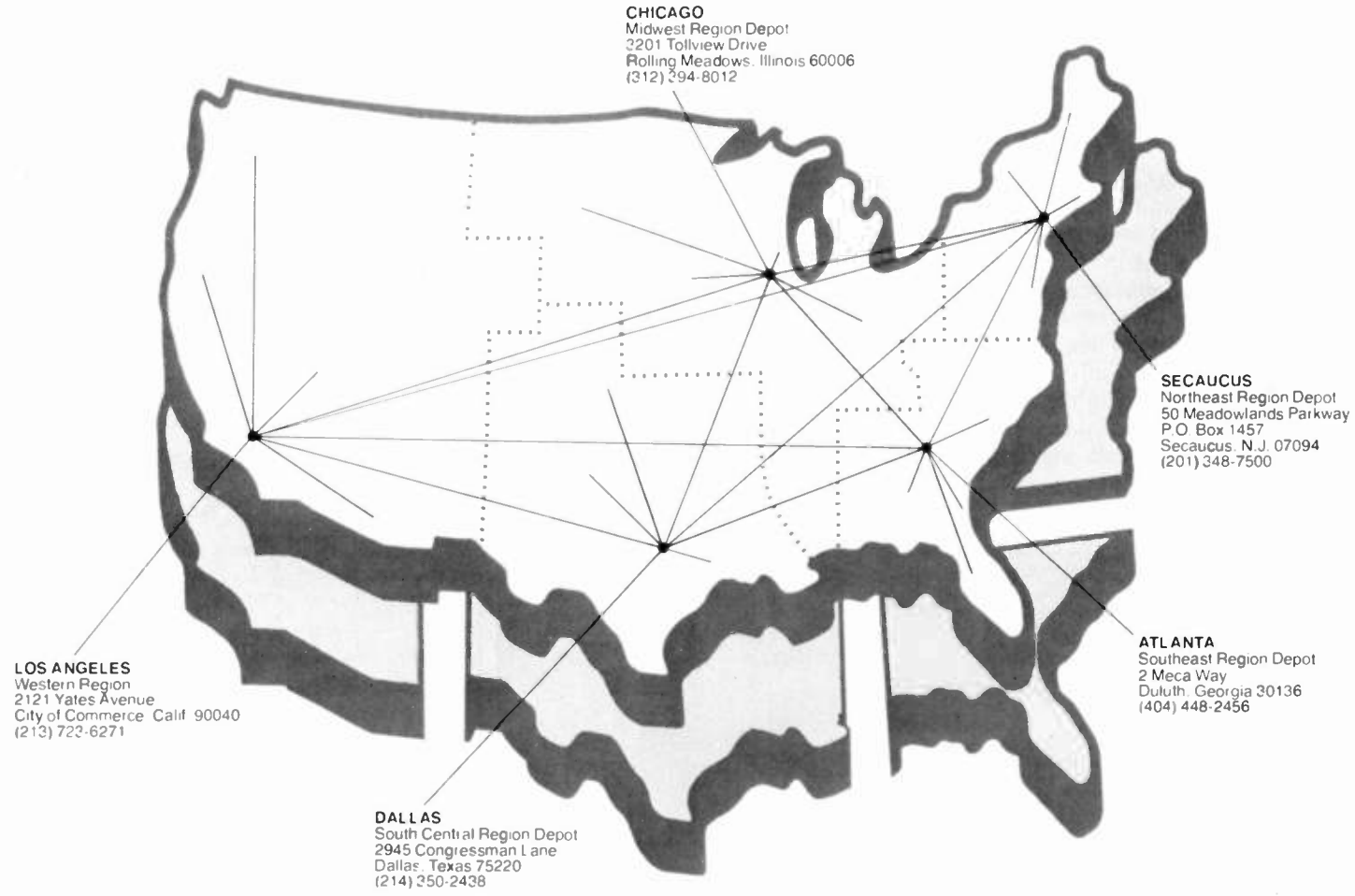
DC VOLTS
Input Impedance: 10Megohm
Maximum Voltage:
±1,200 all ranges; ×6,000V for .5nanoseconds
Accuracy: ±.1% input ±1sd

AC VOLTS
Input Impedance: 10Megohm/100pf
Calibration:
Average Sensing, calibrated in RMS of sinewave
Maximum Input Voltage (Sinewave RMS):
30Hx to 2Khz: 1000V

RESISTANCE
Maximum Open Circuit Voltage:
Hi 2.8V Lo 300MV
Maximum Input Voltage:
500V RMS or 500VDC
Setting Time:
100Ohm to 1,000Kohm: 2 seconds
10MEgohm: 5 Seconds

AC Current: 2 amps
Accuracy:
30Hz to 50 Hz: ±1.5% input ±5 1sd
50Hz to 500Hz ±.75% input ±2 1sd
50Hz to 2KHz ±1.5% input ±5 1sd

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



Recently Panasonic completely redesigned its present computerized distribution network with improvements like:

- **Automatic drop shipment from any one of our five regional depots regardless of where the order originates**
- **Automatic substitutions**
- **Automatic replenishment of regional stocks**
- **On line stock status information**

And the overall result is a binding together of our resources in order to service you better than ever before.

What's more, a facsimile network installed by the Panasonic Consumer Parts Division links each regional depot. These machines are tied to many Panasonic distributors and servicers to receive their orders, instantaneously, any hour of the day.

So now if a part is in stock at any parts depot, you get it.

For more information write to:

Attn: SUPPORT SERVICE DEPT.
Panasonic Consumer Parts Division
50 Meadowlands Parkway
Secaucus, New Jersey 07094

Panasonic
just slightly ahead of our time

Circle No. 134 on Reader Inquiry Card

DEALER'S SHOWCASE

Two-way FM Mobile Radio

Circle No. 151 on Reader Inquiry Card

An FM two-way mobile radio to meet tough MIL Spec 810C for shock, vibration and weatherproof procedure has been introduced by *Motorola Communications*. Called the MITREK radio, the unit is built of die cast aluminum and is said to be weatherproof and dustproof. It features a heavy duty top latch security system and key lock that protects the radio's interior and helps prevent unauthorized tampering. Power levels are 60 watts in low band, 40 and 60 watts in high band, and 30 and 50 watts in UHF band. Intermodulation protection of -85dB is said to help reduce interference even in areas of high channel congestion. It weighs only 10½ pounds.

Base Station Microphone

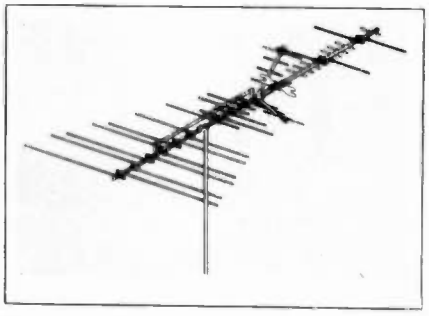
Circle No. 152 on Reader Inquiry Card

A new pre-amplified base station microphone that features a built-in audio meter and external tone and volume controls is new from *Astatic*. The new mike, Model 1104CM, is powered by a 9 volt replaceable battery and allows instant monitoring of audio input and battery output voltage through a base-mounted meter. The tone and volume controls are also located in the base. The 1104CM comes with a six wire coil cord for relay or electronic hook-up, and features an open audio line on receive. The base is available in black, beige or white.

