ET/D

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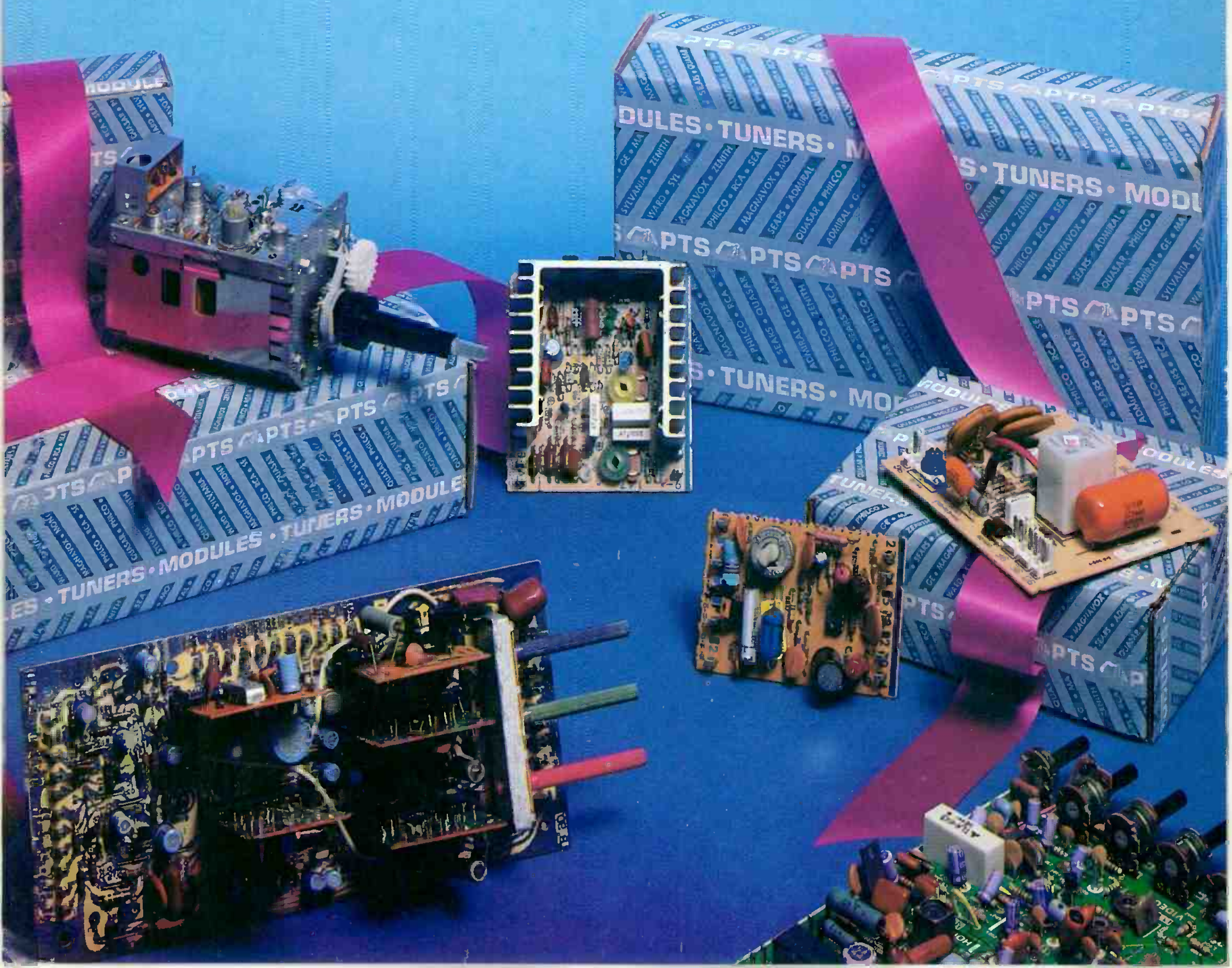


INDUSTRY REPORT

EDS Plans New Show Format

Sponsors of the Electronic Distribution Show have announced that next year's event, May 1-3 at the Las Vegas Hilton, will operate under an entirely new format.

According to EDS Executive Vice President David L. Fisher, the show serves four basic electronics markets: The general line and MRO distributor; industrial electronic components; consumer products: and commercial sound and communications. EDS 1980, Fisher said, will offer manufacturers four different kinds of modes—booths, conference rooms, hotel suites, and demonstration rooms for those in commercial sound products.

All facilities, he added, will be under one roof this year at the Hilton Hotel. The show's theme is "Meeting the Challenge of Change."

Vote on IHF-EIA Merger

Voting on a proposed merger of the IHF into the Electronic Industries Association is scheduled to be completed shortly. Plans for the merger were announced several months ago.

While IHF and EIA boards have given their support of the merger, consumation of the proposals cannot be achieved until the IHF membership, comprised of manufacturers in the high fidelity-stereo area, and the EIA Board of Governors give their approval.

Ballatine to Market Japanese Scopes

Ballantine Labs has announced plans to market a Japanese oscilloscope in this country under the Ballantine name.

Under an agreement with Iwatsu Electric Co., Ltd., Japan, Ballantine will market "selected" Iwatsu test instrumentation, a spokesman said. The first instrument will be a dual-trace, 40MHz scope to be known as the Ballatine 1042A. This latter unit, Ballantine said, is a "natural complement to Ballantine's existing line of oscilloscopes which includes the ... 1020 series Travelscopes—12MHz dual and single trace miniscopes, and the 1030 series 20MHz dual and single trace portable/bench scopes.

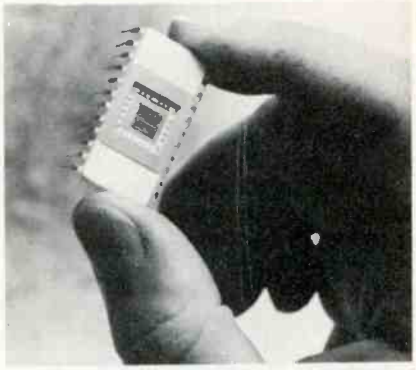
Iwatsu Electric Co. was established in 1938 and makes a broad line of scientific, industrial and commercial products for international distribution. Iwatsu products include telecommunications equipment, electronic test and measuring instrument and information processing equipment.

The model 1042A, Ballantine reports, features independent dual triggering for simultaneously viewing two asynchronous signals. This capability has become necessary, the company said, because of growing service needs in computer peripherals and disc memories.

Racal-Dana announces Lifetime Guarantee

Racal-Dana Instruments, Inc. has announced a lifetime guarantee in association with the introduction of its new 99 Hundred series of frequency counters.

The guarantee, a Racal-Dana spokesman said, applies to the LSI chip which comprises the central logic unit on its new line, comprised of eight frequency counters covering the HF/VHF and UHF bands up to 3GHz. The chip, a dedicated bipolar device, is made by Ferranti Electronics Ltd.



According to the company, statistical information on LSI devices similar to those used in the new Racal-Dana line show a chip life of more than 20 years. "Our own experience," according to Racal-Dana President Webb Scroggin, "using 10,000 such chips over the last few years without a single failure recorded, confirms this high reliability.

The company said every counter in the series uses the custom designed chip which features collector diffusion isolation. It operates at speeds up to 60MHz.

Satellite-to-home pay TV

Comsat Corporation is reportedly discussing a satellite pay TV subscription service with suppliers of both hardware and programming. This programming would be broadcast from satellite directly to the subscriber's roof mounted antenna. Experimentally such a service is presently being tested in Japan and Canada. A Comsat spokesman stated such service could be introduced in the U.S. by 1983.

Sinclair Sells TV business

Sinclair Radionics, maker of electronic calculators, digital multimeters and counters, has announced it is ending its involvement in the consumer electronics market with the sale of its television receiver business.

Sinclair made that exceptionally small, two inch black and white battery powered, unit which sold orignally for $395 and was capable of reception on

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NOVEMBER 1979, VOL. 101, NO. 11

On the cover: RCA's Stacom III, scheduled to be launched next month, is shown in space through the magic of an artist's brush. Representative of the "new technology" in T V signal distribution, it serves as a lead-in to this month's article on private, home television reception from space.

FEATURES

DEPARTMENTS

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C2344	VcBo 180V Ic 1.5A, Pc25W	TO-220 case	D381, D382, C1447. Used for AF driven NPN.	.75
B507	VcBo 60V Ic 3A, Pc30W	ECG 153 TO-220 case	B511, B512, B513, B514, B515, AF output.	.70

Sanyo Number	Specifications	Equivalent To	Replaces	Price
D313	VcBo 60V Ic 3A, Pc30W	ECG 152 TO-220 case	D234, D235, D314, D325, D330, D331, D317, D318.	.55
B633	VcBo 100V Ic 6A, Pc40W	ECG 197 TO-220 case	Most of TO-220 case PNP Audio output transistors.	.90
D613	VcBo 100V Ic 6A, Pc40W	ECG 196 TO-220 case	Most of TO-220 case NPN Audio outputs.	.80
B697K	VcBo 180V Ic 12A, Pc100W	ECG 281 TO-3 case	Most of TO-3 case PNP Audio outputs. STRONG!	2.50
D733	VcBo 180V Ic 12A, Pc100W	ECG 280 TO-3 case	Most of TO-3 case NPN Audio outputs, includes C1079, C1080, D118, D425, D426, D371, D217.	2.45
D24Y	VcBo 300V Ic150MA, Pc65W	ECG 124 TO-66	C515A, C685A. HV Audio power output for TV.	.75

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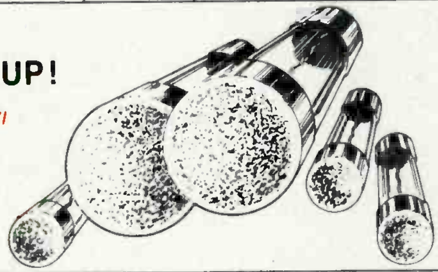

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102	.40	163	4.60	237	2.40	323	2.20	737	3.80	941	.75	1035	4.70	1081A	2.30	1129	7.40	1178	3.40	1219	8.60
103	.70	164	3.35	238	3.35	324	2.50	738	4.80	966	2.80	1036	5.60	1082	1.30	1130	4.20	1179	2.60	1220	9.40
104	1.35	165	3.35	276	7.90	376	2.25	739	3.20	973	1.80	1037	3.00	1085	1.30	1131	4.40	1180	2.70	1222	3.95
105	3.90	171	1.60	277	5.80	500A	12.40	740	2.60	973D	2.00	1038	4.70	1087	1.30	1132	4.20	1181	3.40	1223	2.90
106	.40	175	2.90	279	7.40	506	1.50	742	4.20	975	1.60	1040	1.40	1089	6.40	1133	3.80	1182	7.60	1224	3.20
107	.80	177	.25	280	2.70	526	18.80	743	1.50	976	1.60	1041	1.20	1090	9.60	1134	4.40	1183	4.90	1228	2.90
108	1.20	180	2.80	281	2.80	551	2.00	744	5.20	978	1.60	1042	2.40	1091	3.90	1135	1.90	1184	2.95	1230	2.20
109	.20	181	2.70	282	2.00	601	.30	746	3.80	987	1.40	1043	4.40	1092	1.50	1137	1.90	1185	2.40	1232	5.60
110	.40	182	3.20	283	4.60	605	1.65	748	2.80	1002	1.30	1045	2.60	1093	2.40	1140	1.60	1186	2.75	1234	1.30
116	.20	183	3.75	284	4.30	612	.35	749	2.90	1003	1.30	1046	3.20	1096	3.65	1142	1.40	1187	2.75	1235	1.20
117	.20	184	1.00	285	6.20	613	.40	778	1.80	1004	2.20	1049	3.90	1097	6.80	1148	14.60	1188	3.50	1236	2.90
121	2.75	185	1.00	287	.70	703A	1.50	780	3.20	1005	2.20	1052	1.50	1098	7.85	1149	3.90	1189	8.60	1237	2.00
123A	.35	186A	.60	289	.55	708	1.50	783	3.20	1006	2.20	1053	2.40	1100	1.40	1150	2.20	1190	6.20	1238	3.40
124	1.95	187A	.80	290	.40	709	1.50	788	1.50	1009	2.20	1054	1.70	1101	1.90	1153	2.50	1191	7.90	1239	2.90
125	.20	190	1.00	291	1.30	710	3.00	790	2.80	1010	2.20	1055	2.70	1102	1.40	1154	2.80	1192	1.30	1240	2.20
126	.80	192	.45	292	1.50	711	3.95	791	2.80	1011	2.20	1056	2.80	1103	1.20	1155	2.10	1193	2.40	1241	2.20
127	2.95	193	.55	293	.45	712	1.50	793	3.20	1012	.95	1057	3.15	1104	1.20	1158	3.40	1194	2.20	1243	2.30
128	2.50	196	1.30	294	.40	713	1.50	801	1.50	1013	1.30	1058	1.95	1105	3.80	1159	3.40	1196	8.60	1244	4.80
129	2.20	197	1.50	295	.60	714	1.50	802	8.80	1014	1.90	1060	1.30	1106	2.75	1160	2.30	1200	6.40	1252	7.50
130	1.00	198	1.50	297	.65	715	3.20	803	4.80	1016	2.20	1061	3.95	1108	2.60	1161	6.60	1205	3.00	1256	2.80
131	1.00	199	.30	298	.70	718	1.50	804	4.20	1019	1.30	1062	4.20	1109	3.90	1162	2.40	1206	3.90	1259	2.80
132	.60	220	1.60	299	.75	719	1.50	805	3.20	1020	2.20	1063	4.90	1110	7.60	1163	3.90	1207	5.50	1260	2.90
133	.60	221	1.40	300	.70	720	1.50	806	3.80	1021	2.20	1067	5.70	1115	2.40	1164	5.40	1208	3.30	1261	2.90
152	.80	222	1.60	302	1.00	721	3.80	807	3.20	1024	4.20	1069	9.30	1115A	2.40	1165	2.20	1209	3.20	1301	3.20
153	.95	226	1.00	306	1.30	722	1.50	812	4.00	1025	5.90	1070	3.80	1116	2.60	1166	2.30	1210	2.60	1304	14.50
155	2.90	229	.80	307	.50	723	1.50	814	4.20	1026	1.20	1071	4.80	1117	2.80	1167	5.60	1211	3.10	1308	5.90
157	2.25	230	4.60	308	7.40	724	2.80	818	3.80	1027	4.90	1072	2.90	1122	4.40	1168	5.40	1212	8.40	1312	5.90
158	.40	231	4.90	310	7.40	725	1.50	824	2.50	1028	9.20	1073	1.60	1123	6.10	1169	3.00	1214	5.50	1312	5.90
159	.60	233	.80	312	.60	726	3.50	912	2.40	1029	2.60	1074	2.80	1124	2.90	1170	2.90	1215	2.60	1313	5.90
160	1.80	234	.40	315	1.00	729	4.20	917	3.20	1030	5.40	1075A	2.80	1126	4.20	1171	4.40	1216	3.60		
161	1.20	235	1.60	320	10.60	731	1.50	923	1.00	1032	2.90	1078	7.40	1127	2.30	1172	4.60	1217	3.20		
162	4.60	236	2.30	321	3.60	733	2.80	925	8.00	1034	4.70	1080	3.20	1128	1.75	1173	2.90	1218	5.50		

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Facts from Fluke on low-

cost digital multimeters.

	PRODUCT	FUNCTIONS	RANGES	DIGITS	BASIC DC ACCURACY	CONDUCTANCE	OTHER SPECIAL FEATURES	PRICE
HANDHELD MODELS	8022A	6	24	3½	0.25%		Basic six-function DMM; lowest-priced	$129
HANDHELD MODELS	8020A	7	26	3½	0.1%	X	High accuracy; pioneer in conductance; exclusive two year warranty.	$169
HANDHELD MODELS	8024A	9	26	3½	0.1%	X	Direct temperature readings; continuity/input level detector with selectable audible signal; peak hold capability.	Available soon
BENCH/PORTABLES	8010A	7	31	3½	0.1%	X	True RMS; extra 10A range.	$239
BENCH/PORTABLES	8012A	7	31	3½	0.1%	X	True RMS; two extra low resistance ranges.	$299
BENCH/PORTABLES	8050A	9	39	4½	0.03%	X	True RMS; selectable reference impedances with direct readouts in dBm; offset feature.	$329

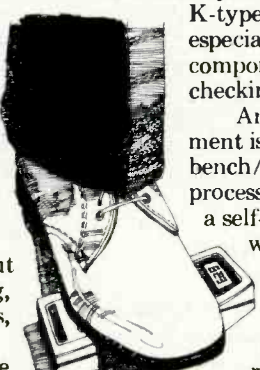
When you're looking for genuine value in a low-cost DMM you have a lot more to consider than price. You need information about ruggedness, reliability and ease of operation. Accuracy is important. And so are special measurement capabilities. But above all, you must consider the source, and that company's reputation for service and support.

Fact is, as electronics become more a part of our daily lives, dozens of new manufacturers are rushing to market their "new" DMM's. In theory, this is healthy; but in practice, crowding is confusion.

To help you deal with this flood of new products, here are some facts you should know about low-cost DMM's.

The economics of endurance.

Even the least expensive DMM isn't disposable. Accidents happen, and test instruments should be built to take the abuses of life as we live it.



Look for a DMM with a low parts count for reliability, and rugged internal construction protected by a high-impact shell. Make sure the unit meets severe military tests for shock and vibration.

Another feature to check out is protection against overloading, whether from unexpected inputs, transients, or human errors.

Just for the record, all Fluke low-cost DMM's meet or exceed military specs, and feature extensive overload protection.

The importance of being honest.

Just because a multimeter is digital doesn't mean it's automatically more *accurate* than a VOM — even though the LCD might give you that impression. The benchmark for accuracy in DMM's is *basic dc accuracy.* The specs will list it as a percentage of the reading for various dc voltage ranges.

Of course accuracy is more critical in some applications than others, and increasing precision and resolution in a DMM usually means increasing price. In the Fluke line, you can choose a model with a basic accuracy of 0.25% (the 8022A), others rated at 0.1%, or the new 8050A bench/portable at 0.03%.

Special measurements: getting more from your DMM.

Actually, for all the variations in size, shape and semantics, most DMM's perform five basic measurements: ac and dc voltage and current, and resistance. Prices vary according to the number of ranges and functions a DMM delivers.

The Fluke line includes DMM's with from 24 to 39 ranges, 3½ and 4½-digit resolution, and some unique functions you won't find in any other DMM. Additional measurement capabilities like temperature, dB, conductance and circuit level detection.

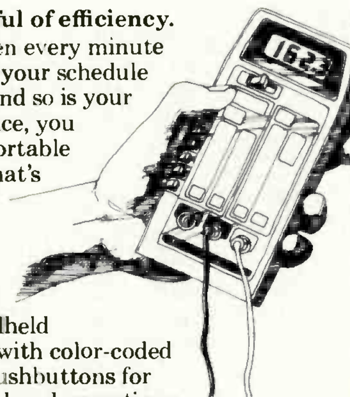
If your work involves temperature measurements, the new 8024A delivers direct temperature readings via any K-type thermocouple. This is especially useful in testing component heat rise and checking refrigeration systems.

Another talented instrument is our new 8050A bench/portable. The microprocessor-based 8050A features a self-calculating dB mode in which dBm readings are displayed automatically referenced to one of 16 selectable impedance ranges — a real timesaver when servicing audio equipment.

And of course no discussion of DMM's is complete without considering conductance — a Fluke exclusive featured on five of our low-cost DMM's — which allows you to make accurate resistance measurements to 100,000 Megohms. You can't do that with any ordinary multimeter, but it's a must for checking leakage in capacitors and measuring transistor gain.