Color TV Antennas

Circle No. 153 on Reader Inquiry Card

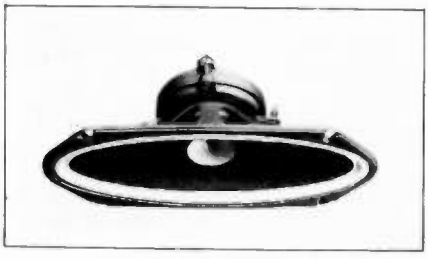
A new line of color television antennas that includes 12 models has been announced by *JFD Electronics*. Called the SuperNova line, the first six models are designed to suit all locations from local to fringe. The second six models include an integral corner reflector-bowtie assemble that is reported to provide extra-powerful reception on UHF channels. Interleaved colinear element design of the new models is said to eliminate the need for parasitics and insulators. Both low and high band VHF elements connect directly to the straight rod phasing system (SRPS), thus eliminating crossover feeder harnesses. This also results in a shorter crossarm that reduces antenna bulk and weight. List prices range from $22.24 to $117.91.



Automotive Speaker

Circle No. 154 on Reader Inquiry Card

A new automotive air suspension speaker, especially designed for rear deck mounting in 1978 intermediate



"Within two minutes from the time a customer calls, a service order is issued. That's *fast*."

"The computer handles the bulk of the time-consuming paperwork. We spend our time on customers."

"Our customers seem to like the system, too. Our overall renewal rate for service contracts is 80 percent."

"The computer helps us give our customers fast, complete service."

James H. (Jim) Bradshaw, President, UHF Television Service, Inc., Chicago, Illinois

A computer partner

1977 was UHF's first full year "on the computer." UHF's two partners—James H. (Jim) Bradshaw, President, and Charles F. (Chuck) Fisher, Secretary-Treasurer—joined forces in 1951 when Fisher was hired by the shop where Bradshaw was shop manager. When their employer lost his TV sales franchise, Bradshaw and Fisher took over the service work with a $250 investment.

Today UHF services all of the metropolitan Chicago area. The bulk of UHF's business involves customers referred from some 20 non-servicing dealers for in-warranty coverage.

The UHF staff includes five office employees trained in the use of the computer, ten field technicians and twelve bench technicians.

Heidi Paturno keys customer service data into computer system. Screen of video display terminal presents data as it is entered.

Field technicians use their own cars—mostly station wagons. All use a routing form prepared by the computer. The form includes customer information and special notes such as "beware of dog" and the customer's description of the problem.

Computer Access to Customer Files

Access to a file is gained by keying in a customer's account or telephone number. Data is read on one of three video display terminals (VDT).

If a customer call is about a set in the shop, the VDT can show the status of the work, which bench technician is involved, the location of the set in the shop, whether parts are on order and when delivery can be expected.

No "hard sell" on service contracts

Approximately 60 percent of UHF's income comes from the sale of service contracts. All solicitation is by computer-prepared mail from a library of 50 "personalized" sales letters or messages.

Special service coupons are included as part of the contracts. Unused coupons are worth $5 each toward the purchase of a renewal contract. Even lost coupons are honored if the computer file shows they are still valid. If a customer needs service just after he declines a contract offer, UHF will sell him a pre-dated contract.

Foolproof Computer Package

Unattended, the computer turns out service contracts, customer correspondence and other materials several nights a week. This keeps the computer free during the day for customer service, accounting, inventory control and service performance records.

A faulty entry cannot hurt the file. The operator merely has to redo the entry. The UHF operators can make necessary alterations when program changes are desired.

The entire UHF computer package is available for purchase by other service agencies. Jim Bradshaw puts it this way: "It works well for us, and we'll be glad to help other servicers convert to a computer-assisted operation."

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

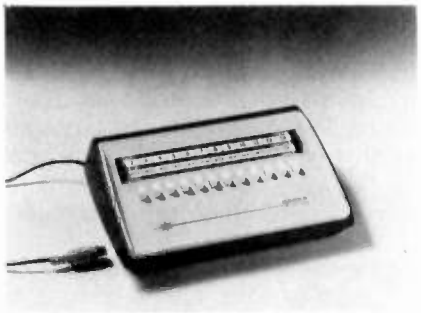
Better Service Through Better Communications

size General Motors cars, is now available from *Quam-Nichols*. Designated Model 410C10FEXGB, the speaker features a heavy duty 10 ounce ceramic magnet, a distinctive orange foam surround, and dual cones. The new 4 inch by 10 inch speaker is available to Quam distributors now only in bulk, and is expected to retail in the $7.50 range.

TV Remote Control

Circle No. 155 on Reader Inquiry Card

An improved and revised TV remote control unit, Model TRC-82, has been introduced by *Taco/Jerrold*. In the new model, a built-in channel switch is included that allows the user to select either channel 3 or 4 as the output channel. Previously, dealers had to inventory two models — one for channel 3 and one for channel 4.



Also, TRC-82 features 'access holes' for custom tuning of all UHF channels. Previously, the cover had to be removed. As with the previous models, TRC-82 is reported by the manufacturer to improve picture quality through the built in AGC and high gain of the varactor tuner. The shielding configuration is also reported to eliminate some CB interference.

Direct Drive Turntable

Circle No. 156 on Reader Inquiry Card

A new low-profile turntable with a quartz-locked direct drive turntable has been added to the *Marantz* line. Model 6350Q, as it is designated, features a phase locked loop servo system, using a quartz crystal as a timing reference to continually monitor and adjust the speed of the platter. Actual speed deviations are said to be less than 0.003% as the system instantaneously compensates for minute line voltage variations and increased stylus drag occurring during loud musical passages. Wow and flutter are specified to be less than 0.025% (WRMS). Motor design of the 6350Q allows speed control to be varied ± 3% by two separate controls

for 33 RPM and 45 RPM. Precise speed is indicated by the raised dots on the platter edge as they pass in front of a strobe light.

HF-SSB Transceiver

Circle No. 157 on Reader Inquiry Card

A new solid state HF-SSB transceiver, designated Model CH150, is being introduced by the *Canadian Marconi Co*. The new unit delivers a power output of 150 watts PEP, operating frequency 2-24MHz, 1 to 20 channels, with 20-40 channel optional, 10 semi-duplex standard, 20 semi-duplex optional. The CH150 can be used with one or two marine extended controls which provide all control functions at the desired locations. It can also be

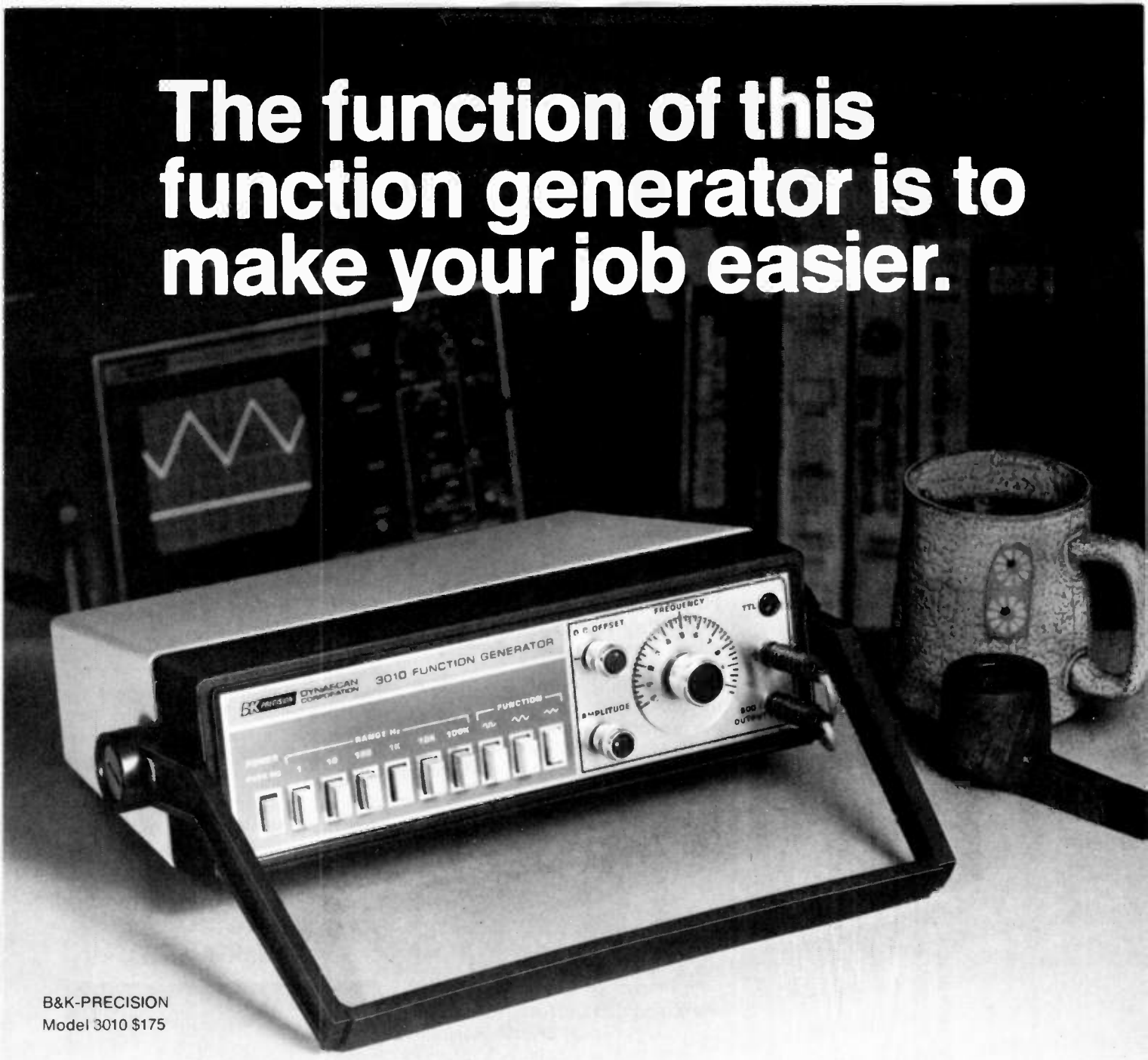
remotely controlled over normal telephone lines and used in conjunction with a linear amplifier to provide power output of 1000 watts or 1500 watts PEP. It is designed for continuous duty at full rated power which makes it useful for transmission of facsimile or RTTY.

Horn Travel Case

Circle No. 158 on Reader Inquiry Card

Musicians and other public address equipment users will find useful a new product introduced by *Altec Lansing*. It is the Model 1242 Horn Travel Case,

The function of this function generator is to make your job easier.



B&K-PRECISION
Model 3010 $175

If you stop and think about it, the function of any generator *should be* to make your job easier. When we at Dynascan designed our new Model 3010 function generator, that's exactly what we had in mind.

How did we achieve this? The 3010 was designed inside and out to be convenient and fast to use, and to provide years of trouble-free operation.

The 3010 generates all of the popular waveforms you're most likely to need, at only $175. In addition to generating square, sine and triangle wave outputs, the unit offers a fixed TTL square-wave output. Sine-wave distortion is less than 1% and triangle-wave linearity and square-wave symmetry are a near perfect 99%. A convenient row of reliable pushbuttons provides fast, error-free selection of the appropriate range and output waveform.

The stable voltage-controlled oscillator (VCO) of the 3010 is varied on each range by the front-panel frequency control, or the VCO external input. A 0 to 5.5 volt ramp applied to the VCO external input will provide a 100:1 output frequency change. In this way, the 3010 can be used as a sweep generator for response tests. Other features that will help your job run smoothly include: .05% stability, a variable DC offset control for engineering and quality control applications, a convenient tilt-stand handle, and a detailed 38-page operations manual.

Because the B&K-PRECISION Model 3010 covers from 0.1Hz to 1MHz in six ranges, you'll probably be able to use it in more applications than you first guessed. These include IF response tests, test-instrument linearity measurements, transducer tests and digital clock-pulse substitution.

For a chance to have your day run a little smoother, contact your local B&K-PRECISION distributor for immediate delivery or a demonstration.

B&K PRECISION DYNASCAN CORPORATION

6460 West Cortland Street, Chicago, Illinois 60635 • 312/889-9087
In Canada: Atlas Electronics, Ontario • Intl. Sls: Empire Exporters, Inc., 270 Newtown Road, Plainview, L.I., NY 11803

Circle No. 107 on Reader Inquiry Card

designed to house the firm's 511B horn and 808-8B driver. The new case, constructed of rugged materials which surround the unit, also has a four cubic foot storage area in the back of the case for storing microphones, cables and other accessories. The case is finished in black leather-grained vinyl and is equipped with steel corner guards for protection.

Highband FM Two-Way Radio

Circle No. 159 on Reader Inquiry Card

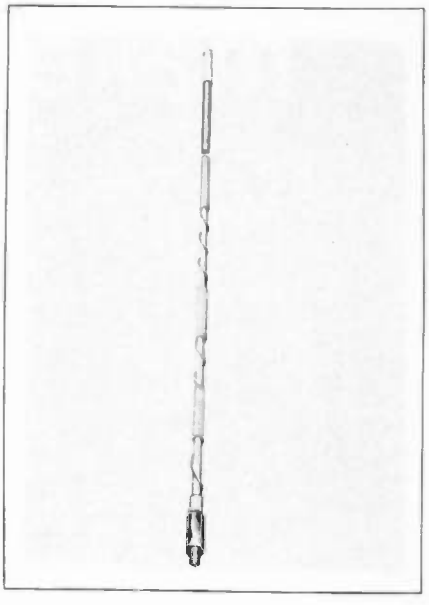
E.F. Johnson has announced introduction of a new two-way FM radio system for the newly opened 800 MHz band. One unit, the 800 MHz Transcom II mobile, can be either front or

trunk mounted and features temperature compensated crystal oscillators for long term reliability, according to the manufacturer. The new radio has five channel capability and additional channels can be added simply by adding more oscillators. In addition, the system includes a Model 3800 desktop control station and a community repeater. The control station is available with tone-coded squelch, time-out timer, VU meter, digital clock and remote control. The community repeater comes with four tones installed and with capability for up to 16 tones.