A handful of efficiency.

When every minute matters, your schedule is tight and so is your work space, you need a portable DMM that's fast and easy to operate. We designed our handheld DMM's with color-coded in-line pushbuttons for true one-hand operation: no need to hang onto the meter with one hand while twisting a rotary dial with the other.



But there's more to convenience than fingertip control. The 8024A, for example, is also designed to function as an instant continuity tester, with a selectable audio tone to indicate shorts or opens. It also has a peak hold feature to capture transients.

A word about warranties.

Last but not least, look closely at the company that manufactures a low-cost DMM. Their service is just as important as their product. Look for no-nonsense warranties, a large family of accessories, an established network of service centers and technical experts you can rely on.

That's how you'll recognize a knowledgeable supplier of low-cost DMM's, a company with experience, resources and a commitment to leadership in the industry.

Incidentally, you'll find it all at Fluke.

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☐ Please send the facts on Fluke low-cost DMM's—specifications, applications information, and selection considerations.

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For literature circle no. 111. ETD 11/79 both the NTSC and PAL systems through a front panel switch adjustment. However, the unit will still be around since the new owner, Binatone—an audio marketer—plans to plans to produce the TVs.

In another development, the founder of Sinclair Radionics, Clive Sinclair, has announced he has left the original firm and formed Sinclair Research. Through the latter corporation he plans to do development work on a flat tube miniature television.

Mitsubishi Opens U.S. Headquarters

Mitsubishi Heavy Industries, Ltd., one of whose divisions makes MGA television receivers, has announced it is opening a U.S. headquarters in Chicago.

However, a spokesman said, the venture at this point in time has nothing to do with the television business. The primary purpose of the headquarters will be to coordinate the efforts of Mitsubishi's five other U.S. offices in providing after sales service to customers of its industrial machinery products.

Mitsubishi, with sales of some $12.6 billion annually, makes ships, airplanes, heavy machinery, trucks, cars, buses, power systems and consumer products. The Chicago office, to be headed by Yutake Aoki, president of Mitsubishi Heavy Industries of America, will be comprised of eight persons, a company spokesman said.

Philips Seeks Larger Test Instrument Market Share

North American Philips' new manufacturing facilities in the United States will initially concentrate on making 25 to 50MHz bandwidth ocilloscopes, according to President Dominick Protomastro.

The plants, the first manufacturing outlets for North American Philips in the United States, eventually will expand their capabilities to include scopes in the 100MHz frequency range, he said. The new sites, located at Mahwah, N.J., are part of Philips' overall plan to capture a "substantially" greater share of the U.S. test instrumentation marketplace, Protomastro contends. He said that market is "burgeoning."

He added that the U.S. plants will have their own engineering capabilities "to satisfy the unique demands of the U.S. market and to support the manufacturing operations."

Last year North American Philips achieved record high sales of $2.2 billion. ET/D

Correction

The correct chassis number for the Hitachi Color TV receiver in September TEKFAX is NP8SX, not NP4SX.

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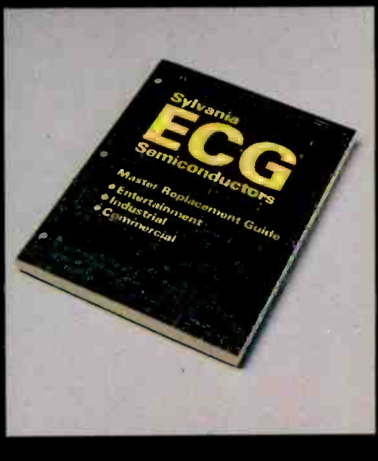

FROM THE EDITOR'S DESK

The high level of technology now associated with consumer electronics products has forged a new breed of home entertainment electronics technician almost overnight. In addition to being young, aggressive, and ambitious, this new breed of technician has been "brought up," as it were, in the fast moving world of modern electronics. He is equally "at home" working on digital or analog circuitry, he understands basic microprocessor theory and he is willing to learn more about the ever changing electronics world which surrounds him.

Those who hesitate to follow in his footsteps will find their days are numbered indeed.

To those in the latter group, I believe this issue of ET/D may be particularly significant. For one thing, it carries the seventh, and final installment of Joe Carr's excellent series on digital electronics basics. It is the second such series he has done for ET/D. If you haven't yet "picked up" on earlier installments you may do so by obtaining back copies beginning with the May issue.

Beyond this, the November issue offers the first installment of another series, I believe a tremendously significant series, on the microprocessor. Written by Bernard Daien, it may well be the last chance, for those who have hesitated in learning about the new technologies, to "jump in" and start swimming.

While we will run other more advanced stories about microprocessor-controlled products concurrently with this series, the latter is specifically designed for the novice in this area who has no prior experience—even insofar as the terminology is concerned. In effect, this series will take you from "day one," up to the present and then point you toward the proper resource material to continue your education.

And in case you haven't noticed it, continuing education has indeed become the name of the game in modern electronics.

In this issue also you will find an article dealing with the reception and demodulation of television signals from satellites in space. For several years now the major networks, as well as others, have used these devices for the intercontinental transmission of television programming. Now, however, there is a new wrinkle in that economically feasible earth receiving stations are within reach of the individual. While they aren't cheap by any means, there are "home receive" stations in existence today in the United States. Their owners enjoy the convenience of program selection beyond anything offered to date by anyone else.

Is this a wave of the future? Who knows? The point is it could be and in this regard ET/D feels a responsibility toward keeping you informed as to just what is going on in the area of satellite transmission and reception.

Richard M. Lay

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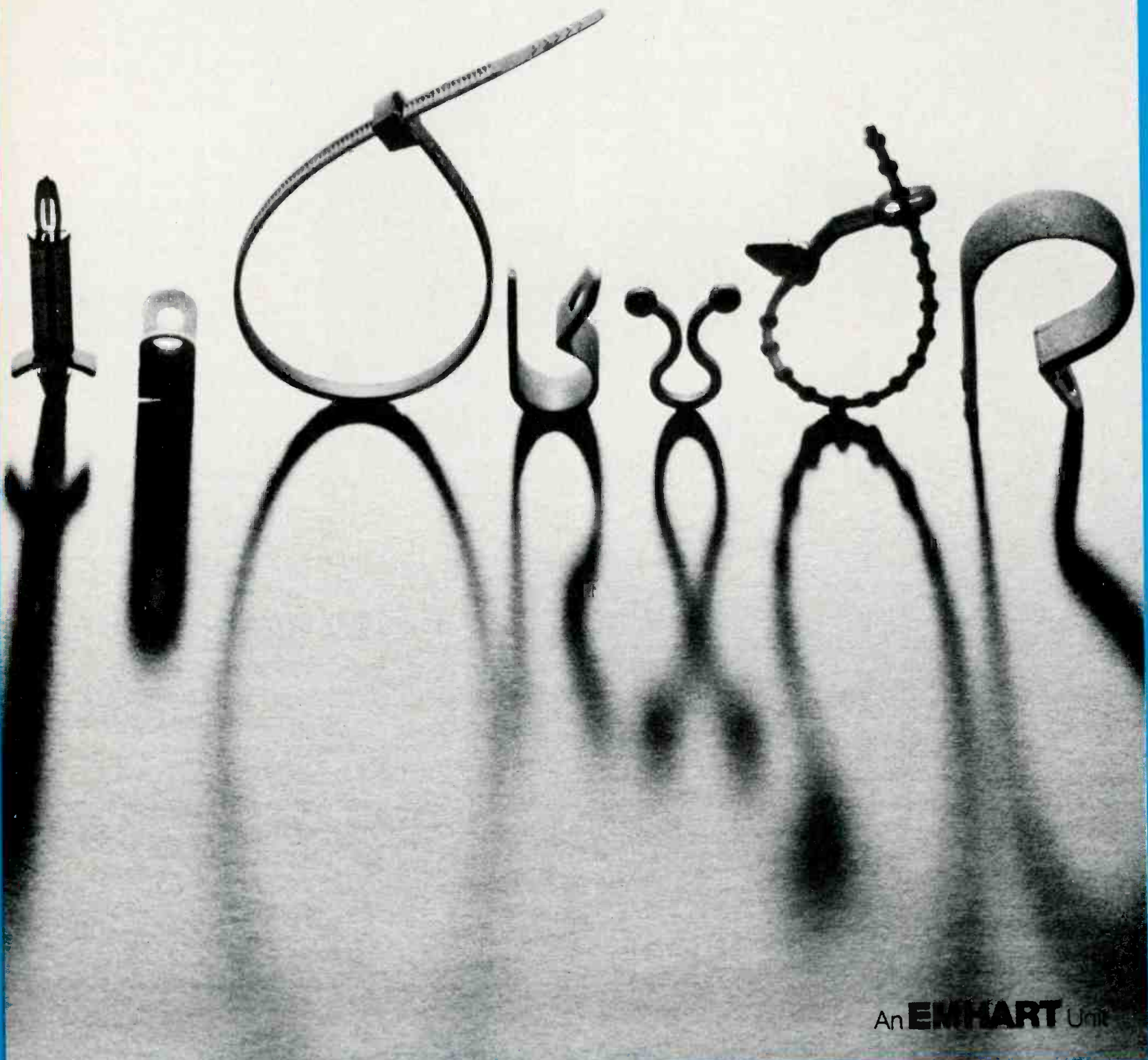

MALLORY

Circle No. 116 on Reader Inquiry Card

NEWSLINE

ZENITH-SCHLUMBERGER FINALIZE DEAL. Zenith Radio Corp. has announced that its acquisition of Heath Company, a wholly owned subsidiary of Schlumberger Limited, has been completed. Heath, the marketer of electronic kits under the Heathkit name, is based in St. Joseph, Mich. Long term financing for the $64.5 million deal has been arranged through Prudential Insurance Company.

NEW ZENITH UNIT TO FOCUS ON MICROCOMPUTERS. The speculation had been that acquisition of Heath Company's small computer line was the key motive in Zenith's takeover. Incidentally, Zenith also makes cathode ray tubes for industry and computer displays. Zenith announced creation of a new data systems division under the direction of Edward J. Roberts who has been Zenith's treasurer since 1975. Zenith Board Chairman John Nevin said Roberts would concentrate technical and marketing resources on the "significant growth opportunities in the small computer systems field."

SONY-PHILIPS CONCLUDE PATENT AGREEMENTS. What could turn out to be a key move in the battle for market share for new and developing consumer products--such as video disc players and Pulse Code Modulated stereo systems--has been announced by N. V. Philips and Sony. The two foreign electronic industry giants have announced plans to trade patent rights for some of their products. The move is seen as an effort to standardize, and make compatible, their new product lines.

MATSUSHITA-RCA COMBINE. A somewhat similar--though legally unstructured alliance -- exists between Japan's electronic/industrial giant Matsushita Electric and RCA. Matsushita--which markets consumer electronics in this country under the Panasonic and Quasar brand names--already is a large supplier of home video tape recorders to RCA. Also, RCA is planning to introduce its own version of a video disc player -- using a different, uncompatible technology than Philips--later this year. Matsushita is currently developing a video disc system.

HOME VIDEO RECORDING GETS LEGAL OKAY. Mickey Mouse took it on the chin in a decision handed down by Federal Judge Warren Ferguson in Los Angeles. In a ruling that surprised hardly anyone, the judge said it is not illegal for the owners of home video recorders to tape off the air for non commercial use. The ruling came in a suit by Walt Disney Productions to prevent Sony Corporation--maker of Betamax video recorders--from making them.

NEWS IN BRIEF...WESCON, the high technology electronics hardware convention for engineers and technicians reported record attendance of well over 50,000 for this year's event in San Francisco...Nippon Electric of Japan, that nation's largest maker of semiconductors, says it will start making large scale integrated circuits next month at its California subsidiary--Electronic Arrays, Inc...and, American Express company has acquired 50 per cent of Warner Cable from Warner Communications. The cable company involves some 140 cable TV systems serving over 600,000 thousand subscribers.

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Shown here are just a few of the more than 150,000 cross-references in the July, 1979 edition of the Zenith Universal Semiconductor cross-reference guide.

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25th ANNIVERSARY

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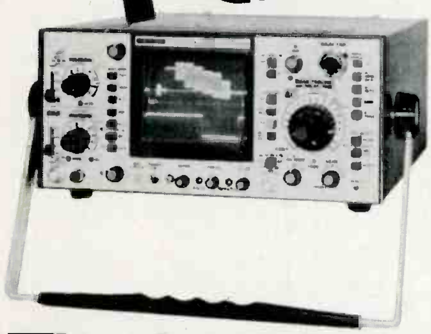

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LETTERS

HELP NEEDED:
I am in need of service data for a portable color television manufactured under the name XAM, and sold by Korvettes. The model number is 18CP4 and it was sold in 1974-75.
Frederic Stern
209-15 18th Ave.
Bayside, NY 11360

I need information on an XAM model 14CP74, bought in 1974 from Korvette's.
Ralph E. Weidler
7424 Warren St.
Forrest Park, IL 60130

Editor: ET/D contacted Korvettes and found them most cooperative. For service information or parts contact:
Korvettes, TV Parts Dept.
99 Constable Hook Rd.
Bayonne, NJ 07002,
giving model number. If they cannot supply parts any longer for an older model, they will, we are assured, supply the name of a supplier who can.

I need a medallion (complete radio dial face-glass) for a GE Model T1001C stereo radio cabinet. It can be used. GE cannot supply this item.
Randall Robertson, Service Manager
107 W. Vine St.
Salisbury, MD 21801

I need help in obtaining the latest tube chart information for a Jackson Tube Tester G48-1T. I will gladly pay for it.
Daniel T. Brown
Danny's TV Sales
922 O 15th St.
Portsmouth, OH 45662

I have two 5 in. black and white Candle TV's in the shop that have vertical problems. I have not been able to get any service data on these sets. The model is 510A. If any of your readers can help me I would appreciate it.
Anthony Christifano
446 N. Denver
Kansas City, MO 64123

Needed: A schematic or service manual for a Bradford Model 1004P41 (WT Grant WTG 609). Will pay for copy.
Race Radio & TV
3274 Mission St.
San Francisco, CA 94110

Help! I need a TV tuner KRK168 & KRK167. New or used.
M. Hardecker
805 Stiles Ave.
Maple Shade, NJ 08502

Would you please put the following in your letters department. Needed: Schematic-service manual for an Edison radio receiver Model R5 and an Edison power unit Type 8P, Receiver Type 7R. Will buy or copy and return.
Jerome Galiley
1303 Tustin
Cardiff, CA 92007

TEKFAX NEEDED:
I would like to obtain TEKFAX's #109, 110, 111, 112, 113
D & R TV
1004 Commercial
Jensen Beach, FL 33457

I need TEKFAX #113
Lee B. Britton
6260 Church St.
Los Angeles, CA 90042

ET/D welcomes letters from readers and tries to answer all requests in this column or individually. ET/D

SYLVANIA ANNOUNCES

The Two for Blue Hawaii Super Semiconductor Sweepstakes.

2300 Prizes in all!

PRIZES INCLUDE:

- **First Prize: A trip for two to gorgeous spectacular blue Hawaii.**
- One 1st Place Award ...... Trip for *two* to Hawaii
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- Five 3rd Place Awards ...... Weatherby Olympian Over/Under Shotgun
- Five 4th Place Awards ...... Motobecane Moped
- Ten 5th Place Awards ..... AMF 10-Speed Bicycle
- Fifteen 6th Place Awards . Weber Bar-B-Que Kettle
- Sixty 7th Place Awards ...... Jiffy Grass Trimmer
- 2200 8th Place Awards .... Cordomatic Power Outlet Reel

There will be winners from every state* – 2300 winners in all.

Enter as many times as you wish to improve your chances of winning.

To enter send in five Sylvania ECG® semiconductor bags or cartons attached to an official entry form. Official entry forms are available from Sylvania distributors. Mail to "Sylvania Semiconductor Sweepstakes Award Headquarters", P.O. Box 4900, Fenton, Mo. 63026.

*The Sylvania Super Semiconductor Sweepstakes program is available only to dealers and service technicians. Employees of General Telephone & Electronics, GTE Sylvania, their subsidiaries, authorized distributors, or their advertising agencies are not eligible to participate. No purchase required. Reasonable facsimile accepted. Void in Utah, and where prohibited by law.

SYLVANIA GTE

All entries must be postmarked no later than midnight, December 31, 1979.

SERVICE SEMINAR

COPING WITH AMP INTERFERENCE

Ideally, audio equipment should be immune to radio-frequency interference and unwanted external noise. In an effort to ensure that it is, many counter-measures are being taken in the design and manufacturing of the equipment. However, due to the high cost involved, it is impossible to eliminate all sources of interference. Radio-wave pollution is everywhere. In addition to numerous public broadcasting stations, there are many business and amateur stations as well as citizens' band users, all contributing to it.

The major causes of interference are excessively high-power transmission, spurious radiation, transmitters located too close to receivers and poor receiver protection. However, before the problem of interference can be tackled, the interests of all parties concerned-users, broadcasters and manufacturers-must be taken into consideration. Here we will discuss the various countermeasures currently being taken against external noise and interference. But first let us explain the meaning of "Amp I."

"Amp I" stands for Amplifier Interference. It is a kind of RF interference, and refers to RF energy transmitted at a high-enough magnitude to interfere with the operation of electronic equipment, in this case audio equipment.

The cause of this interference can come from any one of a variety of sources in which RF energy is detected. And the effects can be noticed in virtually every piece of audio equipment.

Although "Amp I" can be classified in various ways, such as tape deck or tuner interference, for the sake of simplicity we shall refer to everything collectively as "Amp I" here.

1. "Amp I." Its Main Causes and Entry Points

1.1 Main causes of "Amp I"

- Connecting cords used between components in an audio system may, due to their stray capacitance and inductance, act as resonant circuits for RF signals. When a broadcast frequency is picked up by the resonant circuit, the signal passes through the cords and enters the subsequent circuit, where it is detected and amplified by the various circuit components such as transistors and IC's.
- Powerful RF signals may enter directly into the circuit elements, bypassing the normal inputs. Phono cartridges, magnetic heads and circuits with non-linear amplitude characteristics are particularly susceptible to such interference.
- Incorrectly operated broadcasting equipment, or equipment that is incomplete or insufficiently protected against spurious radiation, causes RF signals to be induced into AC lines. This results in unwanted external noise and interference in audio equipment, TV's and other audio transducers in the immediate vicinity of homes using common lines.

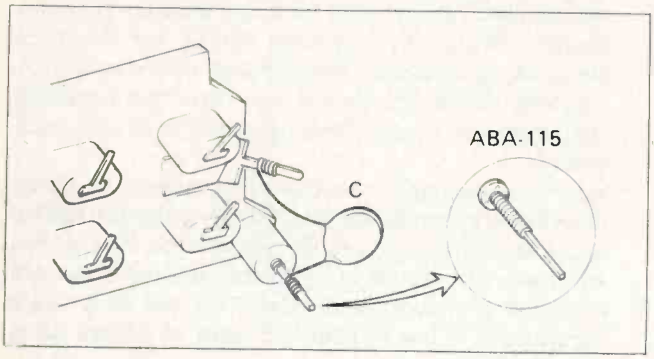
1.2 Major "Amp I" entry points

- Turntable phono cartridges
- Magnetic heads of tape decks
- Connecting cords between audio equipment
- Primary power supply circuits
- Speaker cords
- Tuner antennas and connecting cords

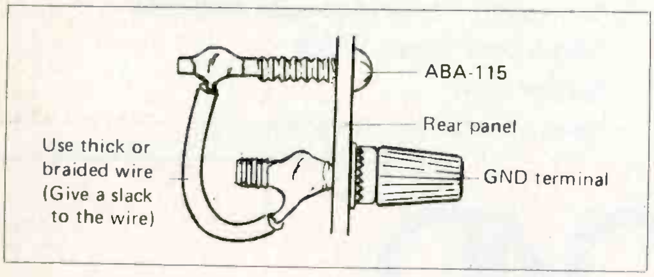
Pioneer

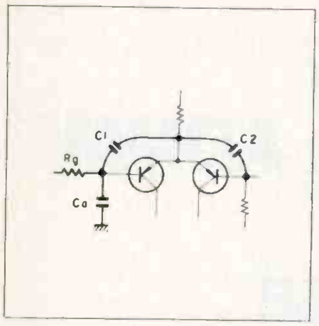
The following Service Seminar items refer to amplifier interference problems and their proper cure.