Mobile CB Antennas

Circle No. 160 on Reader Inquiry Card

A new line of heavy-duty CB antennas from *MayCom, Inc.* is available in colors to match or complement the color of cars and trucks. Called "ColorWhip II," the new line features a full 7/8 wavelength winding of 16 gauge wire and is rated for 750 watts AM and 1500 watts SSB. Coils and tips are tuned twice, both before and after static shields are applied. The antennas feature tapered 3/8 inch



heavy duty fiberglass shafts and are available in 4 and 5 foot lengths. Two different mounting styles are available — regular 3/8 by 24 threaded ferrule, or a new fast disconnect ferrule. Eight colors of poly static shields are offered — red, blue, green, yellow, brown, tan, white, or black.

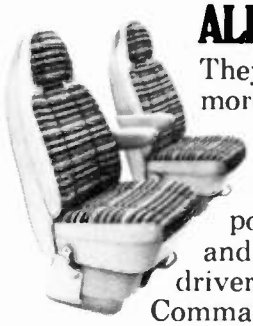
CB Radio

Circle No. 161 on Reader Inquiry Card

Robyn International, Inc. has introduced a new single sideband mobile CB, the SB-505D. According to the manufacturer, the SB-505D carries 40 channels AM and 80 SSB, and features a large digital display, RF gain, noise blanker, microphone gain control, tone, dimmer control, and the "Clar-O-Mic" control. The latter is Robyn's special control which permits tuning SSB stations from the microphone. The unit lists for $295.95, according to the manufacturer.

THIS YEAR, DODGE BUSINESS VANS ARE NEW IN ALL THE RIGHT PLACES.

NEW ROOMINESS, NEW VERSATILITY, SAME OLD DODGE DEPENDABILITY.



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.

HISTORICAL TOUGHNESS.

Of all the Dodge trucks registered in the past ten years, 94 out of 100 are still in operation. (Source: *Trucks in Operation*, as of July 1, 1977.)

MORE ROOMINESS.

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

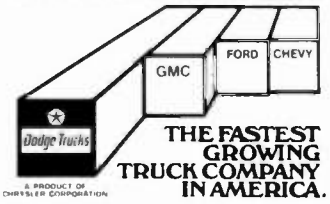
MORE DOORS, MORE WAYS.

Now you can have your choice of optional sliding or standard hinged side cargo doors on all our vans. And we offer the only optional 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.

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 CBs. Sky Lite sun roofs, air conditioning, and more.

357% increase from 1967 to 1977.



THE FASTEST GROWING TRUCK COMPANY IN AMERICA.

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

Circle No. 111 on Reader Inquiry Card

NEW PRODUCTS

Miniature Power Microphone

Circle No. 162 on Reader Inquiry Card

A miniature CB power microphone that fits in the palm of the hand and can be held at the wheel while steering has been developed by *JMR Systems*. Called the CLEAR-1 Model 40, the new mike was originally designed for aerospace communications and contains a high sensitivity electret-condenser microphone. The manufacturer says that it can be used from as far away as arm's length without losing power or clarity. It features a Velcro pad instead of the traditional mike hanger, and thus is easily attached to steering post, dash or any handy surface. Model 40 is compatible with 23 and 40 channel CB transceivers. Priced retail at $44.95.

Solderless Terminal Kit

Circle No. 163 on Reader Inquiry Card

A new solderless terminal kit that includes compartments for a crimping tool and the terminals is new from *Vaco Products*. Numbered 8995C, the new kit has a molded tray with compartments for the 1963 crimping tool and 18 each of the 20 most popular insulated terminal styles. Included is a folder that locates each terminal and explains the use of the tool. The entire kit is shrink packed.

Portable Frequency Counter

Circle No. 164 on Reader Inquiry Card

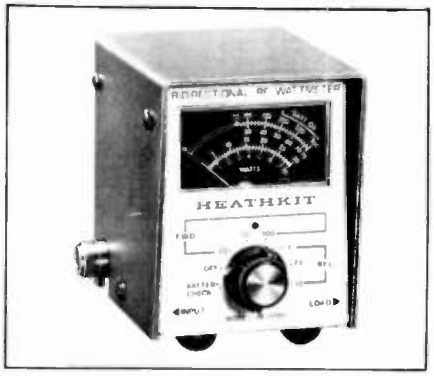
A new 225 MHz direct-count, three-function counter is new from *Ballantine Labs*. Designated the Model 5725C, the new six-digit counter features large 0.43 inch orange LEDS, and is operable from any external 9 to 15 VDC source. It can also be operated with an optional AC to DC wall-mounted converter. Model 5725C uses a simple single switch for selection of readings in Hz, kHz and MHz

over a direct count range of 10 Hz to more than 225 MHz. Through one input, the instrument covers this spectrum at a nominal sensitivity of 50 mV. Sensitivity is adjustable with a front panel screwdriver adjustment. It is priced at $295.

Bi-directional Wattmeter

Circle No. 165 on Reader Inquiry Card

A new bi-directional wattmeter that measures transmitted radio power up to 300 watts and reflected power up to 30 watts is new from the Heath Company. Available in both kit and assembled form, the new instrument covers the 100 MHz to 1 GHz spectrum, and has been designed for use in two-way radio ser-

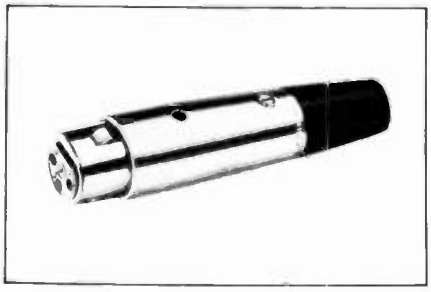


vice and repair, or for the amateur radio enthusiast. Designated Model IM-4190, the new meter is capable of withstanding full power overloads on its lower scales without damage to the meter movement. Powered by a 9-volt battery. The kit sells for $114.95 and the assembled version is $195.

Q-G Connector

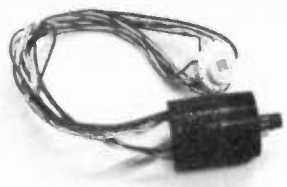
Circle No. 166 on Reader Inquiry Card

Switchcraft, Inc., is out with a newly designed female cord plug which features easy disconnection without the trouble of finding and depressing a latch release button. According to the manufacturer, the connection



was designed in response to demands from musicians and sound technicians and installers. The quick disconnect feature of the plug (Series AFD Audio Plugs) involves a special secure detent latch instead of the

usual locking latch. This permits, Switchcraft says, disconnection with a simple pull. It mates with any of the male Q-G or QCP plugs or receptacles and is ideal for use where quick take-down of audio equipment is required, the manufacturer reports.