Induced in the input terminals or connecting wires. Connect a capacitor to the chassis and grounding point of input terminal. The value should be between .01 and .047μF (CKDYF103Z5CKDY473Z50). To ground the rear panel, replace the original screw with ABA-115 and solder one of the capacitor leads to it. The length of the capacitor leads should be short as possible.



Induced into the grounding wire of turntable output cord. Add a new grounding point near the GND terminal using ABA-115 screw and connect the terminal to the ABA-115 with a thick lead or braided wire.





Induced in audio signal routes of the amplifier, such as preamp stage and control circuits. If it is in a differential amplifier, add a capacitor or replace C1 and C2 to achieve a capacitance of C1=C2=47 to 100pF. Also replace Rg and Ca with larger value components, but do not exceed 2.2Kohms and 100pF respectively.

Next Month in ET/D

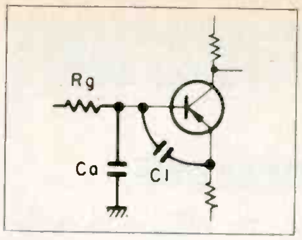
Modules—Repair or Exchange

Magnavox's "Micro-Tune"

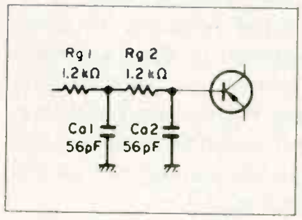
Output Transformerless Amplifiers

More on Microprocessors

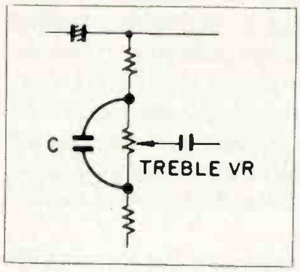
ET/D's Annual Index



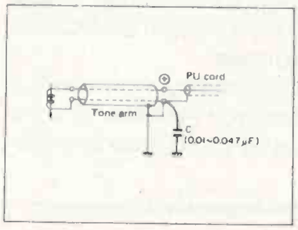
In a conventional amplifier, type 1, add a 47 to 100pF capacitor to C1 between the emitter and base. Also replace Rg and Ca with larger value components, but not exceeding 2.2Kohms and 100pF.



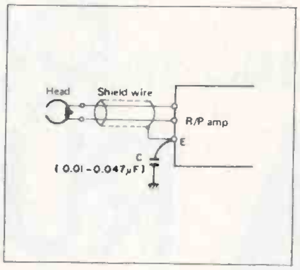
For a type 2 conventional amp, divide the filter consisting of Rg and Ca into two stages to get a sharper effect. The value of the parts should be:
Rg1 + Rg2=2.2Kohms
Ca1 + Ca2=100pF



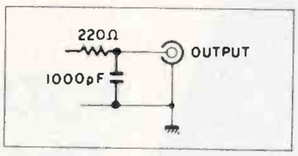
If Amp I is entering through tone control circuits employing B-type VRs (VAX or LUX), insert a capacitor across the treble control volume. The values should be 470 to 680pF: 100Kohms up to 1000pH: 10Kohms.



Induced in phono cartridge or turntable lead wires. Connect the earth lead to the ground via the capacitor specified; employ the shortest route from the tonearm to the chassis. Never connect to the positive lead.

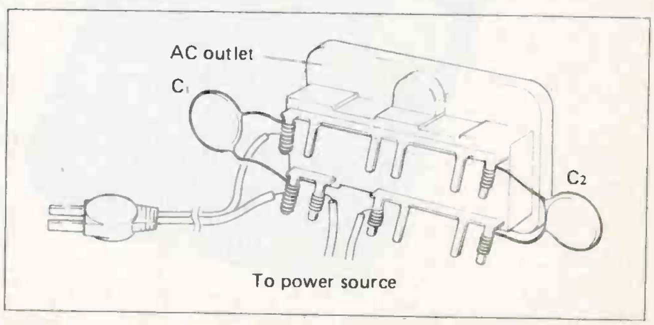


Induced in the tape deck. Connect C, specified head lead wire, to the chassis. Also, replacing the head leads with the shielded wire is sometimes effective, if the shielded wire is not employed. **Caution:** Never connect a capacitor to the signal line.



Induced in the signal line of the tuner. Connect a specified RC filter to the output terminal.

Induced into the AC line. Insert a line-cross capacitor (C1 or C2) into the AC outlet terminals. An ACG-003 with insulator cover (AE279) should be used. **Caution:** Don't let capacitor leads touch others. ET/D



STRICTLY BUSINESS

Not everybody is motivated by a money incentive. It is true that in many cases, men will work harder and smarter when paid a bonus or an incentive or if working on straight commission ... but not all of them.

Sometimes it is a matter of the man's position in life. If the man is young and struggling, trying to put food on the table, trying to build a life for himself and his family, he will really turn on to an incentive program.

Other men, though, are in a more comfortable position. They have a nice place to live, they eat steak about as often as they want to, there are two cars in the garage and plenty of beer in the refrigerator, and they have the boat and the outboard for fishing. These men may be a lot more interested in working conditions than in making more money. They don't want to work overtime ... they want to go fishing.

There are other men who have established in their minds what they consider a good day's work. Once they reach that level in a day, they slow down or even come to a dead stop, regardless of the incentive.

Still others may find it psychologically impossible to work under a commission type of system. They may be buying expensive cars in the winter, and eating macaroni and cheese in the summer. If the men can accommodate this, often their wives cannot.

There are some additional problems that may be encountered when installing an incentive system. If, for instance, you weigh the program for speed, you may well get speed ... but at the expense of quality, or good customer relations. Or the men may get to bickering over the "good" jobs.

The bottom line on incentives is that they require a great deal of consideration on the part of the manager. A good incentive program can be very effective in raising productivity, but take care to avoid the pitfalls.

Make sure your program does not inadvertently reward unwanted behavior, such as undue speed, bruskness, or "loading" the job.

Make sure the program is simple and that the men thoroughly understand it. Each man should be able to compute his bonus each day.

Make sure you have established standards which the men must meet and set up a way to measure each man's performance against those standards.

Make sure your program provides adequate income for the technician in the months in which productivity is low.

Make sure your program considers the effect of days off ... holidays, sick leave, days spent in training.

Make sure that you, as the manager, are in close touch with the men, guiding them, helping them achieve.

Make sure you get the most mileage from the program, through recognition and awards.

And finally, if you would like a free copy of NARDA's four-page brochure on Incentives for Technicians, just write me at NARDA, 2 N. Riverside Plaza, Chicago, IL 60606.

Incentive plans can increase productivity, sometimes dramatically, but they require your careful attention.

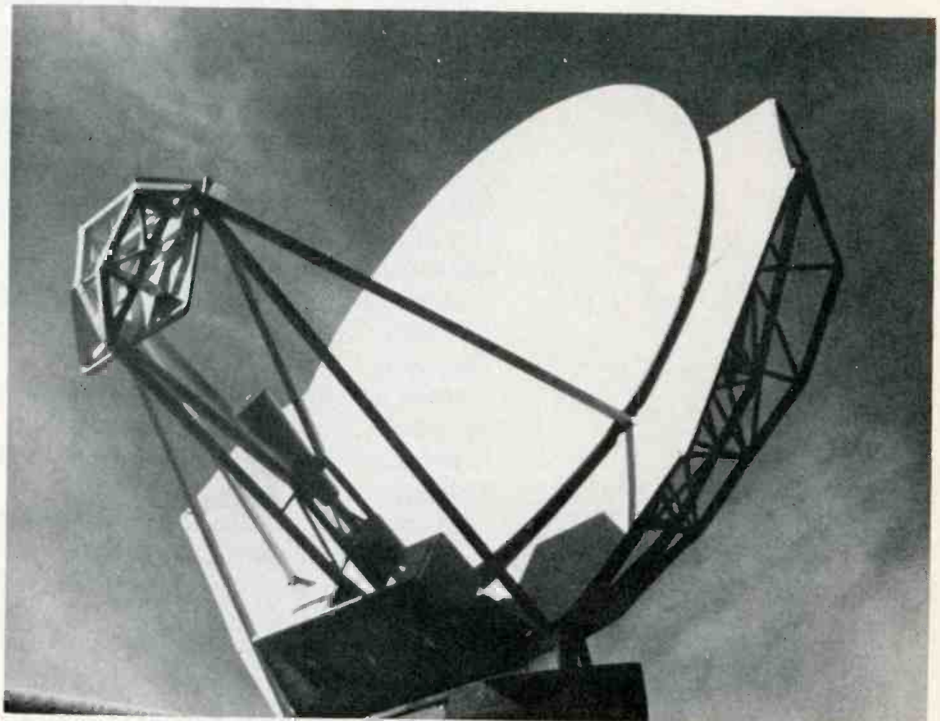
Mgr., NARDA's Service Division

Satellite television reception

Forty channels direct

For those remote from television stations or those dissatisfied with local reception, direct from satellite TV may be the answer, though an expensive ($5000 up) one.

By Walter H. Schwartz



General Telephone and Electronics' new, low sidelobe, antenna, said to allow spacing of communication satellites within two or three degrees of each other.

More than 22,000 miles above the equator, some 30 geostationary (so-called because they revolve once each 24 hours, and thus stand still relative to the surface of the earth) satellites relay various types of communications back to earth.

These satellites can be spaced about 4 degrees (about 1800 mil) apart at present, in an orbit about 172,000 miles in circumference. These satellites are maintained within an area about 70 miles on a side by hydrazine rockets, which can be operated to correct for drift in position. The life of a satellite is about seven years (it finally runs out of hydrazine).

The electronic system involved in this transponder is simple in concept. Solar cell powered, they receive signals from the ground over a frequency range of approximately 5.9 to 6.4GHz, and then hetrodyne it with a local oscillator at 2.225GHz to transmit an output of 3.7 to 4.2GHz

The input is filtered through a bank of 40MHz bandwidth filters, goes to the mixer and then to a traveling-wave tube amplifier. The ground stations can transmit the power required to insure good reception at the satellite. However, the TWT amplifier output is only five watts. This, coupled with highly directional antennas, results in an effective radiated power of over 3000 watts, directed at the north central U.S., and a power level about 1 or 2dB less for the rest of the contiguous 48 states. Alaska and Hawaii receive lower signal levels. The receive path loss, however, is 196dB; the maximum signal to be received then is about -1600Bw.

The signal is a bit different than the standard TV signal we are accustomed to. It is a wideband FM signal with an audio subcarrier at 6.2MHz or 6.8MHz, usually; apparently other subcarrier frequencies are sometimes used. To further complicate matters, the carrier also is frequency modulated at a lower deviation by a 30Hz signal for energy dispersal, a process which reduces interference with ground microwave links.

Consequently, the total receiving system is more elaborate than anything we usually observe in standard television reception (Fig. 5).

Antennas

Two types of antennas are possible

SATELLITE	POSITION LONGITUDE	NUMBER OF CHANNELS
SATCOM I	135°W	24
SATCOM II	119°W	24
SATCOM III*	132°W	24
WESTAR I	99°W	12
WESTAR II	123.5°W	12
WESTAR III**	91°W	12
COMSTAR I	128°W	24
COMSTAR II	95°W	24
COMSTAR III	87°W	24
ANIK III	114°W	12
ANIK B	109°W	12

*To be launched October or November '79

** To be launched Aug. '79

Fig. 1 Satellites of interest for TV relay.

WESTAR AND ANIK	SATCOM CENTER FREQUENCY (GHZ)	
CENTER FREQUENCY (GHZ)	HORIZ	VERT.
3.720	3.740	3.720
3.760	3.780	3.760
3.800	3.820	3.800
3.840	3.860	3.840
3.880	3.900	3.880
3.920	3.940	3.920
3.960	3.980	3.960
4.000	4.020	4.000
4.040	4.000	4.040
4.080	4.100	4.080
4.120	4.140	4.120
4.160	4.180	4.160

RCA (SATCOM) gets twice as many channels (24 instead of 12) by overlapping adjacent channels and staggering horizontal and vertical polarization.

Fig. 2 Satellite down frequencies.

Fig. 3 Paraframe R & D's laminated framework dish with rotatable feed horn for polarization change.

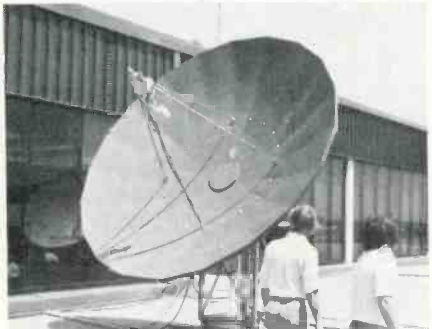


Fig. 4 The United States Tower Company's four meter dish. Fiberglass over aluminum.

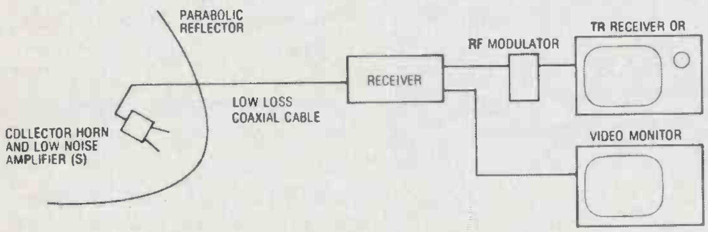


Fig. 5 Satellite TV reception system.

candidates for use in satellite reception. Horns and parabolic reflectors can be used; phased co-linear or yagi arrays have too much loss in the interconnecting harness.

A parabolic reflector about eight feet in diameter would appear to be just about the absolute minimum size usuable. Diameters of less than eight feet not only have less gain, but the beam width widens, and especially as you get farther north and east and begin looking closer to the ground, as the angle of the satellite above the horizon decreases the more noise your pick up from the hot earth. The larger reflectors provide a narrower beam pattern, and more gain makes reduced demands on the system following. It has to be decided whether to spend the money on antenna size or low-noise preamplifiers. Practically 10, 12 and 15 foot reflectors seem to be popular, Fig. 3, 4, 6.

At far north latitudes, where the antenna angle is very low, reportedly horns are used, since the mouth does not have to be elevated appreciably there and the horn is more free of side lobes that potentially would pick up terrestrial noise. The horn could be interesting, since it has no curves. Construction of its framework could possibly be a carpentry job, since it is the size of a small building. (If you want to design a horn, see Henry Jasik ed. *Antenna Engineering Handbook.)*

The signal is focused by the parabolic reflector into a feed horn mounted, obviously, at the parabolic focus point. (Fig. 7.)

LNA's

Mounted at the feed horn, to avoid coaxial cable losses, are usually one or more preamplifiers known as low-noise-amplifiers, LNAs. These are costly little items of hardware, but the signal available at any practical antenna requires the use of an amplifier for usable reception. The noise figure of the LNA is extremely important. The larger the antenna, the poorer the noise figure that can be tolerated. For example, according to Dexcel, their Model SXA-3091-01 (33dB minimum gain, 1.8dB noise figure) will produce superior reception with a 12 foot dish and adequate reception with a 10 foot dish in most North American locations. These low noise amplifiers are usually built right on the wave guide for mounting to the feed horn (Fig. 9).

The receiver

We are not speaking here of your TV receiver. The signal needs special processing before you can feed it to a standard TV set.

A typical receiver, Avcom's PSR-3, is a wide band double superhetrodyne FM demodulator (Fig. 10). The output is video which can be viewed on a video monitor or modified TV set, or fed to a remodulator for input to the antenna terminals of an unmodified TV set.

The first local oscillator is voltage tuned at a sub-multiple of the approximately 2.8GHz to 3.3GHz injection frequency. A step recovery diode multiplier, multiplies the frequency into the proper range resulting in a first IF frequency of 880MHz. A 950MHz oscillator in turn hetrodynes the signal to a second IF of 70MHz. The 70MHz signal is amplified, limited and demodulated. The resulting video is clamped to remove the 30Hz energy dispersal modulation, and amplified to a level suitable for a video monitor.

The audio subcarrier demodulator can be tuned to either the 6.2MHz or 6.8MHz subcarriers and the receiver has audio output to drive an external speaker. An optional subcarrier demodulator can be connected to the input of an FM stereo receiver and

Fig. 6 Dalsat uses an Andrews dish with the feed horn and wave guide rotatable from its base.

Fig. 8 Four Dexcel LNA's. Each has 33dB, minimum gain.

provides reception of the stereo transmissions from the satellites simply by properly tuning the FM receiver.

The PSR-3 voltage controlled first oscillator can sweep its range to scan-tune the entire 3.7GHz to 4.2GHz band. This is most useful during antenna setup.

So there you are. A parabolic antenna costing, including mounting, concrete work, etc., perhaps as little as a couple of thousand dollars. A low noise preamplifier (LNA) costs from one thousand dollars up. The receiver prices seem to begin at about two thousand. The minimum costs of commercial equipment would be about $6000 at this time. Advances in semiconductors for the LNA's and in manufacturing techniques for low priced antennas may make significant cost reductions possible, however.

The legal situation is in flux. The FCC is due to clarify the situation shortly, however. The transmissions are all by common carrier; you are supposed to pay for the service. For example, Channel 17 from Atlanta is open to anyone for a payment of $60/yr; C-SPAN, the new sports service which was to have begun September 1, is reportedly available for a single one time payment of $2.40. The movie channels, HBO, Showtime, etc., have a standard

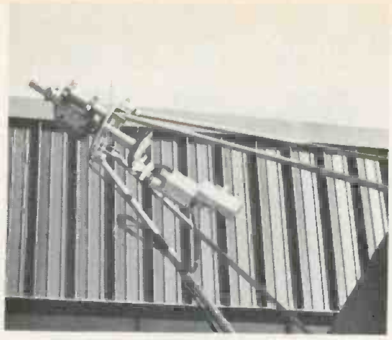


Fig. 7 The rotatable feed horn assembly of the Paraframe R & D antenna.

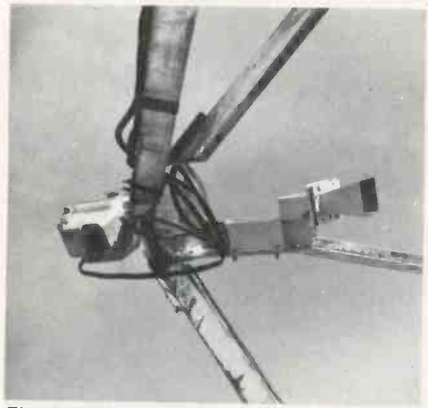


Fig. 9 A rotatable feed horn and an LNA at its base.