Solid State TV Brightener

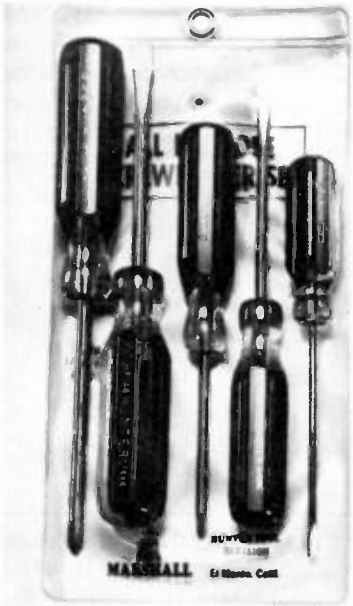
Circle No. 167 on Reader Inquiry Card

A new 100% solid state color TV tube brightener has been introduced by *Workman Electronics*. Designated Model W35, the new brightener does not use the conventional step-down autotransformer. Solid state circuitry is reported to provide more stable filament boost voltages with a minimum of power loss/heat dissipation. The W35 has extra long leads to facilitate installation in even the largest console combinations. Inations. List Priced at $11.75.

Screwdriver Set

Circle No. 168 on Reader Inquiry Card

Hunter Tools has announced a new 5-piece mechanics round screwdriver set, Number 31802. According to the manufacturer, the set covers about 90 percent of screwdriver needs. It comes packaged in a prepunched

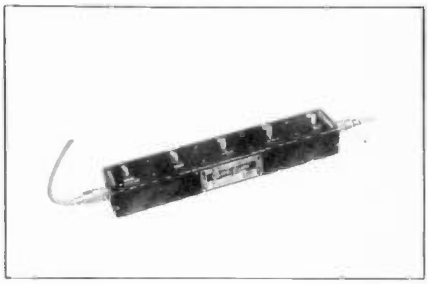


heavy vinyl pouch, Hunter's "comfort grip," and four flute design handles. According to Hunter, the tips are cross ground to insure proper fit and to reduce "slip outs" resulting in gouged work and hands.

CB Antenna Tuner/filter

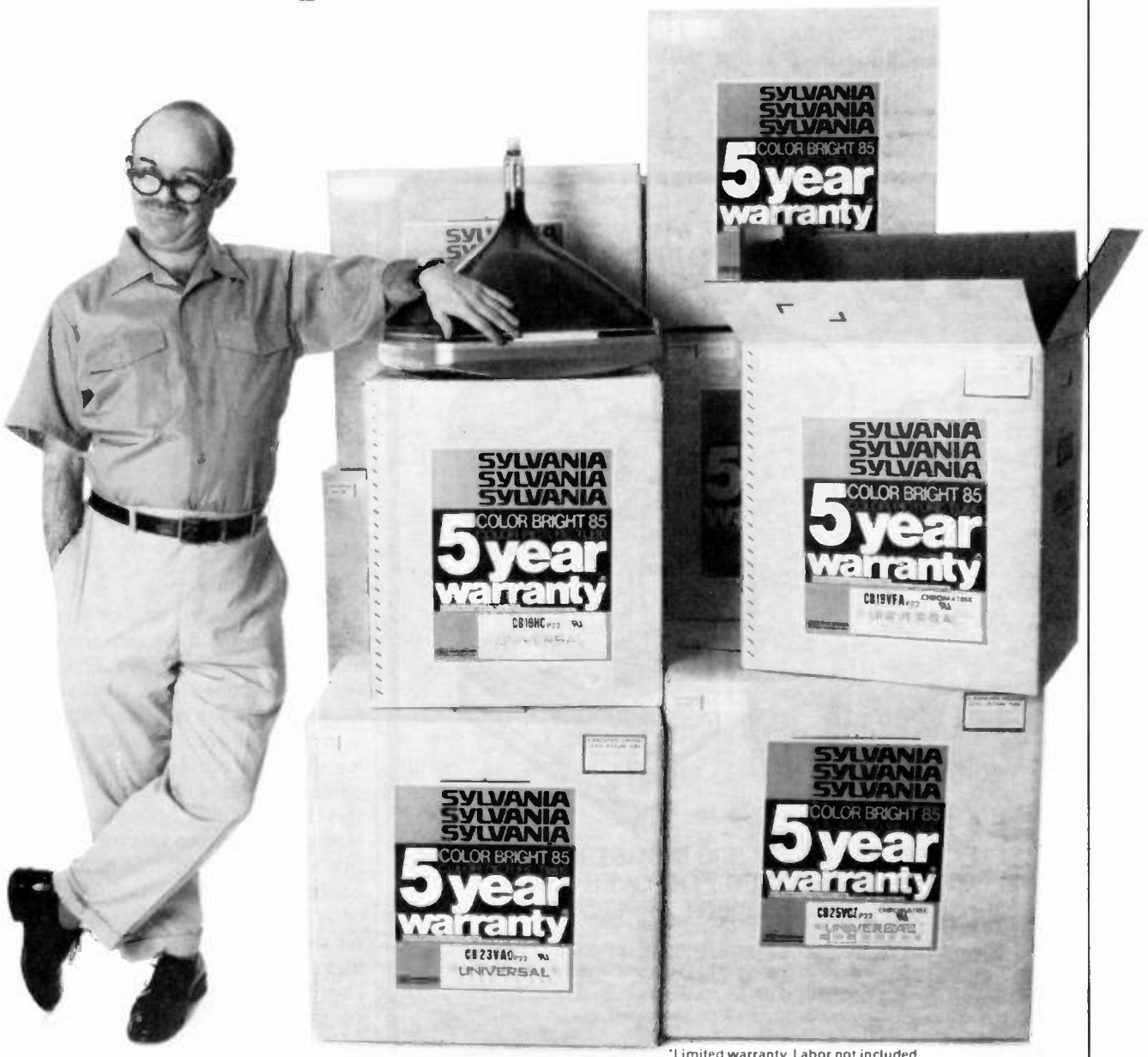
Circle No. 182 on Reader Inquiry Card

A new 40-channel antenna tuner and adjustable low pass TVI filter has been announced by *Telco Products*.



Designated Channel Guard XL-1000, the new tuner/filter is reported to allow the operator to eliminate all unwanted harmonic radiation at the source when the device is used below 30 MHz. At the same time, the operator can match his 23 or 40 channel

Only eight TV tubes can make a warehouse out of your backroom.



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You can order a Color Bright for immediate delivery right from your own backroom.

SYLVANIA **Electronic Components** GTE

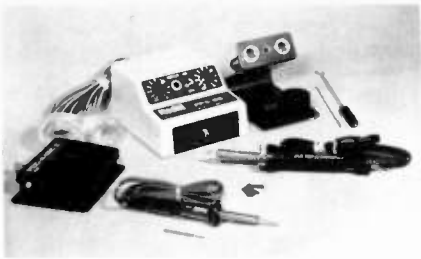
Circle No. 121 on Reader Inquiry Card

rig to an existing 23 channel antenna system. The unit is a five section, tuneable, in-line, low-pass tuner/filter designed with negligible insertion loss. It is reported to be able to handle up to 1 K watt PEP power, and attentuate all frequencies above 40 MHz by 100 dB. It sells for $34.95.

Solder/Desolder System

Circle No. 169 on Reader Inquiry Card

Pace, Inc. is now offering its Model SX 214 Ped-A-Vac II soldering and desoldering work station. Known as the

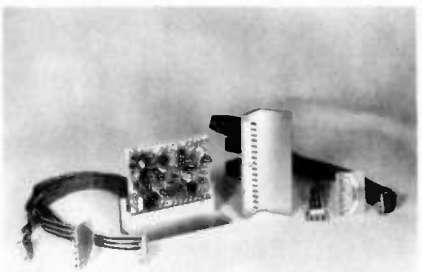


Sodra-X-Traction system, all that's required is an air supply of from 60 to 80 pounds per square inch, Pace reports. The manufacturer says the system, retailing at a single unit price of $325, is ideal for quickly removing components from any circuit board, regardless of configuration. The manufacturer also contends the system will not generate electrical spikes and is therefore compatible with all MOS-type devices. Sodra-X-Traction comes with a floor-mounted vacuum generator, Thermo-Drive heat control — for automatically reducing tip temperature during vacuum operation — and a temperature controlled soldering iron. A stand, tip cleaning facilities and holders, and replacement tips are included, the manufacturer said.

Module Extension Cables

Circle No. 170 on Reader Inquiry Card

Repairs on TV modules are made easier by a new series of extension cable kits kits recently introduced by *Sylvania*. Called "Chek-A-Board Cables," the



new product allows service on solid-state modules without removal of the module from the chassis. The cable kits are designed now for use with RCA and Zenith module television sets, but will eventually be available for use with other brands. The kits contain cables with female connectors for modules on one end and mating chassis connectors on the other end. Using the cables, an operating module can be brought out onto the work bench for testing and repairs. The cables feature plated alloy conductors on heavy-gauge fiberglass printed circuit boards and consist of stranded, multi-lead ribbon wire. Each side of the cable is colored differently to assure proper orientation.

50MHz Logic Probe

Circle No. 171 on Reader Inquiry Card

A new logic probe, capable of measurements from DC to 50MHz, has been introduced by *B&K-Precision*. The probe, Model DP-50, is a multi-family device compatible with TTL, DTL, RTL, HTL, CMOS, MOS and high-noise immunity logic. The

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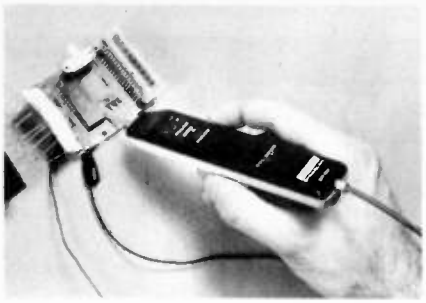


DP-50 is reported by B&K to simplify the troubleshooting and analysis of digital circuits by clearly displaying in-circuit logic activity. Three bright LED indicators display pulse presences and high and low logic states, and the probe will continue to indicate pulse presence through its maximum frequency of 50MHz. It has a memory mode to "freeze" and store the pulse display — and in the pulse mode, short duration pulses are "stretched" for a clear visual indication. It sells for $50.

CB/RF Generator

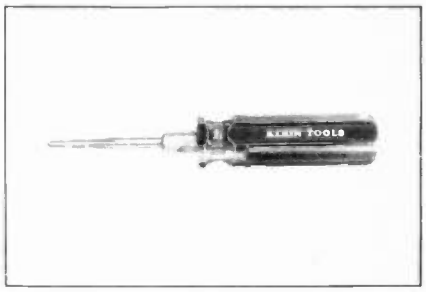
Circle No. 172 on Reader Inquiry Card

A new phase-lock-loop CB/RF generator that measures only 8¼ inches by 7 inches by 9½ inches has been introduced by *Hickok Electrical Instruments*. Called the Model 266, the new unit is reported to take less bench space and can be rack mounted. It features pushbutton operation with keyboard entry for instant selection of all 40 channels. It also features a bright LED channel display, 455 kHz IF output with an auxillary IF oscillator and front panel mounted socket that accepts crystals from 1 mHz to 20 mHz for extra IF outputs at other frequencies, and a double shielded metered precision attenuator for signals down to 0.3 microvolts. Model 266 is priced for less than $500.

Six-way Tap Tool

Circle No. 173 on Reader Inquiry Card

A new tap tool for forming new threads, cleaning out plaster obstructions and reforming burred threads is available from *Klein Tools*. The new tool has two replaceable taps that cover six thread sizes: 6-32, 8-32, and 10-32 on one side and 10-24, 12-24 and ¼-20 on the other side. It rethreads to the next larger size if threads are stripped. The taps are made of special high carbon steel with a uniquely designed lead thread for faster, more accurate threading. Taps are held in a sturdy reversible holder that snaps into the large clear-plastic handle.



Pager Antenna Protector

Circle No. 174 on Reader Inquiry Card

A new antenna protector for Motorola Metro and Pageboy II pager units is now available from *JaBro Batteries, Inc.* The