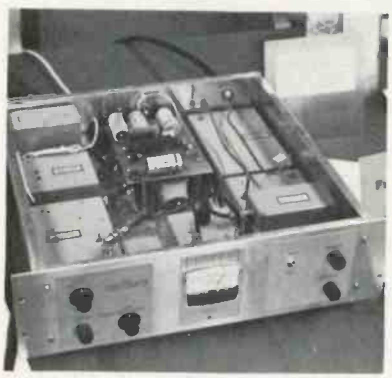


Fig. 10 Avcom of Virginia's PSR-3 satellite video receiver.

rate; but they seem to be ignoring home terminals *at this time*. Three religious channels and the live Congressional sessions are reportedly free.

Sources of Information and Equipment

GENERAL INFORMATION:

SATELLITE TELEVISION TECHNOLOGY
P.O. Box G
Arcadia, OK 73007
Publications covering background, licensing, as well as several working systems are available. Also information on program material.

SATELLITE INNOVATIONS
P.O. Box 5673
Winston Salem, NC 27103
Polar mount and feed horn rotation information package, $10.

ANTENNAS:

PARAFRAME R&D
P.O. Box 423
Monee, IL 60449

VSC
PO Box 582
Guin, AL 35563

UNITED STATES TOWER COMPANY
P.O. Drawer "S"
Afton, OK 74331

LOW NOISE AMPLIFIERS:

SCIENTIFIC COMMUNICATIONS, INC.
3425 Kingsley Road
Garland, TX 75041

DEXCEL, INC.
2285C Martin Ave.
Santa Clara, CA 95050

RECEIVERS:

AVCOM OF VIRGINIA, INC.
SATELLITE SYSTEMS DIV.
10139 Apache Road
Richmond, VA 23235

SCIENTIFIC COMMUNICATIONS INC.
3425 Kingsley Road
Garland, TX 75041

INTERNATIONAL CRYSTAL MFG. CO., INC.
10 North Lee
Oklahoma City, OK 73102

MICROCOMM
14908 Sandy Lane
San Jose, CA 95124

COMPLETE SYSTEMS:

STARSCAN
Two Post Oak Central
1980 S. Post Oak Road, 20th Floor
Houston, TX 77056

DALSAT
P.O. Box 1960
Plano, TX 75074

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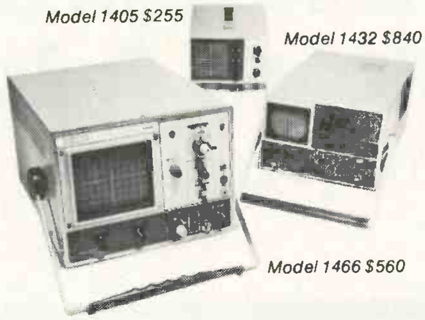
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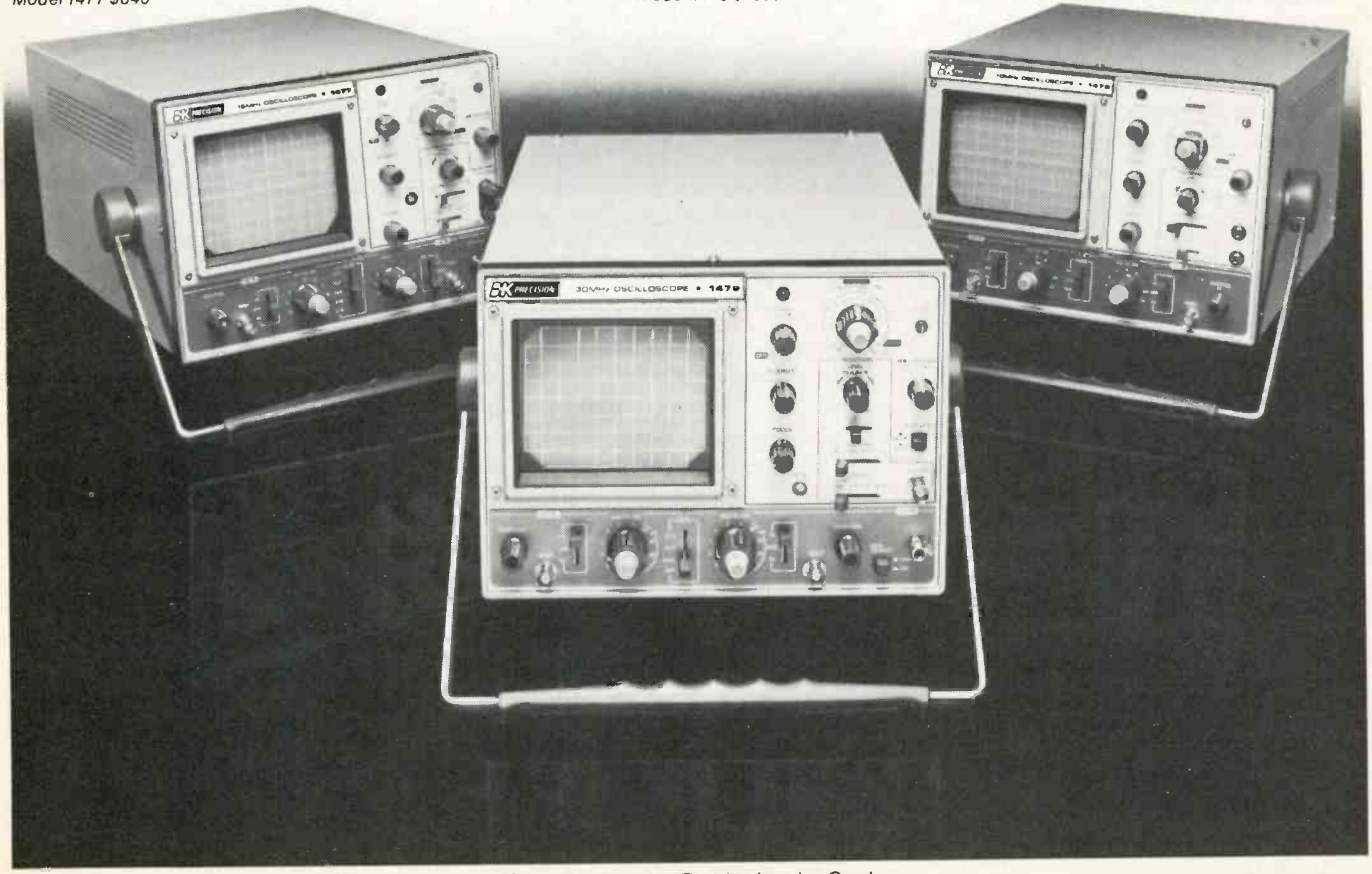

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Microprocessors from A to Z

Doing it the easy way

ET/D begins a series for people who want to know what a microprocessor is, how it works, and how to use it. It is a "stand alone" course with all terms defined and no previous computer technology knowledge required.

By Bernard B. Daien

This series provides an easy entry to the world of microprocessors by stressing concepts, instead of details. These articles can be quickly read by those who understand basic electronics, but not digital electronics.

Upon completion, the reader should be capable of understanding the trade literature covering the installation, use, troubleshooting, and programming of microprocessors.

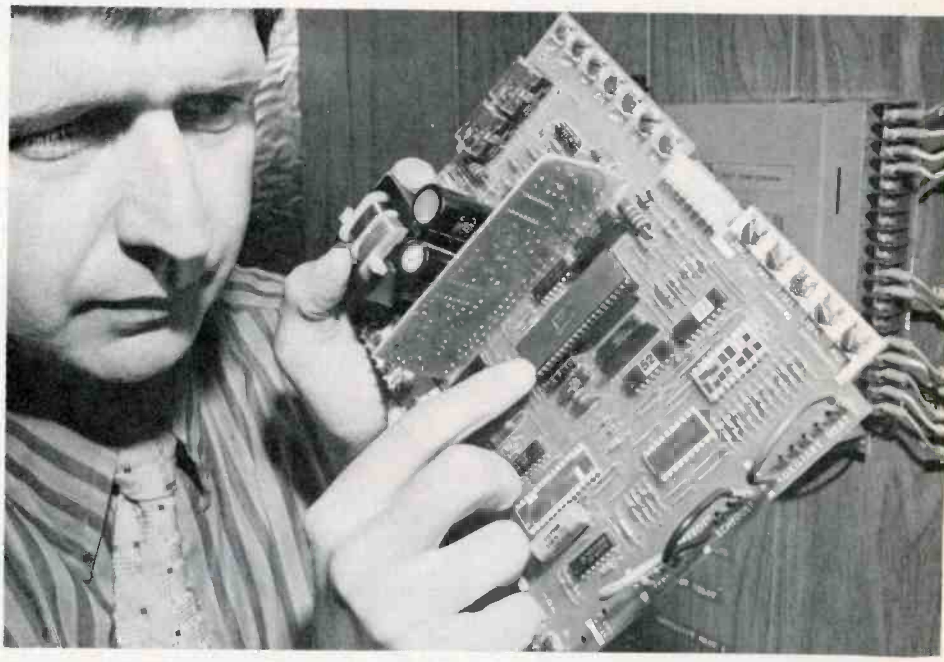

Fig. 1–A sophisticated, programmable microprocessor is the heart of this advanced heat pump control system from Honeywell's Residential Controls Center. Transducers encode indoor, outdoor and wall temperatures in home or office buildings for computerized control of indoor air flows.

Microprocessors' growth

Although microprocessors (MPUs) are usually viewed as "computers," the computing function is only a portion of the MPUs applications, since it is well suited for data processing and controller uses. "Data processing" includes, but is not limited to, the gathering, analyzing, sorting, organizing, arranging, and distributing of data. To do this, data may have to be stored, retrieved from storage, displayed, printed out, or altered, as needed. The data may be used in computation, but as you can now appreciate, the computation would only be a small part of the data processing.

For example: customer lists are first sorted alphabetically, then placed on punch cards, which are used later for billing, mailing lists, or other uses. The customer list might also be placed on magnetic tape for storage, encoded in digital form. 'The term "digital" will be explained later.) The MPU would be used to encode and decode the information, and use it to perform desired tasks in accordance with the instructions given to the MPU in the form of a "program" written by a programmer.

This handling of digital data is a very large and important use of MPUs. Data transmission over telephone and other communication systems is now a huge business, and growing faster than any other type of communication. Banks communicate about credit cards and accounts. Stock markets reports and other business transactions are included in data transmissions.

In some cases, large computers are required because of the amount of data to be handled, and the speed required, but there are many situations in which a smaller, slower, and less expensive machine (the MPU) is adequate.

Because of the tremendous amount of data being handled every day, manual handling is far too slow and error prone to suit our modern society. The MPU can be utilized to perform thousands of operations per second, involving different types of data, performing many different operations, and is faster than all other methods of data processing, excepting only a larger, more expensive, general purpose computer.

MPUs also are used extensively in "process control." In this case the MPU acts as a "controller," achieving desired conditions and results, by controlling machines in accordance with programmed instructions. Some automobiles now have MPUs which control the mixture of gasoline and air so as to achieve complete combustion. These MPUs take into account such variables as altitude, air temperature, barometric pressure variations due to weather, and engine loading. In the past, controllers were devised using combinations of mechanical, electrical, hydraulic, and pneumatic systems. But the MPU is faster, more accurate, smaller, lighter, cheaper, and it is programmable. It is therefore very flexible, and can be used in a wide

Fig. 2–An example of types of test gear field service technicians of the future will be working with is this portable, microprocessor controlled diagnostic tool. For use in troubleshooting Honeywell's heat pump control system, the field technician simply connects to the unit under test and automatic "error" messages display location and type of trouble.

variety of applications, which results in large sales, which further reduces the price due to mass production. This is a main reason for the MPUs' success ... wide applicability, mass production, low price, due directly to its *programmability*.

The MPU invasion

In many cases the MPU is a built-in unrecognizable part of the equipment it controls. Using data from the equipment itself, and instructions from humans, and drawing upon its memory banks, the MPU makes fast, accurate, complex decisions, which control the host equipment in a very versatile manner. The MPU is being used more and more to control machinery, and again the word "speed" crops up.

Of course it isn't practical to use a $500,000 computer to control a $50,000 machine in most cases. The MPU with its lower cost makes practical the use of digital control for medium, and even small sized, business.

The MPU can be programmed, and readily reprogrammed, to do many different tasks. Thus, one MPU can be many things for many people, like a magic circuit board, which changes its functions in accordance with the wishes of the operator! An MPU can be purchased, secure in the knowledge that it will not be rendered useless by some change required in the manufactured product.

So ... if you think about it, we are saying that *MPUs use programming to replace hardware*. By changing the programmed instructions, the MPU can be made to perform a new and different task, without the necessity of purchasing new equipment. And *that* is the secret of success of the MPU.

What a microprocessor is

MPUs have been defined many different ways, which often confuses readers of most microprocessor texts. Usually the discussion concerns computers, and then the MPU is defined as "part of a computer." We will attempt to define the MPU in simpler terms.

Modern MPUs are large scale integrated circuits (LSIC), containing 8,000-to-10,000 transistors which can be used to *replace* many different types of integrated circuits, by *imitating* their functions. The MPU is fed an input, called "data," and instructions telling it what to do with the data. It is the *instruction* that tells the MPU what type of circuit it must emulate.

The term "large scale integrated circuit" indicates the size and complexity of the integrated circuit. An IC which replaces a single stage of an amplifier, is considered "small scale." If it replaces an entire sub-section, such as the entire sound amplifier, or color section, in a TV set, it would be regarded as "medium scale." Larger ICs with thousands of transistors are "large scale." Today we have "very large scale" ICs, with hundreds of thousands of transistors, and the end is *not* in sight!

Let's be specific. Suppose we want an MPU to add some numbers. The numbers to be added are the "data." An instruction, "add" indicates what we want to do with the data. In this case, the MPU is performing the function of an adder.

The MPU can perform a very wide variety of functions, some requiring an entire series of steps to complete. The MPU can perform several functions, in sequence, in order to accomplish a given task. This requires a series of instructions, called a "program." Since we wish to enter the program into the MPU all at once, we need some "memory" circuits, which can accept the entire program of instructions, and then implement it, step by step, in the necessary sequence. This establishes the fact that the MPU IC, by itself, is very limited in usefulness. Some memory circuitry is required to "support" the MPU. Other "supporting" circuitry also includes input and output "interface devices. Interface devices are not new to you. A hi-fi amplifier often uses a matching transformer to interface between the amplifier and the speakers, for example. MPUs often communicate with the user over the telephone, in which case the interface device would be a telephone coupler.

Interfacing can be defined as the process of *connecting* different circuits together in such a way that they operate in a coordinated manner. When we interface "input" or "output" devices, we abbreviate them to "I/O devices."

Let's get some feeling for how complex the MPU IC is. Relating to what you are familiar with, the MPU is more complex than the student type electronic pocket calculators, which can perform only the functions indicated on the keyboard. The MPU remember, can be programmed for a wide variety of tasks.

On the other hand the MPU is less complex than the larger general purpose computers, because the MPU by itself cannot do very much. It requires support circuitry consisting of a power supply, interface devices, memory circuitry, a control panel, some kind of readout, etc. The general purpose computer has all of these things within its cabinet.

Before the advent of the MPU, logic circuits were constructed on printed circuit boards to perform specific functions. If the function had to be changed, the circuitry had to be rebuilt, with loss of time, labor, and money. With the MPU, a library of programs permits frequent, quick, task changes.

Hardware vs. software

It is important to understand that programs do not materialize out of the air! They are costly. A programmer needs skill, time, and equipment to write a program of instructions. The program must be run on equipment similar to the MPU it is to be used with, in order to

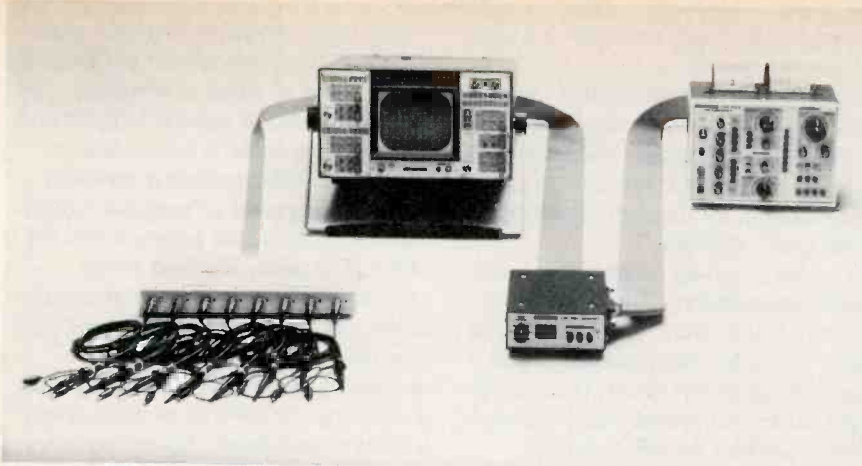

Fig. 3–Leader Instruments Corporation's "computerized" 5800 production test oscilloscope system is perhaps typical of the types of sophisticated production control units soon to be common. This system permits anyone who can use an oscilloscope to select up to 32 preset configurations for the viewing of waveforms at up to eight preselected test points.

detect any errors in the program. Eliminating all of the errors requires running, and rerunning, and correcting, and recorrecting the program. This is called "debugging," and may take weeks, depending on the length and complexity of the program. We are stating that we have exchanged one set of problems for another set of problems. In the language of computers, we have traded "hardware" for "software." Hardware is defined as actual physical apparatus including electrical, electronic and mechanical parts. "Software" is defined as programs and instructions, on paper. Sometime the MPU and software can be used to replace hardware with economic advantages. At times the reverse is true. Each application must be examined to determine the most cost effective approach.

Microprocessors vs microcomputers

The MPU alone is not a self sufficient device. It needs much support circuitry to perform most tasks. If we add the required circuitry ... power supplies, memory, I/O to interface devices, etc., we can perform computing tasks, and at that point we have expanded our MPU into a minimal computer ... a "microcomputer." This small computer is not as fast, and not as flexible as a large computer. It can only do one operation at a time, step by step, in accordance with the program. Most tasks take the MPU through many steps, requiring milliseconds to accomplish. A large computer would do the same task in a few microseconds, thus accomplishing more work per second. This ability to do work fast is called "computing power," therefore MPUs are not considered to be very powerful computers. They are adequate where great speed and flexibility are not paramount.

MPUs are also limited in the amount of memory capacity that can be controlled. Great strides are currently being made in MPU design, and the new MPUs are as powerful as some of the larger computers of a few years ago ... but ... in the meantime, the larger computers have also grown more powerful, so that the gap still remains when comparing the performance of an MPU with a large computer.

A large bank needs a large computer to handle the thousands of transactions occurring daily, and recording and storing enormous amounts of data in memory. A small factory, on the other hand, might only require an MPU with appropriate supporting hardware to control a production machine. The difference in cost between the two systems would be large. As a matter of fact, the MPU would cost so little, that the cost of the software programs required would probably be greater than the hardware costs!

The MPU and you

By now you should be starting to understand the implications of the MPU and the new industry it has created. People are needed to build MPUs, sell MPUs, install MPUs, maintain MPUs, and program MPUs. Other people are needed to build the required support hardware ... power supplies, keyboards, cabinets, semiconductors, etc.