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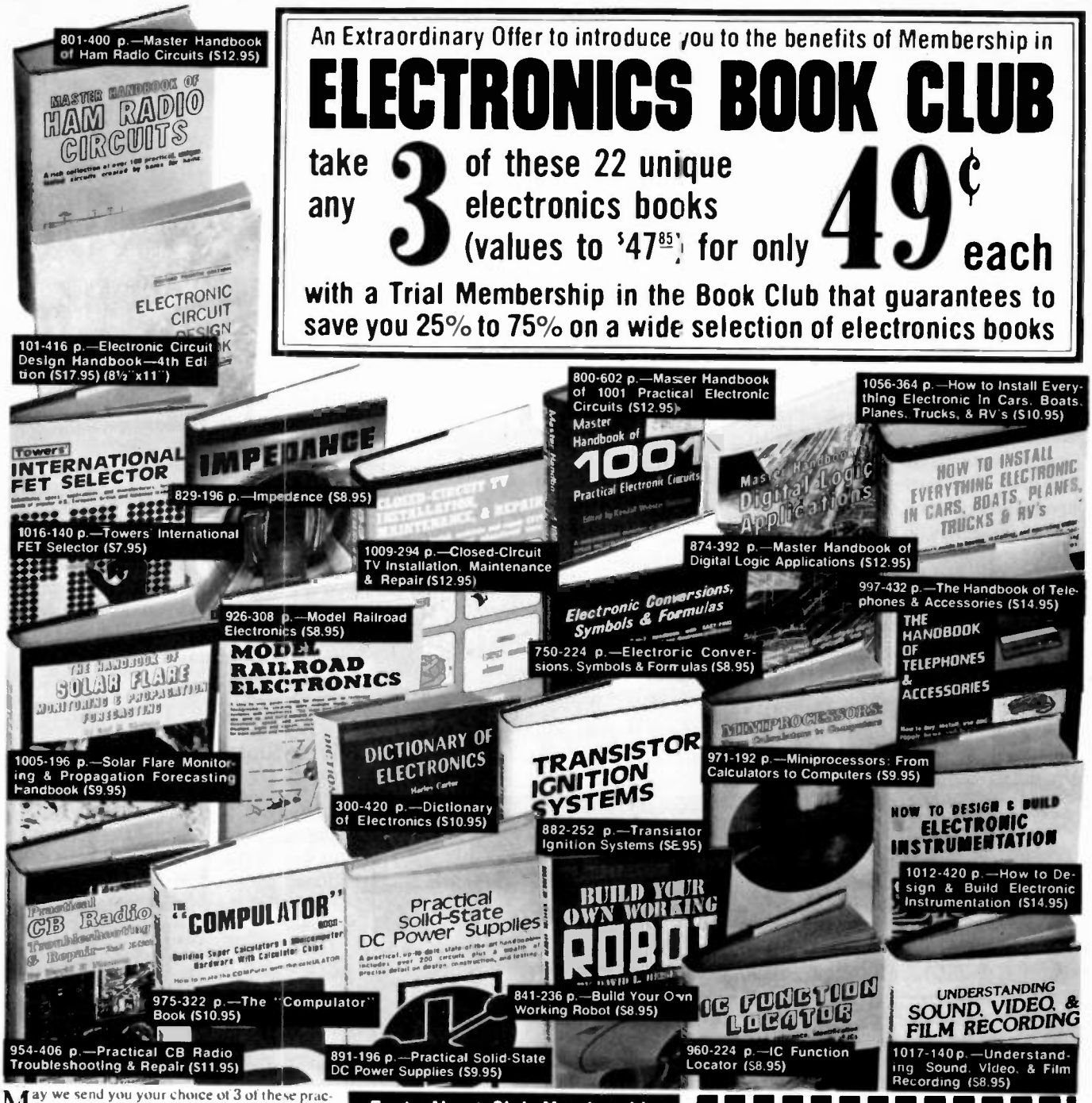

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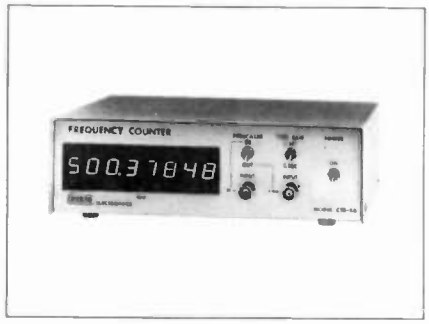
new protector consists of a 12 mil mylar brushed metal-like silver finish with a dry adhesive backing for easy application. The protector helps to identify pagers with their owners through design and imprint and restores the pager appearance without having to replace the antenna.

Frequency Counters

Circle No. 175 on Reader Inquiry Card

A new series of 500 MHz and 1 GHz frequency counters is being introduced by *Davis Electronics*. Covering the entire frequency spectrum to 1000 MHz, the CTR-2A series of wide range VHF-UHF counters combines a 50 MHz counting range with built in prescaler and preamplifier. Features include an 8-digit display, high stability TCXO time base, automatic input limiting, protected input and automatic Dp placement. Selectable gate times are 0.1 and 1 sec., with resolution to 1 Hz. Available low cost options are oven crystal, 12V DC operation, tilt handle,



oversize digital display and period measurement. Prices, in kit form, range from $249.95 to $399.95, and assembled, from $349.95 to $549.95.

Digital Multimeter

Circle No. 176 on Reader Inquiry Card

A new digital multimeter that is reported by the manufacturer to offer

true root mean square AC voltage and current measurements has been introduced by *Non-Linear Systems*. Called the Model RMS-350, the new instrument is battery operated and is said to be designed to fit any tool box or carrying case. It uses Unichip A to D electronic circuits which are reported to offer greater reliability through a low component count. AC voltage ranges are from 1 millivolt to 750 VRMS. In addition, the RMS-350 measures resistance from 1 ohm to 10 megohms, DC voltages from 1 millivolt to 1000 VDC, as well as RMS AC and DC current from 1 microamp to 1 ampere. It features LCD readouts. Priced at $189.

Micro-duster Spray

Circle No. 177 on Reader Inquiry Card

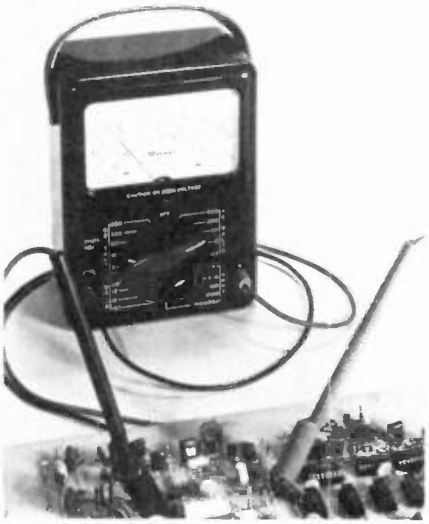
A new servicing aid that permits compressed-gas dusting of delicate instruments and assemblies has been introduced by *Chemtronics, Inc*. Called Micro-Duster, the product contains pure,

moisture-free, non-flammable and non-toxic filtered gas, providing controlled removal of dust, lint, oxide particles, etc. without depositing harmful contaminants. A single 15 ounce can is said to produce over 1800 one-second gas

bursts, or 25 to 30 minutes of continuous dusting. Comes with a 6 inch extension tube for pin-point application. Suggested retail price is $2.50.

V-O-M

Circle No. 178 on Reader Inquiry Card



A new V-O-M with 20 ranges (plus dB), extra overload protection, completely insulated housing and newly designed safety test leads, has been introduced by *Triplett Corporation*. Designated Model 630, the new tester features a single range switch to minimize operator errors, plus a new rectangular viewing window and a mirrored scale. Ranges include: 3-600 VAC in 5 ranges; 0.3-600 VDC in 6 ranges; .06-120 mA in 4 ranges; 1000 ohms - 1 megohms in 5 ranges with 4.4 ohms center scale; and -20 dBm to +57 dBm decibels in 5 ranges. Priced at $86.

Dual Counter/Timer

Circle No. 179 on Reader Inquiry Card

Systron-Donner has introduced a new dual channel counter/timer called the Model 6361A. The heart of the new dual instrument is a pair of LSI chips which reduce the parts count, but, according to the manufacturer, allow increased performance and dual simultaneous measurements not possible before. The new instrument is a 100 MHz. 10 ns time interval/period, ac/dc coupled universal counter. Both channels are identical in characteristics and capability. This allows each channel to be used for frequency measurements from DC to 100 MHz and period measurements with resolutions of 10 microseconds to 10 nanoseconds. Both channels can be used simultaneously to display on the two readouts any combination of frequency, period, TIM and frequency ratio measurements. Priced at $895.

Crystal Clock Oscillator

Circle No. 180 on Reader Inquiry Card

A new thick film crystal clock oscillator in DIP form has been introduced by *Motorola*. Called the Loco II, the new oscillator is available in six discrete frequencies: 19.6608 MHz, 18.432 MHz, and 16.000 MHz. This miniature oscillator operates from 5 VDC and drives 10 TTL gates. Stability from 0-70°C is ± .05% and includes calibration, stability versus temperature, input voltage change, load change, aging and normal environment.

Portable Digital Multimeter

Circle No. 181 on Reader Inquiry Card

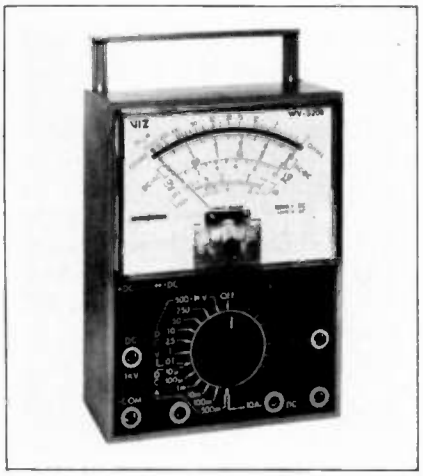
The latest digital multimeter from *Data Precision* combines 10μV sensitivity and true RMS measurement of AC volts and current with liquid crystal display and the convenience of 40-hour continuous battery operation from rechargeable batteries. Called Model 258, the new instrument is a full function (DCV, ACV, DC current, AC current and resistance) high resolution unit offering 4½ digits on all parameters. It differs from the firm's Model 248 in offering the liquid crystal display and the 40 hour battery capacity. The new meter has 10 microvolt sensitivity, DC and AC, and basic one-year accuracy of ±0.05% of input without need for recalibration. It is priced at $295.

Relay-protected VOM

Circle No. 183 on Reader Inquiry Card

A new, moderately-priced VOM has been added to the *VIZ* line of test instruments. The new instrument, the WV-520B, is a general-purpose 100,000 ohm/VDC VOM which is fuse- and relay-protected against overload in all ranges and functions. It employs an easy-to-read taut-band meter movement with color-coded scales and mirror and precision resistors throughout the circuitry. The WV-520B measures DC voltages as low as 1mV, and up to 1000V in eight ranges; AC (RMS) from 100mV to 1000V in five ranges; DC current from 0.1μA to 10A in seven ranges; resistance from 0.25Ω to 20MΩ in four ranges; and decibels from -20 to +36dB. A special jack is included to measure AC current from 0-10A and it has a polarity switch for DC measurements. Priced at $68. ET/D

Circle No. 138 on Reader Inquiry Card



MICROS

continued from page 28

could be expanded into a full-blown article. Children of the new technology are going to grow up with it, taking it for granted, not even batting an eye at the mid-1980's introduction of the cryogenic super-computer or the proliferation of $29.95 pocket computers (NOT calculators). As quaint analog signal processing techniques like those used in today's television and stereo systems fade into the oblivion of the 70's, the world of people who have been living with them is going to be in for some surprises.

Those surprises can be avoided. It is not too late to jump in and experience the growth, excitement, and profit that result from current technological awareness. There is a rapidly increasing vacuum in the industry for "current" people at all levels, and it will only be filled long after today's events are being dealt with historically, in the classrooms of the future. Until then, the opportunities for personal and financial growth (survival?) are rich indeed. ET/D

SERVICE

continued from page 15

just over the horizon is a new step and the tech has damned little time away from his busy schedule to prepare for it."

Several key factors are working simultaneously that will have a critical impact on the future of electronics servicing, Moch said. First, as already mentioned, is the dawning of the electronics age.

Secondly, the higher level of both technical and professional business skills is causing an accelerated dropout of the smaller inefficiently operated service businesses, with the resultant service backlog being picked up by the more efficiently run organizations.

"Actually, the loss of these people is not entirely a bad thing," Moch said. "It would be our hope that there will be larger, though fewer, shops. Our (NATESA's) recommendation has been for some time now that many people in the business should not be in it as employers or business operators because their knowledge of business concepts is abysmal.

"Consequently," Moch said, "what we're trying to say is look! You can make more personal income for yourself by joining another organization as an employee and specializing.

"We are independent," Moch added. "But, if I had anything to do with it I would substitute the word interdependent. The main problem has been the way some independents interpret the word. Their idea has been, 'I'm independent — don't try to tell me how to run my business even if you can tell me how to run it better!'" ETD

REGULATORS

continued from page 25

program +9.99 volts. This eliminates the need for checking the output voltage with a meter, since the accuracy of the internal circuitry exceeds that of a magnetic movement meter. It would take a digital voltmeter to check the output of a digitally programmed supply.

It should be pointed out that such regulators are really *power* op amps, or op amps with a power amplifier, and are not in the same family as the true IC voltage regulators. They are covered, in the newer op amp text books, and will not be mentioned further here.

Switching regulators

The switching regulator is a form of oscillator. In normal operation it is constantly switching on and off, and that is the basis for testing. Remember, when the input voltage increases, the off time increases as compared to the on time. If the load current increases, the on time increases as compared to the off time. We are always dealing with the ratio of off time to on time.

There are a few variations of this basic method, however. We can hold the on time constant, and vary the off time. In this case the on time is constant, but the frequency varies, since frequency is inversely proportional to the period (time) of a cycle, and the total cycle time changes as the period of the off time varies. We can hold the off time constant, and vary the on time ... again the frequency changes. Finally, we can hold the frequency constant, and vary the ratio of the on time to the off time ... as one increases the other decreases, but the total of the off and on times are constant ... and with a constant period, the frequency must be steady.

Thus for a switching regulator to function properly *regardless of the method used*, the ratio of on time to off time must vary with input voltage and output current, as previously described. If the loads are normal, and input voltage is normal, the regulator must switch. Failure to switch, or vary on to off time is a positive indication of regulator failure. Since the inductor is a rugged device, the most likely causes of failure are the semiconductors which get hard use in this rapid cycling at high power levels. Capacitors too must handle high currents at a fast switching rate, which induces unusually high internal heating. As a matter of fact, the capacitors used are usually rated for high ripple currents, and are not inexpensive off the shelf items. They usually have a fairly high failure rate in this use.

"Invisible" regulators

The trend for more small regulators has reached its inevitable conclusion. Many medium scale integration ICs have internal voltage regulation ... as, for example, some chroma demodulators in color TV sets. So although you may not see any indications of voltage regulation, the critical voltage sensitive circuitry inside the IC does have a regulated supply voltage.

A little more insidious is the use of an "on board" regulator on one plug in module, which, by means of interconnecting cables, supplies regulated voltage to another module. This leads to troubleshooting problems, as is self evident. Sometimes the on board regulator is nothing more than a zener diode, in which case removing the module also removes the zener (shunt type regulator) causing the voltage to go higher than normal.

In the days of a large central power supply, these problems did not exist ... but today's regulators can be tucked away and practically invisible. ETD

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