Technicians who understand the microprocessor (MPU), can take their pick of jobs offered in all the trade periodicals. There is an optimum time to enter each new technology. For example, five years ago a TV technician who understood vacuum tubes could get along nicely, but today a TV technician needs to know both vacuum tube and solid state to service the existing sets. In another five years a tech will only need to know solid state. Most of the tube type sets will have worn out. Another example: A tech working in a factory making auto radios would have had to learn about solid state when technology mandated a fast changeover to transistor auto radios. If he did study solid state in the 1950's, he had only to learn about the bipolar transistor, and then, when JFETs, MOSFETs, Darlingtons, integrated circuits, etc., came along, they were learned easily, one at a time. The tech who delayed getting into solid state, had to learn all the devices at once, a much more difficult task. So there *is* an optimum time to "get into" a new technology, and it is now.

It has been said that a programmer really does not need to know what is inside the MPU in order to write a program. This is only partially true. The programmer who understands how the MPU works, however, can generally generate shorter, more concise programs than the programmer who merely follows certain rules, without knowing why. You will certainly be working with apparatus that uses, or interfaces with, MPUs. You will benefit from the knowledge about how the MPU works. This fact has not escaped the notice of most employers, and there is now arising a good demand for employees who understand the MPU.

There are several well known companies now manufacturing MPUs, and others are still entering the race, as the market grows. Each brand has its advantages, and disadvantages. Some have more internal memory, others more speed, others more flexibility of application. There is still no real standardization in many areas ... therefore you cannot replace one MPU with another in most cases. Certain brands have arranged for other manufacturers to build the same device so as to have a "second source," which most customers require.

Some brands have a wide variety of support hardware available, while others do not. There is no hard and fast rule. This series of articles has been written to enable you to deal with most of the popular MPUs now on the market.

Firmware

You already know the terms hardware and software ... there is a third term coming into popular use, "firmware."

Firmware, as you might guess, is somewhere between hardware and software. Hardware is by its very nature, quite permanent. Software can be easily changed. Firmware consists of memory that can *not* be readily changed by the user, such as a permanent memory IC. Such devices are called "Read Only Memories" (ROMs), because, like a book, once written they can be read over and over again without changing the contents of the book. It is not possible to add, delete, or change information stored in a ROM. The information is unchanged by use.

ROMs can be purchased already programmed with the desired information, ready to plug into an MPU system. Other ROMs can be programmed by the user, or by the local distributor, and these are called "Programmable Read Only Memories" (PROMS). We will discuss memories further, later on, but for now it is only necessary to know that it is possible to buy memories large enough to store more information than most MPU users will need. These add-on memories have already enabled the MPU to compete with larger machines in some areas which were formerly the sole domain of the large computer. This accounts, in part, for the growth of the MPU market.

As MPU costs drop it becomes feasible to use them in more applications. Today they are being used in food mixers, microwave ovens, and washing machines. They are used in automobiles to control air gas mix in order to *prevent* pollution, which is a lot easier than trying to clean up pollution. (An advantage is better performance and fuel economy.) Perhaps one of the largest factors limiting faster MPU growth is the lack of personnel trained to use the MPU. The MPU is a high technology device, and skilled personnel are required for this technology. By reading the following articles in this series, you will gradually, and easily, move into this technology.

Summary

In this article you learned what an MPU is, and what it does. You also acquired some "buzz words," the working language of the MPU technician, trade definitions. More than this, you have now an insight into the implications of the MPU, the factors responsible for its rapid growth, and how the MPU is affecting you and your occupation. This lays the groundwork for the more specific articles to follow, covering the different parts of the MPU, and how they coordinate with each other. **ET/D**

Intro to digital electronics part VII

Putting it all together

In his seventh and final installment, Mr. Carr describes the theory and operation of the most common digital counting circuit configurations.

By Joseph J. Carr, CET

A digital counter is a device or circuit that operates as a frequency divider. The most basic form of digital counter is the JK flip-flop connected with the J and K tied HIGH. This makes the output produce *one* output pulse for every *two* input pulses. It is, then, a binary, or divide-by-two counter.

ET/D readers are familiar with digital frequency counters. These are simply test instruments that are used to measure frequency. Those instruments contain decade counters (i.e. divide-by-10).

There are two basic classes of digital counter circuits, serial and parallel. The serial counters are called *ripple* counters because a change in the input must ripple through all stages of the counter to its proper point. Parallel counters are called synchronous counters.

In a ripple counter, the data is transferred serially, which means that the output of one stage becomes the input of the following stage.

The basic element in most counters is the J-K flip-flop (Fig. 1A). Note in the figure that the J and K inputs are tied HIGH, so they will remain active.

A timing diagram for this divide by two circuit is shown in Fig. 1B, and it shows the action of the circuit. J-K outputs change state on negative-going transitions of the clock pulse. In Fig. 1B, the first negative-going transition causes the Q output to go HIGH. Q will remain HIGH until the input sees another negative-going clock pulse. At that time the output will drop LOW. The action required to make a complete output pulse requires two clock pulses, so this J-K flip-flop is dividing the input frequency by two.

We can make a binary ripple counter by cascading two or more stages, as shown in Fig 2A. This particular circuit uses four J-K FFs in cascade. Any number, however, could be used.

The major problem with this type of counter is that only those division ratios that are powers of two can be accommodated. In the four stage circuit shown, the possible division ratios are 2, 4, 8 or 16.

Frequency division is one major use for a counter circuit. In some electronic instruments, for example, we may want to prescale a frequency, i.e. divide it from some higher frequency to a lower frequency that can be handled by a digital counter or other instrument.

But this is only one application for the counter circuit. One of the most common applications, alluded to in the last paragraph, is to *count*, i.e. tell us the total number of pulses that passed. Consider again the circuit of Fig. 2A, and the timing diagram of Fig. 2B. Outputs A, B, C and D are coded in binary, with A being the least significant bit and D being the most significant bit. These are weighted in a 1-2-4-8 code system to represent decimal, or hexadecimal, digits 0-15. These are the normal weights of the binary number system.

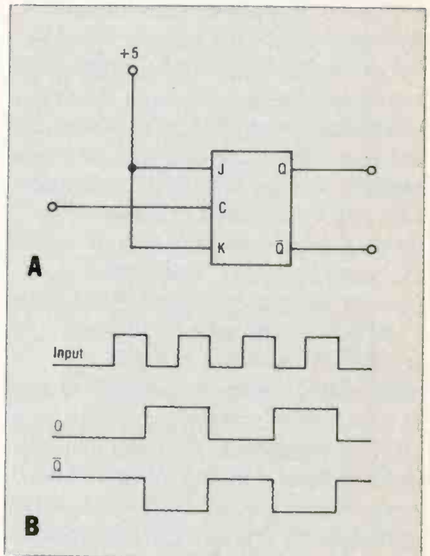

Fig. 1 The J-K flip flop is the basic element in most counters. Figure 1B is the timing diagram for the circuit illustrated in 1A.

Consider the timing diagram of Fig. 2B. Note that all Q output changes occur *following* the arrival of each pulse. After pulse number one has passed, the Q_A line is HIGH and all others are LOW. This means that the binary word on the output lines is 0001_2 (i.e. 1_{10}); *one* pulse has passed.

Following pulse no. 2 we would expect 0010_2 (i.e. 2_{10}) because *two* pulses have passed. Note that Q_B is HIGH and all others are LOW. The digital word is, indeed, 0010_2. If you follow each pulse, you will find the binary code to be as shown in Table I.

The counter shown in Fig. 2A could be called a "modulo-16" counter, a "base-16" counter, or a "hexadecimal" counter. (All meaning the same thing.)

The output of a hexadecimal counter can be decoded to drive a display device

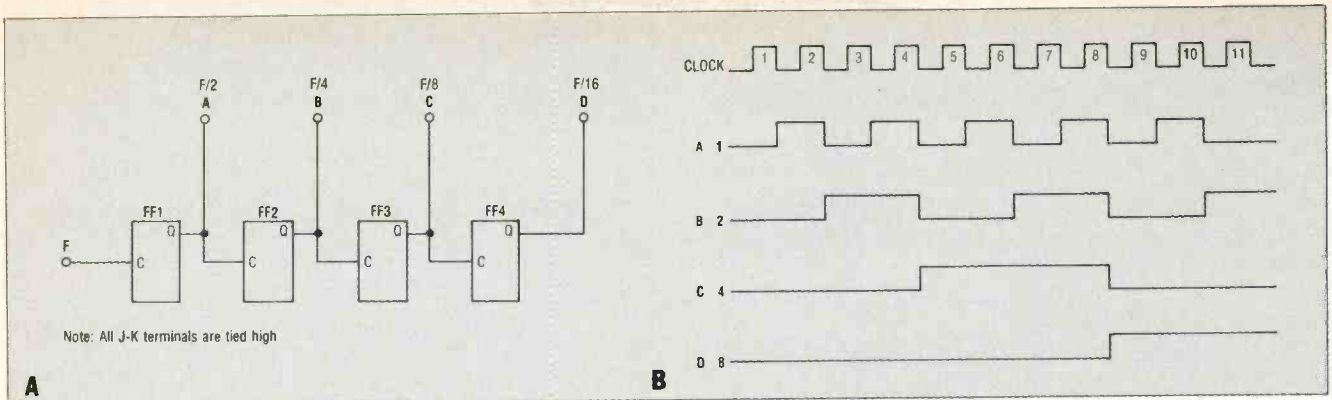

Fig. 2 Cascading four J-K flip flops as in 2A produces this divide by 16 counter, the timing diagram of which is shown in 2B.

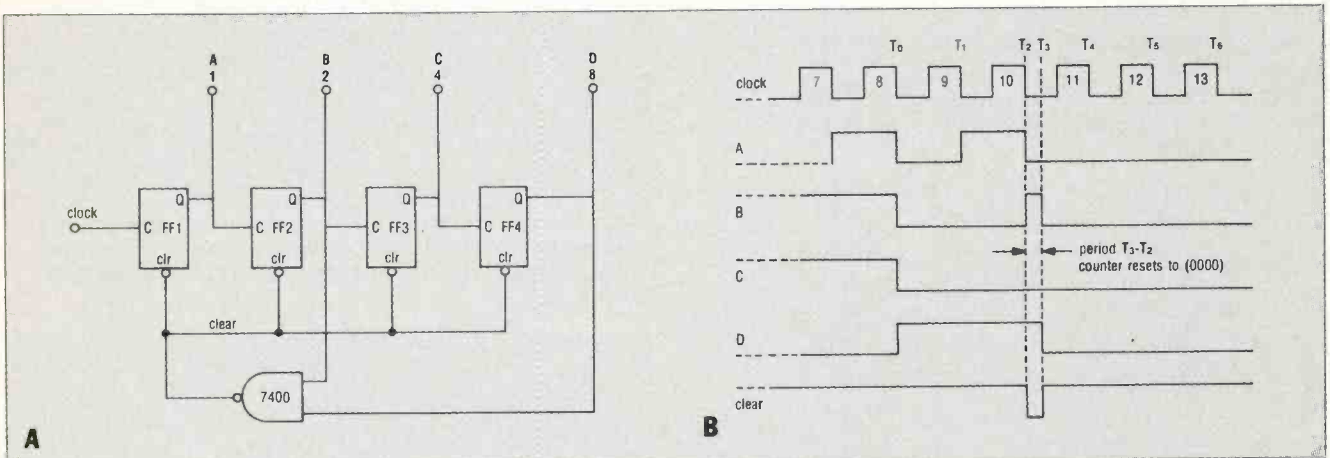

Fig. 3 Figure 3A shows the divide by 16 counter of figure 2A modified with a standard 7400 NAND gate to function as a decade counter. Figure 3B shows the timing diagram for the eighth, ninth, and 10th pulses.

TABLE I

After Pulse	Word
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
10	1010
11	1011
12	1100
13	1101
14	1110
15	1111

TABLE II

0	0000
15	1111
14	1110
13	1101
12	1100
11	1011
10	1010
9	1001
8	1000
7	0111
6	0110
5	0101
4	0100
3	0011
2	0010
1	0001
0	0000

that indicates 0-9 (decimal) or 0-F (Hexadecimal). In most applications where a person is to read the output, however, a decimal counter is used.

Decimal counters

A decimal counter operates in the base-10, or decimal, number system. The most significant bit of a decimal counter produces one output pulse for every ten input pulses. Decimal counters are also sometimes called *decade counters*. The decimal counter forms the basis for digital event, period, and frequency counters. Thus, the hexadecimal counter in Fig. 2A is not suitable for decimal counting, unless it is modified for base-10 operation.

Fig. 3A shows a TTL hex counter modified by adding a single 7400 TTL NAND gate. Recall that a TTL J-K flip-flop uses inverted inputs for the *clear* and *set* functions. As long as the *clear* input remains HIGH, the flip-flop will function normally. But when the *clear* input is momentarily brought LOW, then the Q output of the flip-flop goes LOW.

How it works

The decade counter in Fig. 3A is connected so that all four *clear* inputs are tied together to form a common *clear*. This line is connected to the output of a TTL NAND gate (i.e. one section of a 7400 device). Recall the rules of operation for the TTL NAND gate: if either input goes LOW, the output goes HIGH. But if *both* inputs are HIGH, then the output goes LOW.

The idea behind the circuit of Fig. 3A is to clear the counter to 0000 following the 10th input pulse. Let's examine the timing diagram in Fig. 3B to see if the circuit does the correct thing. Up until the 10th pulse, this diagram is the same as for the base-16 counter discussed previously.

The output of the NAND gate will keep the *clear* line HIGH for all counts through 10. The inputs of this gate are connected to the B and D lines. The D line stays LOW (forcing *clear* to stay HIGH) up until the eighth input pulse has passed. At that time (i.e. T_0 in Fig 3B), D will go HIGH, bit B drops LOW. We still have at least one input of the NAND gate (line B) LOW, so the *clear* line remains HIGH.

The *clear* line remains HIGH until the end of the 10th input pulse. At that point (T_2) both B and D are HIGH, so the NAND gate output goes LOW, clearing all four flip-flops (i.e. forcing them to go to the state where all Q outputs are LOW). The counter is now considered reset to 0000.

The reset counter produces a 0000, so both B and D are now LOW, forcing the *clear* line HIGH again. The entire reset cycle occurs during period (T_3-T_2). This period has been expanded greatly for graphics purposes in Fig. 3B. In actuality, the reset cycle takes place in nanoseconds or microseconds.

The 11th pulse will increment the counter one time, so the output will

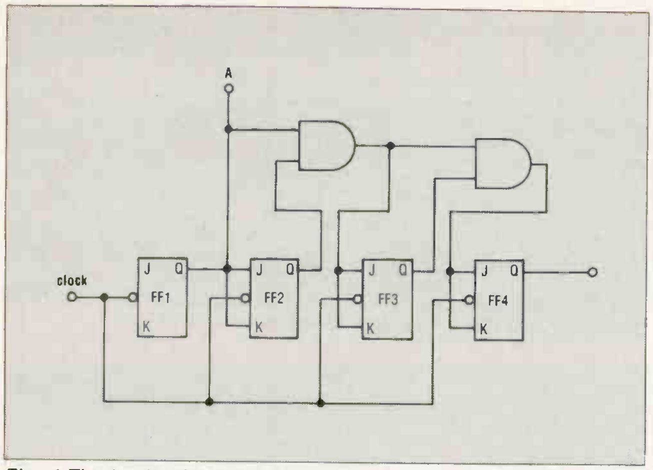

Fig. 4 The basic diagram for a parallel counter–four flip-flops plus two NAND gates.

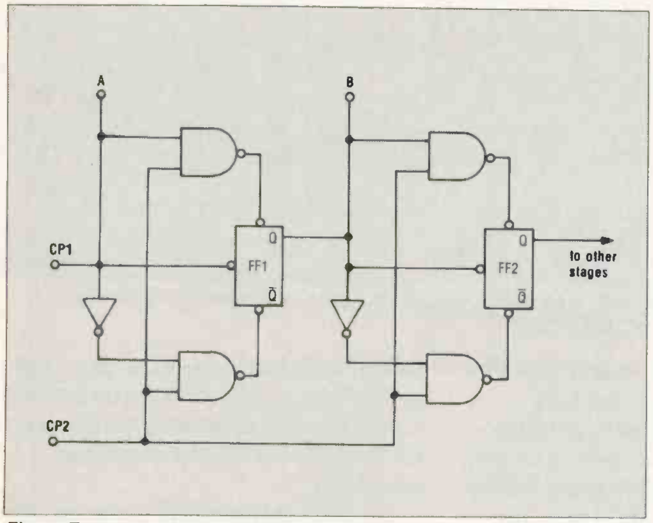

Fig. 5 Two stages of a preset counter using "jam" input.

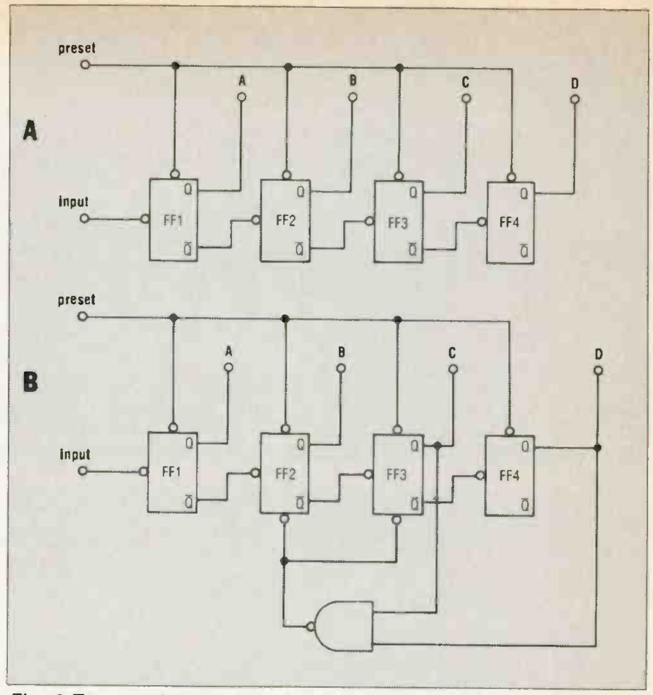

Fig. 6 Two versions of the "down" counter, hexadecimal and decimal. In 6B a NAND gate "reduces" the count to nine after the eighth pulse. Note outputs taken from Q while signal inputs are from Q.

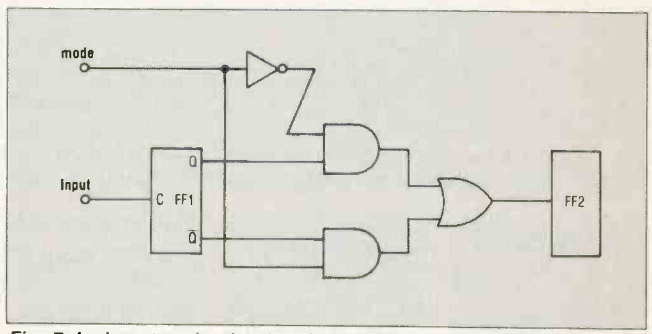

Fig. 7 An inverter circuit, plus three NAND gates, change this typical cascade counter into either an "up" or a "down" counter, depending on the state of the mode input.

indicate 0001_2. This counter, then, counts in the sequence 0-1-2-3-4-5-6-7-8-9-0-1 . . . The output code is a ten digit version of four-bit binary (hex), and is called *binary coded decimal* (BCD).

Synchronous counters

Ripple counters suffer from one major problem: speed. The counter elements are wired in cascade, so an input pulse must ripple through the entire chain before it affects the output. A synchronous counter feeds the clock inputs of all flip-flops in parallel. This results in a much faster circuit.

Fig. 4 shows the partial schematic for a synchronous binary counter. We accomplish synchronous operation by using four flip-flops, with their clock inputs tied together, and a pair of AND gates.

One AND gate is connected so that both Q1 and Q2 are HIGH before FF3 is active. Similarly, Q2 and Q3 must be HIGH before FF4 is made active. On a clock pulse, any of the four flip-flops scheduled to change will do so simultaneously.

Synchronous counters attain faster speeds, although ripple counters seem to predominate in most applications.

Preset counters

A preset counter increments from a preset point instead of 0000_2. For example, suppose we wanted to count from 5_{10} (0101_2). We could preset the counter to 0101_2, and increment from there. The count would be as in Table III.

Fig 5 shows a common method for achieving preset conditions: the jam input. Only two stages are shown here, but adding two additional stages will make it a four-bit counter. Of course, any number of stages may be cascaded to form an N-bit preset counter.

In fig. 5, the preset count is applied to A and B, and both bits will be entered simultaneously when clock line CP2 is brought HIGH. Line CP2 is sometimes called the *enter*, or *jam*, terminal.

Once the preset bit pattern is entered, the counter will increment from these with transitions of clock line CP1.

Down counters

A down counter decrements, instead of incrementing, the count for each excursion of the input pulse. If the reset condition is 0000_2, then the next count will be (0000-1), or 1111. It would have been 0001 in an up counter. The count sequence for a four-bit down counter is shown in Table II.

We use basically the same circuit as before, but toggle each flip-flop from the $\bar{Q}$ (not-Q) of the preceding flip-flop. An example of a four-bit binary down counter is shown in Fig. 6A. Note that the outputs are taken from the Q outputs of the flip-flops, but toggling is from the $\bar{Q}$.

The *preset* inputs of the flip-flops are connected together to provide a means to preset the counter to its initial (i.e.

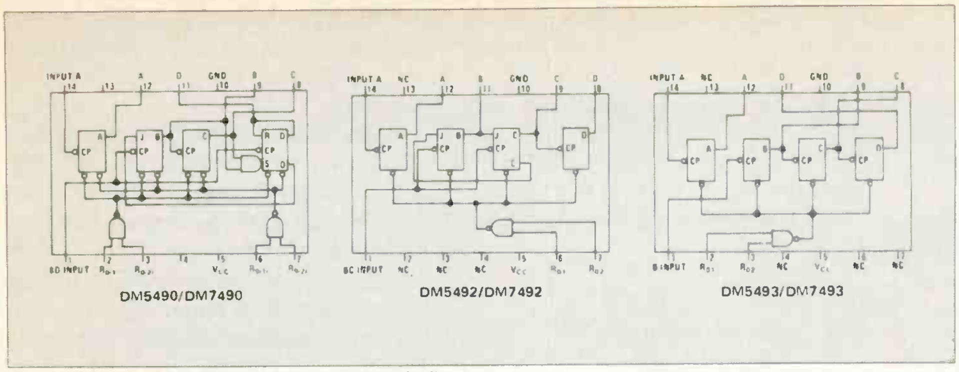

Fig. 8 The three basic counters in the TTL line.

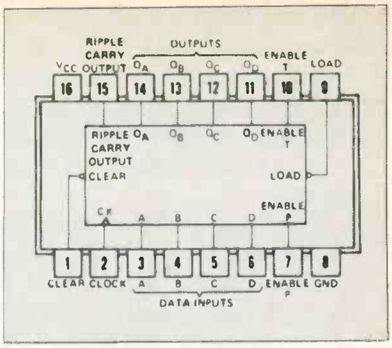

Fig. 9 Pinouts for the TTL series 74160-74163.

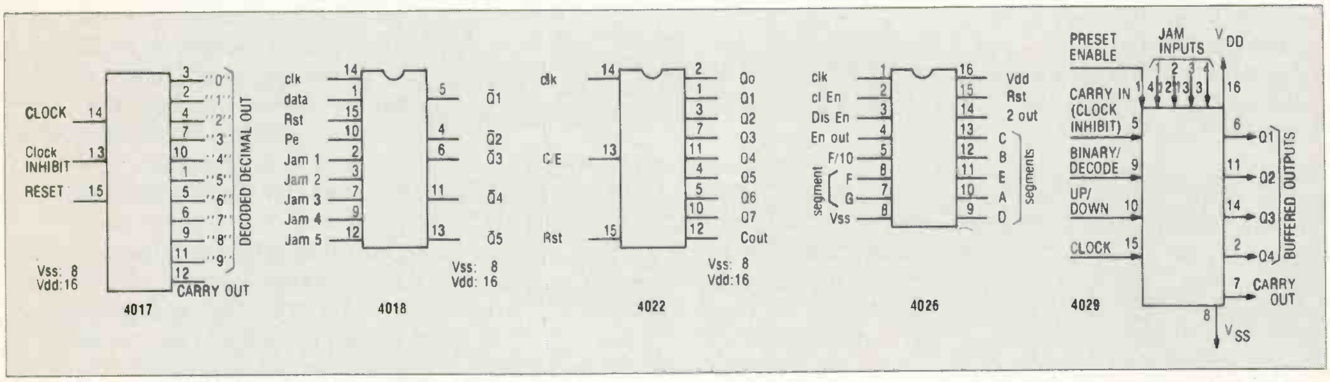

Fig. 10 The pinouts for several popular CMOS counters.

TABLE III

Counter	Count
5	0101
6	0110
7	0111
8	1000
9	1001
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101

1111_2) state. This counter is also called a *subtraction counter*, because each input pulse causes the output to decrement by one bit.

A decade version of this circuit is shown in Fig. 6B. As in the case of the regular decade counter, a NAND gate is added to the circuit to reset the counter following the 10th count. We detect the states when C and D are HIGH, and then *clear* the two middle flip-flops. This action forces the output to 1001_2 (9_{10}). The counter then decrements from 1001_2 in the sequence 9-8-7-6-5-4-3-2-1-0-9. Simple, huh!

Up-down counters

Some counters will operate in both up and down modes, depending upon the logic level applied to a *mode* input. Fig. 7 shows a representative circuit, in which the first two stages of a cascade counter are modified by the addition of several gates. If the mode input is HIGH, then the circuit is an up counter. But if it is LOW, then the circuit is a down counter.

TTL/CMOS examples

Very few digital circuit designers construct counters from individual flip-flops; there are too many "ready-built" IC ounters available in all of the major logic families.

There are three basic counters available in the TTL line: 7490, 7492, and 7493 (see Fig. 8). The 7490 is a decade counter, the 7492 a divide-by-12 (also called modulo-12) counter, and the 7493 is a binary (divide-by-16) counter.

All three of these counters are of similar construction, and their respective pin-outs are shown in Fig. 8.

The 7490 is a biquinary counter, meaning that it contains a single, independent, divide-by-2 stage, followed by a divide-by-5 stage. Decade counting is accomplished by cascading the two sections.

Both 7492 and 7493 follow similar layout schemes. In both, the first stage is a single divide-by-2 flip-flop, followed by a) divide-by-6 (7492), or b) divide-by-8 (7493). These form divide-by-12 and divide-by-16 counters, respectively.

The 74142 is a special function TTL IC containing a divide-by-10 counter (BCD), a four-bit latch circuit, and a display decoder suitable for driving a Nixie® tube. The 74142 is housed in a standard 16-pin DIP package.

Fig. 9 shows the pin-outs for the TTL types 74160 - 74163. These are BCD and binary four-bit synchronous counters:

74160- Decade (BCD) synchronous (parallel) direct clear
74161- Binary, synchronous, direct clear
74162- Decade, fully synchronous
74163- Binary, fully synchronous

These counters operate to 32 MHz (typically) and dissapate approximately 325 milliwatts. All are housed in 16-pin DIP packages.

These four counters are different from those that we have seen previously, because they are "divide-by-N" counters (where N is an integer). The value "N" is applied to the Data inputs, and is loaded into the counter when the load terminal is momentarily brought LOW.

Examples of basic CMOS counters are shown in Fig. 10. Again, these examples are not exhaustive, merely representative of those commonly used. None of them are multi-digit decimal counters such as the eight digit, 10 MHz, intersil device.

4017. This device is a fully synchronous decade counter, but the outputs are decoded 1-of-10. The active output is HIGH, while the inactive outputs are LOW.

The 4017 is positive edge triggered. The *reset* and *enable* inputs are normally held LOW. If the reset is momentarily brought HIGH, the counter goes immediately to the zero state. The enable input is used to inhibit the count; that is, if made HIGH the count ceases, and the output remains in its present state.

The output terminal produces a pulse chain of $F_{in}/10$; which is HIGH for 0, 1, 2, 3 and 4, and LOW for 5, 6, 7, 8 and 9.

4018. This device is a synchronous divide-by-N counter, where N is an integer of the set 2, 3, 4, 5, 6, 7, 8, 9 and 10. It is difficult to decode the outputs of this counter, so its principle use is in frequency division.

For normal operation, the reset and load inputs must be held LOW. The 4018 is positive-edge triggered.

N	Connect Input (pin 1) To	Pin No.
2	Q1	5
4	Q2	4
6	Q3	6
8	Q4	11
10	Q5	13

The N-code for determining the division ratio is set by connecting the input terminal to an appropriate output, or (in certain cases) an external AND gate. For *even* division ratios, no external gate is needed. Merely connect the input terminal as shown at left.

The *odd* division ratios (i.e. 3, 5, 7, 9) require an external two-input AND gate. The 4018 outputs are connected to the AND gate inputs, and the AND gate output is connected to the 4018 input (pin 1):

N	Connect To AND Gate Inputs	Pin No.
3	Q1,Q2	5,4
5	Q2,Q3	4,6
7	Q3,Q4	6,11
9	Q4,Q5	11,13

The feedback line described in the paragraph above is also the main output from the counter. If, for example, we connect "input" pin no. 1 to Q3 (pin no. 6), then the pulse appearing on pin no. 1 will be (by the table above) 1/6 of the clock frequency.

We may also parallel load the 4018 using the jam terminals, P1-P5. These terminals will program the 4018. A LOW on a jam input, forces the related Q output HIGH, and vice-versa. For example, if a LOW is applied to P2, it will force Q2 HIGH.

4022. This device is an octal (i.e. divide-by-8) counter that provides 1-of-8 decoded outputs. The 4022 is nearly the same as the 4017, which is a decade.

4026. The 4026 device is a decade counter that produces uniquely decoded outputs for seven segment displays. The 4026 is a positive edge triggered device, and is fully synchronous.

This chip is similar to the 4017, in that it provides an F/10 output in addition to the seven-segment decoded outputs. The decoded outputs are HIGH active.

There are two *enable* inputs. One is a *clock enable*, which will cause the count to cease when brought HIGH. The counter remains in its present state when the clock is inhibited. The other enable terminal is a *display enable*. A HIGH on this input will turn the display on, and a LOW will turn the display off.

4029. The 4029 is an up-down counter that will divide by either ten, or sixteen, depending upon whether pin no. 9 is HIGH or LOW. A HIGH on pin no. 9 causes the 4029 to be a base-16 counter (binary), while a LOW causes it to be a base-10 (decade) counter.

The count direction (i.e. up/down) is determined by the level applied to mode pin no. 10. If pin no. 10 is HIGH, then the 4029 operates as an up counter. But if pin no. 10 is LOW, then it operates as a down counter. ET/D

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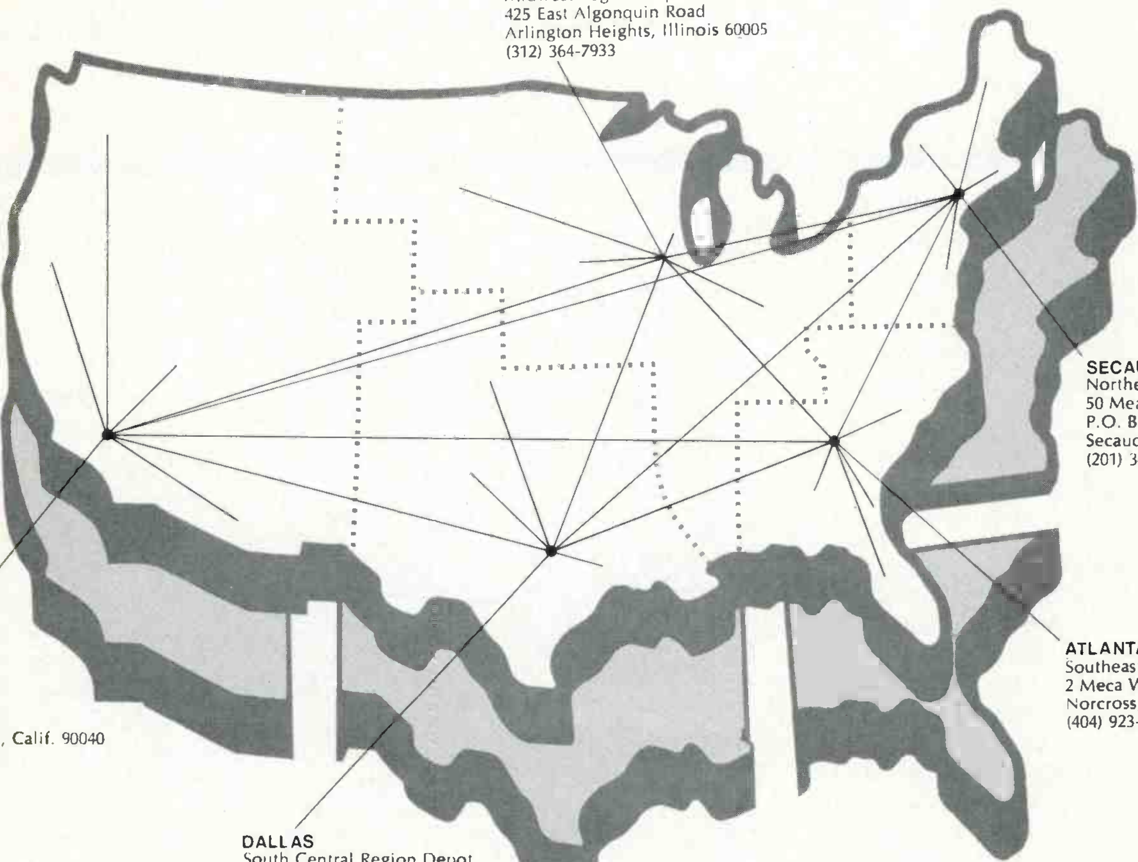

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Electronic service in life support areas

An overview of Biomedical Engineering

New career opportunities appear almost daily for the young, professionally trained electronics technician. In this article the author discusses opportunities in the medical field.

By Elliott S. Kanter, BA*

It is just barely dawn and John, a CET is at work. He changes from his street clothes to a loose fitting green uniform, putting shoe covers over his sneakers and a disposable cap over his trim hair. He enters his 'office', large, well lighted room comfortably maintained at 72° with not less than 50% relative humidity. He then begins his ritual ten minute scrub. While up to this point, John was like many other technicians throughout the country—up to a point; but, why the need for a ten minute scrub? The reason for the scrub and specialized uniform will become quite apparent as you read this article. John's office is a surgical operating room at a hospital and John is a Biomedical Engineering Technician.

☐ What is a biomedical engineering technician?
☐ What does he do and where?
☐ How does one break into this profession?
☐ Where are training programs located?
☐ Who hires such technicians?
☐ Is there a future as a biomedical engineering technician?

To answer the questions posed here, we will first examine and explain the term *biomedical,* and give some historical perspective. Don't quit your job yet. The best way to begin or explain this relatively new field is at the beginning, which in this case is the early 1900's.

After centuries of lighting by candle, open flame and oil burning lamps, a young gentleman by the name of Thomas Edison perfected the electric light. This paved the way for valves, or vacuum tubes, which were capable of amplification of minute amounts of electrical energy that were present in the human body. To give you an idea of just how small "minute" is, the human heart provides signals which can be picked up through the skin. However, these signals are in the order of one millivolt (0.001V). Naturally, with the exception of some of our more sophisticated meters and more specifically the newer digital types, we would not be able to discern voltages of this low magnitude. But, in a manner of speaking, this is putting the horse behind the cart or vice versa.

The wonderful machine we live in is a curious mixture of mechanical, electrical and control circuitry. Each of the body's cells will polarize and de-polarize producing a tiny electrical current which will then travel through a complex cable network of nerves in order to activate control circuitry in the brain. Scientists

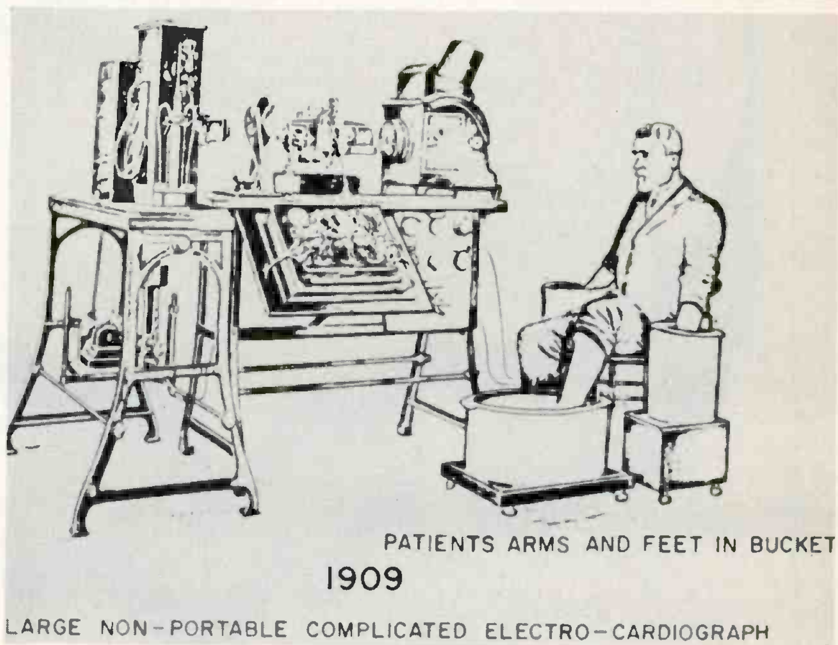


Fig. 1 One of the first examples of biomedical equipment, an early electrocardiograph represented a first and the beginning of a long and prosperous marriage between the medical profession and electronics. (Photo courtesy of Hewlett Packard)

Mr. Kanter is Director of Biomedical Engineering, Memorial Medical Center, Savannah, GA.

Fig. 2 A scrubbed and suited BMET checks a computer assisted monitor display prior to its application to a patient. (Photo courtesy Roche-Medical Electronics)

had been able to prove through a variety of studies, mostly on cadavers (dead bodies), that these things existed. But they were unable, until the advent of electronics in medicine to view and prove these theories on the living body.

Early devices

Figure 1 is from an old print and shows an early electrocardiograph, a device which takes the minute electrical energy produced by the heart, amplifies it and displays it via a galvanometer on a strip of paper with a heated stylus tracing the actions for all to see. The early EKG machine, was a breakthrough for medicine, and electronics, although its size and the need for buckets of liquid for electrodes did not make it all-too-portable. The key to this "breakthrough" was the fact that a graphic representation of the heart's action in a living breathing body had been achieved; and the strange marriage between electronics and medicine was on!

The honeymoon has been going on for many, many years now and the grandchildren and great-grandchildren of these early instruments have included the ability to receive radio signal representations of heart rates and other vital signals from astronauts walking the surface of the moon, as well as monitoring patients during surgery. The equipment shown in Figures 2 through 4

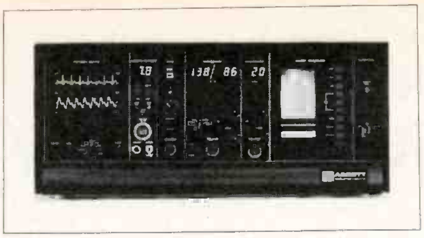


Fig. 3 A typical state-of-the-art patient monitor capable measuring heart rate, displaying analog waveforms of direct blood pressure and heart action, graphic "hard" copy of any parameter in the cabinet as well as cardiac output and a second direct pressure expressed in CmH_2O. (Photo courtesy Abbott Medical Electronics)

Fig. 4 A compact monitor acts as an additional set of eyes and ears to surgeons during a complex surgical procedure. During surgery, the monitor constantly updates the doctors on the heart rate and blood pressure of the anesthetised patient. (Photo courtesy of Roche Medical Electronics)

represent state of the art monitoring equipment, including computer assisted data interpretations for medical determinations. All in all, from an historical standpoint, biomedical electronic devices have kept pace with the general growth of the industry. What is state-of-the-art in many home entertainment devices is likewise found in medical electronics equipment. The difference being that what your customer might consider a mild irritation on a television set, would prove to be fatal in an open heart operating room. The schematic shown in Figures 5 and 6 represents a digital readout temperature probe with resolution in tenths of a degree and alarm capability. As we examine the circuitry, we find it quite a surprise. We discover it is not complex, but, rather quite straight forward—*even simple*.

In a single phrase, biomedical equipment or medical electronics equipment encompasses any device which can be used on a person to aid his doctor in providing quality medical care. It can be a simple suction pump or a complex multi-mode monitor or a sophisticated X-ray machine. It might even include computer-assisted equipment such as the full-body-scanners known as C.A.T.'s (computerized - axial tomography) which look at the entire body in "slices" and provide a computer-enhanced view of possible tumors or blockages. All in all, medical electronics is a fascinating field, one that is growing daily. It is a field open to both men and women and, while some training requirements are specialized, entry level positions are usually readily available.

What does a Bio-Tech do?

A simplified answer to this question would be that he or she would repair, install and maintain equipment either in a hospital, laboratory or doctor's office. In fact, this question also is combined with another which we posed earlier in this article: Who will hire me? Because these areas are interrelated, we shall examine them collectively. BMET's, as they are known, are found in three areas of industry. The first and most likely place for a majority of new technicians would be on the "staff" of a hospital or medical center. The second area in order of numbers of technicians employed in a service capacity would be factory-direct service engineers or technicians. Also lumped into this category might be the factory assembly personnel. The third and last area would be the independent service agency or specialist who contracts with the hospital, a company or a doctor to provide service in much the same manner that the home entertainment industry service shops would sell a service contract to a TV or stereo retailer.

The hospital staff-technician is a full time employee of the medical facility. He is usually assigned to a department and can be under the overall guidance of the chief hospital engineer. At Memorial Medical Center, the department is a separate entity and we cooperate with the general 'plant and engineering' departments to avoid crossovers which can reduce efficiency and increase costs, factors which ultimately must be paid by patients in the form of higher room rates. The department which I head consists of four full time technicians, one of whom is assigned to radiology equipment repair duties. The remaining staff is considered

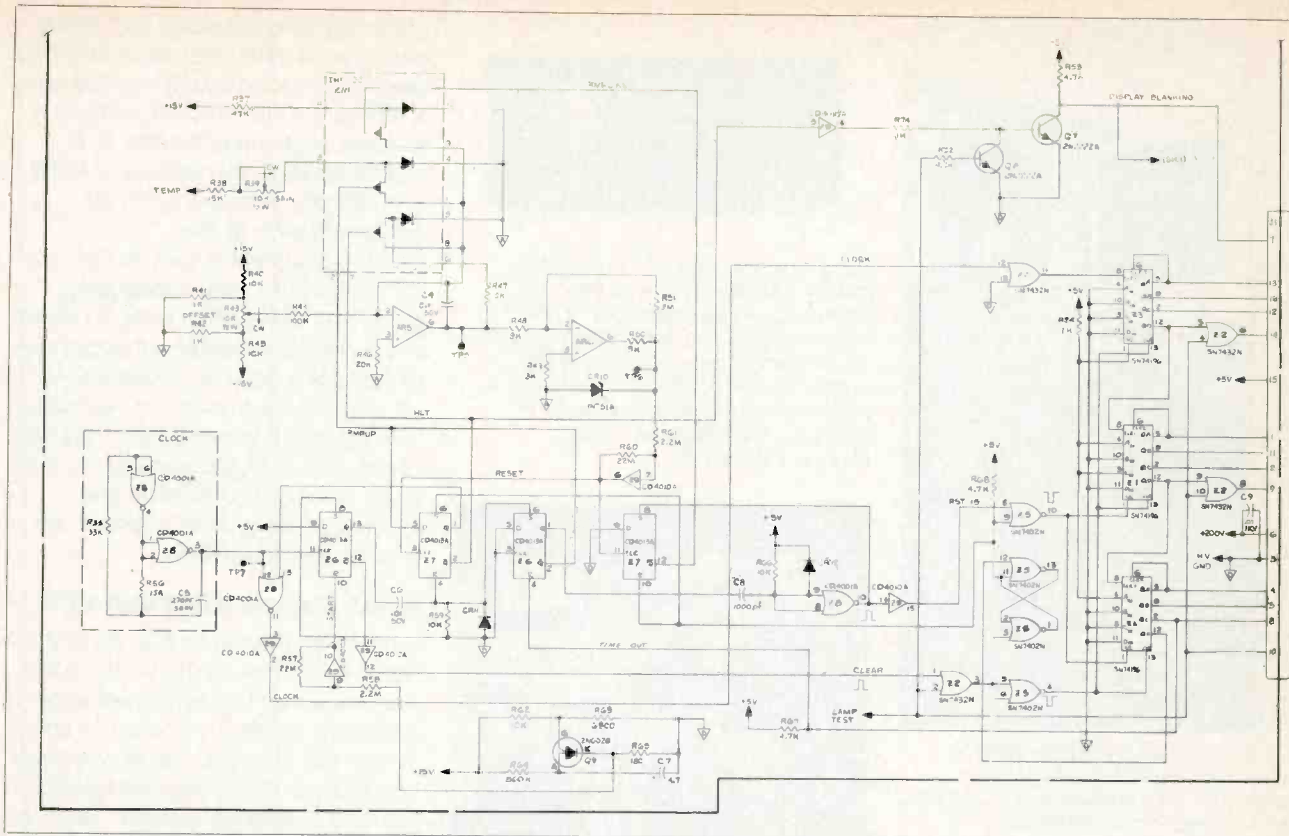


Fig. 5 Schematic of Abbott Medical Electronics" analog to digital converter for the TE-4 Temperature Module.

'generalists' and will work on literally any and all equipment which comes into the shop. Frequently, however, we *go to* the equipment because it is mounted on a wall or located within a surgical suite. The center also has a part-time technician whose duties are to assist in repairs to equipment, run patient TV service calls and act as a "gopher." All full time technicians have attended formal electronics schools and supplemented this training with personal home study and attendance at seminars and factory schools. Education in this field is an on-going process which begins on your entrance and will continue until the day you retire.

The obvious advantages of being on a hospital staff are the benefits which would be yours as well as opportunities for continuing education. This can include discounted, or free, medical service for you and your dependents. Working in the hospital is always going to be diverse and at times quite exciting. Being assigned to a surgical suite, you might view a child being born, a defect in human heart repaired, or a severed limb reimplanted. Granted, much of your day to day routine will not be this dramatic, but, it would be safe to assume that there is seldom a dull moment.

Factory reps

The factory-direct service-person is employed by one of the countless manufacturers of biomedical equipment. He might be assigned to a field service center, or be on the "road" making on-site repairs. He is both the factory's service-specialist as well as a public-relations person in that he is probably going to be the best or worst-remembered representative of his company for a long time. The technical qualifications of most factory-service personnel are similar to those of the hospital staffer with the exception that they tend to be more specialized. Frequently the factory service tech might be a specialist on only one portion of his company's line as opposed to the requirement that the hospital staffer be a generalist. Formal electronics training is a must, and some companies require either an associate's degree or a B.S. before you enter their own training program. The obvious differences are that salaries might be higher in private industry and the work could be more specialized. If you like to travel, the field specialist's job is tailor-made for you!

The independent

The last category is that of *independent service specialist*. This individual may operate his own shop or be part of a combined shared service organization. Basically, he operates in much the same manner that the independent home entertainment repair specialist does. However, he is infinitely more specialized and trained, with a considerable investment in test equipment. Additionally, an insurance premium for third-party liability (malpractice) which approaches the salary of a TV repair technician for an entire year is a necessity due to possible law suits. Being independent, he is his own boss, sets his hours and rates, and must depend on advertising and word of mouth to build his business. He might elect to take on installations and warranty service for a manufacturer who does not have service capabilities in his area. Unlike television service on a warranty-basis, biomedical repairs are at least profitable. Most manufacturers pay $25.00 per hour plus travel time, usually ½ the labor rate and/or mileage. Installations are figured on a per bed basis. The average per bed fee approaches $70.00, according to my industry sources. Taking on these jobs helps the independent build his customer list and frequently will permit him to attend specialized factory training schools which would have been closed to him as an outsider.

The obvious disadvantages of the independent service specialist is that he has no assured income sources, at least at first; he must pay for his own liability insurance as well as hospitalization, etc., and he may be limited in what he can service and where. The advantage is he is his own boss. Regardless of

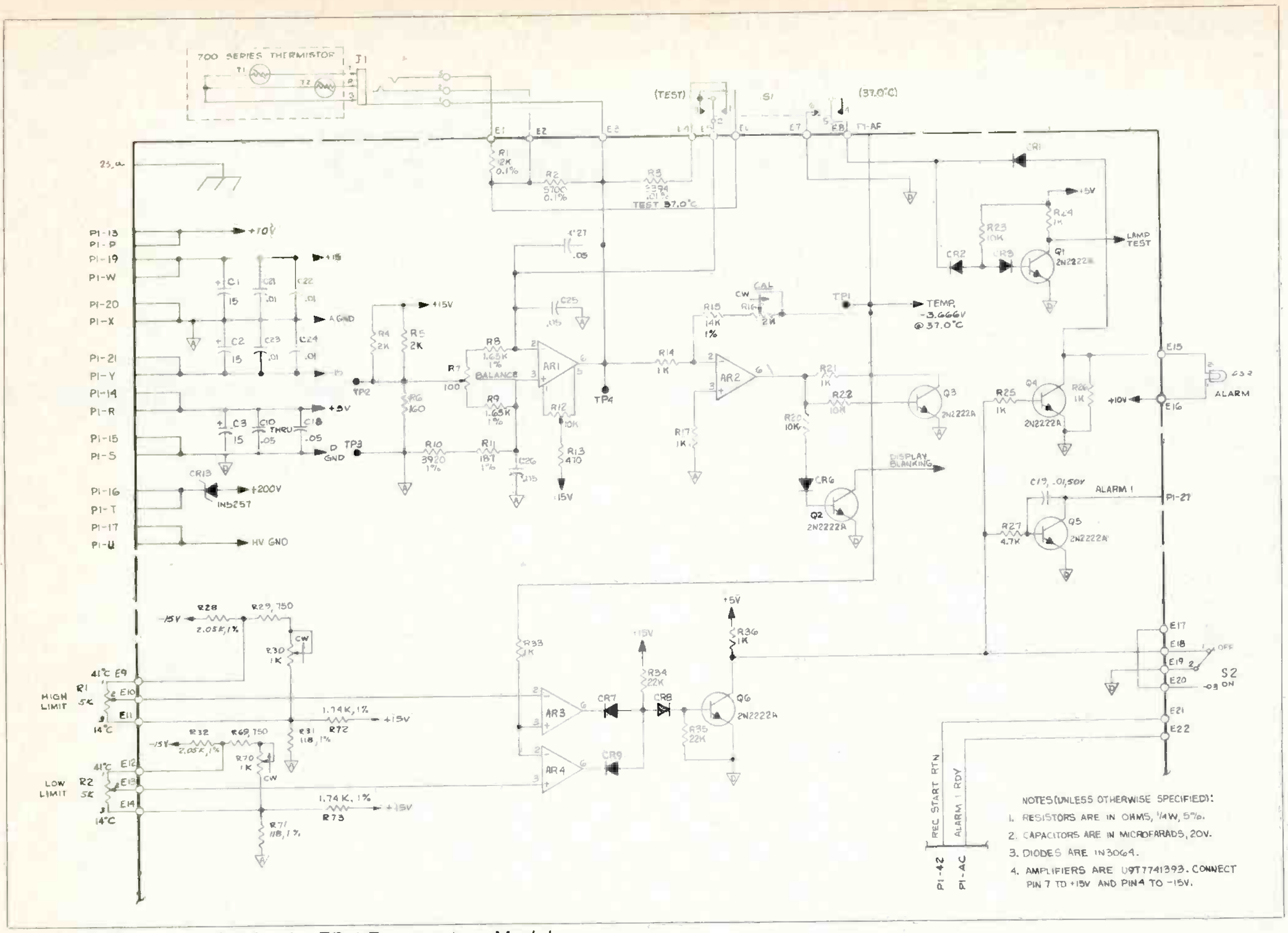


Fig. 6 Processor circuitry for the TE-4 Temperature Module.

which of the three types of service you consider, the field is rewarding both from a monetary as well as an intangible basis. No two days will ever be alike, and one thing's for sure—it will never be boring!

There is one catch to whatever area you might elect to join. Hospitals and things related to the medical field happen 24 hours a day, seven days a week. In your local hospital, Christmas is just another day. For that reason, if you join the biomedical field, you will probably be issued, or lease a pager. This will allow the hospital or your answering service to reach you 24 hours a day! While carrying a pager in some areas can be somewhat of a status symbol, I personally recall sitting in a theater, watching "The Way We Were," about fifteen minutes were left, the show was quiet and the tension was building. Suddenly, from my belt came a loud series of beeping and a voice literally screaming "... Please call Cook County Hospital—STAT! ..." Needless to say, the tension was broken in the theater, and I received a goodly number of less than friendly stares as I went up the aisle to find a telephone. My date went home with the other couple, and I spent the balance of the night in the intensive care unit trying to get a monitor working again. So, it would be wise to consider the fact that biomedical engineering at any level is not a 9 to 5 job. It requires total commitment on your part, and the cooperation of your family.

Getting started

Basically, we have examined almost all of the questions posed earlier, and can summarize by giving you specifics about how you would go about entering the field, getting training and answering the questions in my somewhat biased manner: is there a future and is it secure? Again, we shall tackle them one by one and interrelate where necessary. Getting the skills is probably easier now than it was, say three years ago. Numerous vocational and junior colleges are offering courses, which can even include internships in local hospitals. If you already have a good solid background in vacuum tube technology, solid state and digital, you will be ahead of the game. All you will have to do is learn to speak "medical," which if you have been looking carefully as you read, part of this article is written in. We don't drip anything, we "infuse it." It's not all that hard to learn and after a while we tend to speak it quite fluently. You might get strange looks from your friends down at the local parts house when you need a 1.2K ½ watt resistor with 1% accuracy, but don't despair, it's part of the medical field's, high degree of reliability and equally high cost.

If you are just finishing a two year electronics program, you might want to contact some of the larger manufacturers of biomedical equipment, they are looking for people just like you for entry level positions which pay considerably more than you'd imagine. In fact, eight dollars an hour is not unusual for entry level, plus a car, expense account, tools, fully paid hospitalization, dental coverage and literally any and every benefit you can dream about, and that's during training! It gets better when you are in the field. On the other hand, if you haven't got the formal training, there's a good chance that no major company will want you. You have to have credentials in this field, the more the better. The military offers excellent BMET schools, in all branches, and graduates are assured good jobs when they leave the service. The key word in this field, like any other electronics area today is *education!* Without it you are no better than "an

continued on page 47

RCA for '80

'Dynamic Detail Processing'

A comb filter using a new charge-coupled device IC, synthesis sound (simulated stereo effect) and a countdown vertical sweep are major features of RCA's new top of the line chassis, the CTC101.

By Walter H. Schwartz

The CTC101 is another step in the evolution of RCA's single, main circuit board concept, which they returned to a couple of years ago. There are many familiar areas of circuitry and some notably new ones. Starting at the IF input we'll follow the signal covering the new areas of circuitry most thoroughly.

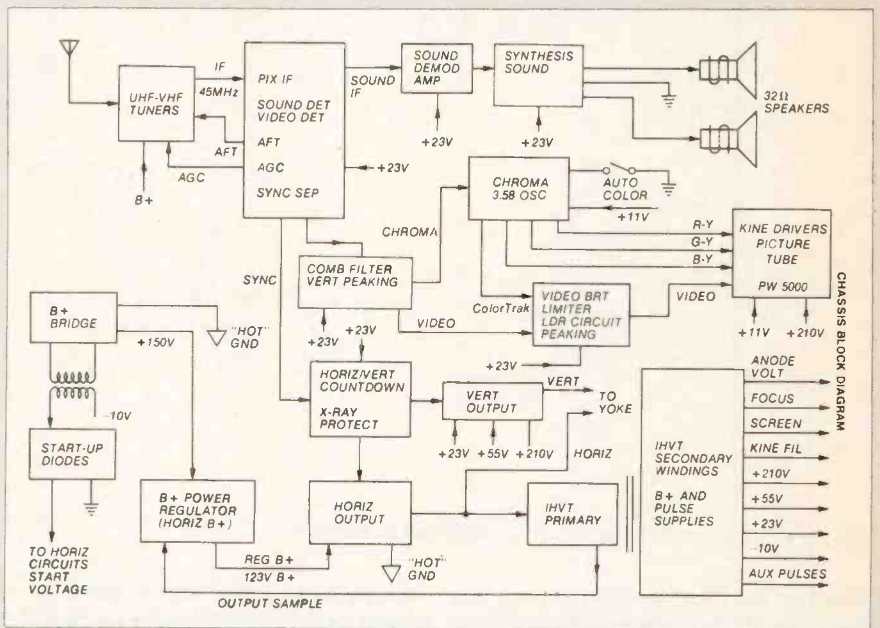


Fig. 1–Block diagram of the RCA CTC101 series.

Signal processing

The video IF consists of three IC stages with sound take off between the second and third stages. The sync/R-F AGC IC shares a package with the first two IF amplifiers, and the third IF and the 4.5MHz amplifier/AFT are in the same package. Also in this last IC package are the video detector and a video preamplifier.

Audio

Output from the 4.5MHz amplifier is further amplified by a single transistor stage and fed through a *crystal* filter to the sound processor IC. This IC (Fig. 2) contains a 4.5MHz IF amplifier and limiter, a quadrature detector, a dc controlled volume attenuator, and a power amplifier, and a power regulator. U200 in turn, supplies audio signal to the MSS001A, Dual Dimension Sound Module, which consists of two output stages fed audio with some phase difference, each driving its own separate speaker.

The comb filter

New in the CTC101 is a video processing circuit called the Dynamic Detail Processor, a comb filter (Fig. 3). This comb filter uses a charge-coupled device to achieve the necessary one horizontal line (63.5µsec) delay.

In the NTSC interleaved color system, the video signals occur between 0 and 4.2MHz. The subcarrier is inserted at 3.58MHz and modulated by chroma, producing sidebands which extend about 1MHz above and below the subcarrier.

To keep these sidebands from appearing in the picture and generating crosstalk and interference pattern, the video bandwidth in most receivers is limited to approximately 3MHz. This limitation of video bandwidth causes a loss of high frequency detail. The comb filter makes it possible to keep the video information between 3MHz and 4.2MHz, and restore much picture detail.

The relationship between the transmitted video information and the scanning rate causes the video information to occur in "bursts" of energy at horizontal rate multiples; every 15.73kHz from 0 to 4MHz there exists a "burst" of energy containing the video (luminance) information. The chroma information also occurs in "bursts" of energy at horizontal rate intervals. However, because of the selection of the chroma subcarrier frequency (3.58MHz); the energy bursts are offset from the video energy bursts by one-half the horizontal rate. Thus, the chroma information is "interleaved" with video information.

The comb filter operates on two basic principles. 1) From one line to the next the video information is basically the same; as the picture is scanned vertically, there is very little change in the video information from one horizontal line to the next. 2) The chroma information is reversed by 180 degrees from one line to the next, so the chroma information on one line is 180 degrees out of phase with the chroma information on the previous line.

The composite video in the comb filter circuit is divided three ways. One path is through the 63.5µs (1H) CCD delay, another is through a luminance processing channel and the last is

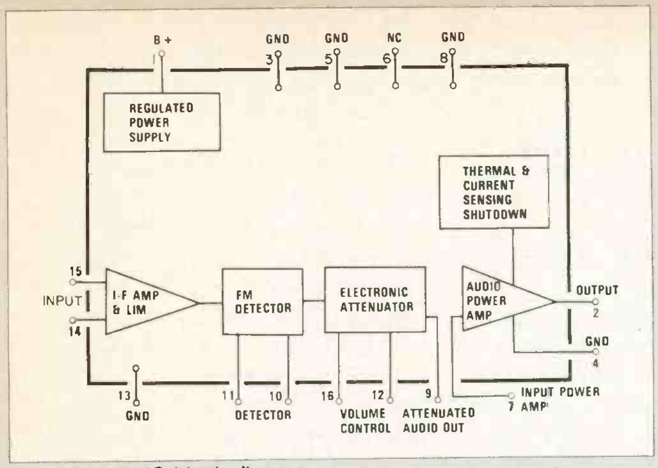


Fig. 2-Sound IC block diagram.

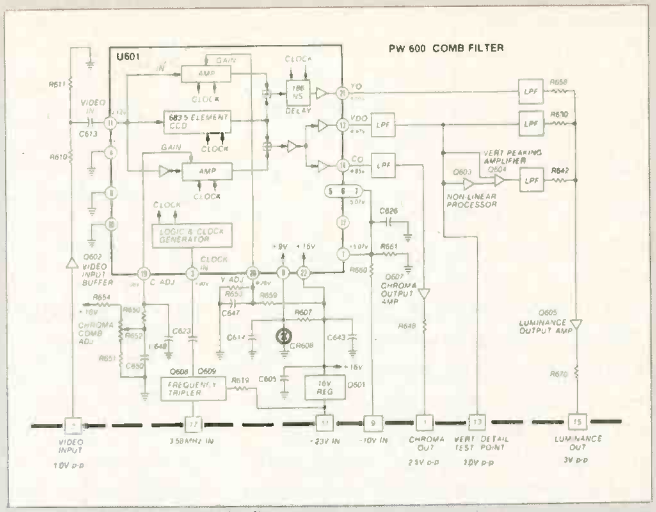


Fig. 3-Comb filter block diagram.

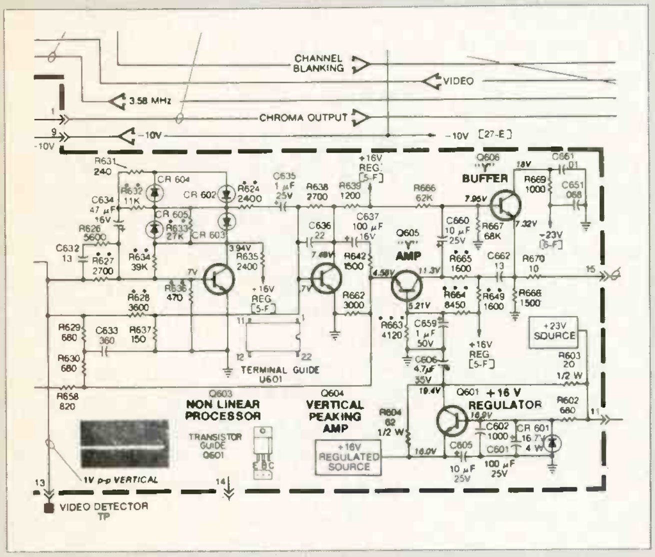


Fig. 4-Non Linear processor circuitry.

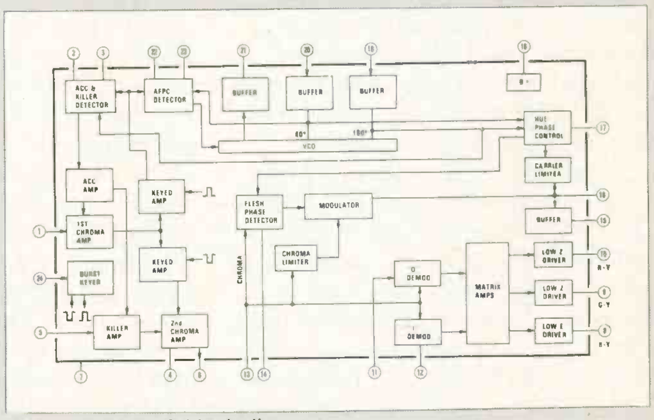


Fig. 5-Chroma IC block diagram

through a chroma channel.

The signal supplied through the luminance processing channel is amplified by the gain stage and applied to one input of it, the summing (or adder) circuit, the other input to the adder is the 1H delayed signal (previous horizontal line). Because the video information from one line to the next is basically the same, the adder will double the amplitude of all the in-phase signal components. Both signals contain chroma information, which is also added at the summing point of the comb filter. However, because of the 180 degree phase shift between adjacent lines, the chroma signal is cancelled. This almost completely eliminates the chroma signals from the combed video information.

The composite video signal coupled to the chroma processing stage is first inverted. It is next passed through an amplifier which sets the proper gain, then to one input of another adder circuit.

Now inverted, the video signal present at this point is out of phase with the video signal present at the output of the 1H delay. However, the color information, because of the inversion, is now in phase with the 1H delayed signal. When these two signals are added together, the video output is zero, but the chroma information is doubled.

The output of the comb filter takes on the "comb" effect. The video information energy occurs in groups around multiples of the horizontal rate with every multiple of one-half the horizontal rate being reduced to zero and every multiple of the horizontal rate being processed to provide maximum output. The opposite is true for the color signals, every multiple of the horizontal rate being reduced to zero and every multiple of one-half horizontal rate being processed for maximum output.

The heart of the comb filter is integrated circuit U601—a charge-coupled device which provides all the functions of comb filtering; it provides the delay, the amplifiers for video and chroma processing channels, and the summing circuits.

The charge-coupled device is basically an analog storage semi-conductor. The CCD delay line used in the CTC101 comb filter consists of 683½ storage elements. The video information is "clocked" into these elements at a 10.7MHz rate, three times the chroma subcarrier frequency. As each 10.7MHz clock pulse occurs, the video information is sampled, and a "charge" equal to the video information is applied to a CCD element.

The action of each CCD element is analogous to a capacitor storing a given amount of charge. At the application of each clock pulse, the charge in each CCD element is shifted to the next element along the line. This information is shifted from element to element at a 10.7MHz rate with each shift representing a delay of .0093µs. The total number of elements (683.5) times the delay of each particular element (.0093µs) provides a total delay of 63.5µs, which is the duration of one horizontal television scanning line.

U601 is powered from several power supplies. These are: regulated 16 volts B+ via pin 22; 9.1 volts B+ via pin

9; -5 volts B- via pins 1, 5, 6, and 7. Video information is coupled into U601 at pin 11. The 10.7MHz clock pulse, developed from a 3.58MHz chroma subcarrier frequency tripler circuit, is inserted at pin 3. Pin 21 is the combed luminance output; pin 13 is the vertical detail information output; pin 14 is the combed chroma information output.

Video processing

The comb filtering process results in some loss of video frequencies below 1MHz. To combat this, video below 1MHz is amplified by a bandpass amplifier and added back into the luminance. This can cause some problems, however; some stations transmit with minor modulation discrepancies which can, for instance, cause a field to field shift in black level. To avoid having this effect appear in the picture, the peaking automatically varies with video modulation level. This is achieved through the use of a non-linear amplifier.

RCA describes the operation of the amplifier as follows (Fig. 4):

"The gain of the circuit, Nonlinear Processor Q603, is determined by the ac modulation level of the input signal and feedback paths via CR603/CR605 and CR602/CR604. The output of the amplifier appears at the junction of the diode pairs. The output will be small for input signals below 5IRE, because the amplified signal will not be sufficient to turn CR603/CR605 'on,' some signal will pass due to R633. As the input signal strength increases above 5IRE, diodes CR603/CR605 will begin conducting. As they conduct, the signal is fed back to the base of the nonlinear amplifier through R632 and C634 and to output coupling capacitor C635. As the input signal further increases above 40IRE, diode pair CR602/CR604 will begin conducting. Their conduction will modify the feedback path by paralleling R632 with another resistor R631. This reduces the impedance of the feedback path, reducing the gain of the amplifier. The nonlinear processed signal is applied to the base of mixer transistor Q604 through capacitor C635 where it is added to the nonpeaked vertical detail signal. The nonlinear processed signal is phase reversed from the vertical detail output signal being fed through C670. After these two signals are added together at the base of Q604, a difference signal will appear at the collector containing only the overshoots (or peaking information) with no other vertical detail restoration signals being present. The peaking signal (overshoot) is coupled to the video summing transistor Q605 through C635."

The luminance signal is developed by summing the combed luminance, the vertical detail signal and the peaked detail signal at the emitter of Q605, the "Y" amplifier. The rest of the luminance circuitry resembles closely that of previous modular ColorTrak® chassis.

Chroma processing

Chroma processing circuitry also resembles that of earlier ColorTrak® chassis. A 24 pin IC (Fig. 5) performs most color functions (there are in the chroma only a burst keyer, a chroma buffer, and the matrix and driver transistors, in addition to the IC). The IC performs two major functions. One is the regeneration of the 3.58MHz chroma subcarrier. The other is the signal processing, (amplifiers, demodulators, matrix amplifiers and drivers for the red, green and blue matrix transistors).

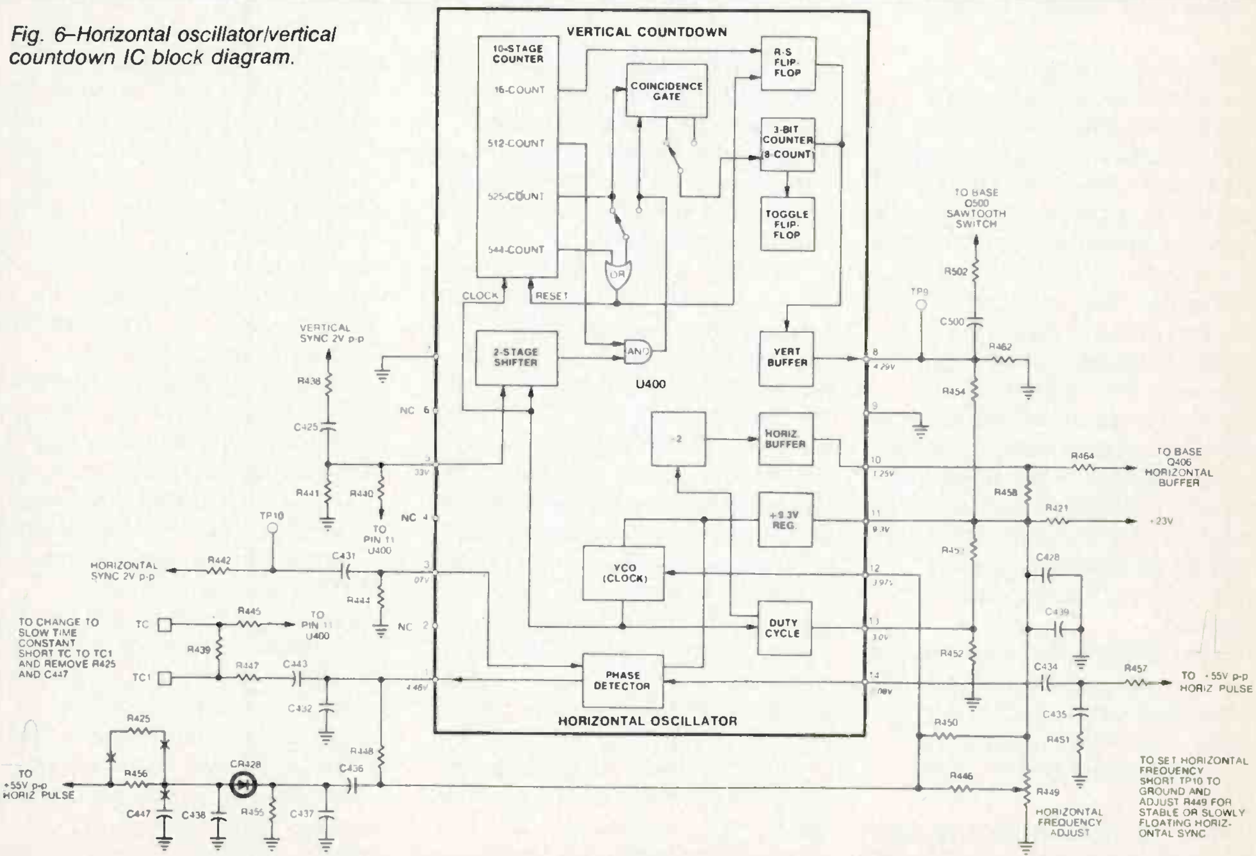
Sweep

Both the horizontal and vertical output circuitry are quite similar to earlier chassis. The major development in the sweep is the use of a horizontal oscillator/vertical countdown IC, U400 (Fig. 6).

The voltage controlled oscillator in U400 operates at 31.468 kHz, twice the horizontal rate (so it can be divided neatly by 525 for the vertical rate) and is divided by two before being fed to a buffer stage and the horizontal driver.

The vertical countdown is a two-mode system. One mode is the countdown operation, the other is a sync operation.

Fig. 6–Horizontal oscillator/vertical countdown IC block diagram.



The two modes of operation allow the system to be compatible with nonstandard sync signals. The IC internally switches between the two modes of operation depending upon the type of signal being received. Mode switching occurs after eight consecutive cycles of receiving vertical sync that is either in coincidence or not in coindence with the 525 count from the countdown system.

The countdown IC uses logic circuits to achieve the necessary functions. The operation of the vertical countdown circuit operating in the countdown mode with an NTSC signal present is as follows: A 10-stage counter counts every clock pulse from the 31.5kHz VCO. After the counter has received 512 clock pulses, the greater than or equal to 512 count line goes high, or to a logic "1." This places a logic "1" at one input of an AND gate. The other input of the AND gate remains at zero until vertical sync occurs. When vertical sync occurs, both inputs to the AND gate are ones, providing a "1" at the output which is supplied to one input of the coincidence gate. The other input of the coincidence gate is received from the 525 count line of the 10-stage counter. With the presence of an NTSC sync signal, the 525 count line goes to a "1" at the same time vertical sync occurs. This provides a "1" at both inputs of the coincidence gate causing a "1" to occur on the "Yes" line of the coincidence gate. This "1" is applied to the clear line of a 3-bit counter—clearing the counter—thus keeping the toggle flip-flop from changing states.

In addition to feed an input to the coincidence gate, the 525 count line data is also supplied to one input of a two-input OR gate. The output of the OR gate is coupled to an R-S flip-flop causing the output of the flip-flop to change state (set) generating a vertical pulse via the output buffer stage. The pulse to the output buffer stage is also counted by the 3-bit counter. The logic "1" pulse at the output of the OR gate is also coupled back to the reset line of the 10-stage counter forcing it to reset to a "0" count.

The 10-stage counter again begins. counting the clock pulses. After it has counted the 16th clock pulse, the 16 count line goes to a logic "1." This line is connected to the R-S flip-flop, resetting the flip-flop; thus, the length of the vertical output pulse is 16 clock counts. As long as an NTSC signal is being received, the operation of the countdown remains in this mode. On every 525th count, the countdown circuit checks for coincidence of the 525 count and sync. As long as coincidence occurs, the coincidence gate clears the 3-bit counter, allowing the 525 count to trigger an output pulse through the OR gate and R-S flip-flop, completing the cycle.

If no vertical sync is being received by the countdown IC, the second input to the AND gate remains at logic "0." This means that the one input to the coincidence gate stays at logic "0." Therefore, when the 525 count is reached and applied to the coincidence gate, the coincidence gate develops a "1" on the "No" line and a "0" on the "Yes" line. This will not clear the 3-bit counter. As before, the 525 count line energizes the R-S flip-flop through the OR gate. The flip-flop again drives the output buffer stage and also sets a "1" into the 3-bit counter stage. Also, the output of the OR gate resets the 10-stage counter to "0." Again, after 16 counts, the R-S flip-flop is reset, terminating the vertical output pulse. This cycle continues until the 3-bit counter counts eight occurrences of no vertical sync occurring (indicated by the lack of a clear pulse on the "Yes" line of the coincidence gate). After receiving the eight consecutive pulses without being cleared, the 3-bit counter energizes the toggle flip-flop which shifts the mode of operation from the countdown mode to the sync mode.

Vertical is then initiated by the occurrence of vertical sync. If no vertical sync is present, the countdown circuit will "freerun." The OR gate, which triggers the output generating R-S flip-flop has two inputs—the output of the AND gate and the 10-stage counter 544 count line. With no incoming vertical sync present, the AND gate will generate no output pulses; therefore, the OR gate will be activated by the 544 count line only.

If a nonstandard or a non-NTSC sync system is being received by the instrument, the AND gate provides a "1" pulse to the OR gate, provided that sync occurs between the 512 and 544 counts. If sync does not occur before the 544 count, the 10-stage counter is reset, starting the cycle over. When vertical sync occurs, it causes a "1" pulse at the input of the AND gate (the other input is supplied by the 512 count line). The resultant "1" at the output of the AND gate is applied to the coincidence gate and the OR gate generating a vertical output pulse.

The coincidence gate compares the occurrence of vertical sync to the 525 count line. If coincidence does not occur, there will be a logic "1" on the "No" line clearing the 3-bit counter and keeping the circuit in the sync mode. If coincidence does occur, the output on the "No" line will be "0," which eventually allows the 3-bit counter to increment by 1. However, operation continues in the sync mode until the 3-bit counter receives eight input pulses at which time it triggers the toggle flip-flop changing the mode of operation back into the countdown mode.

The 3-bit counter, which governs the switching between the two modes of operations, prevents switching between the two modes due to transient noise by requiring eight consecutive cycles of coincidence or noncoincidence before the changing modes of operation.

Power supplies

The power supply circuitry of the CTC101 follows the pattern of that of earlier chassis. A non-isolated, bridge-rectified +150V supply is the basic source of power for the CTC101 and supplies the horizontal output through a regulator which operates at +123V. The remainder of the operating voltages are scan derived.

Service

Service has been facilitated by a logical chassis layout, with circuit areas differentiated. The chassis is "road mapped" and components are designated and labled. Component numbers correspond to the following circuit areas:

100 series–ac input, voltage regulator and major transformers
200 series–sound processing
300 series–IF/AFT, AGC and sync processing
400 series–horizontal deflection, X-ray detection, pincushion processing
500 series–vertical deflection
600 series–dynamic detail processor (comb filter)
700 series–luminance processing
800 series–chroma processing
4100 series–auxiliary control assembly mounted components
4200 series-auxiliary controls
5000 series-kine drive circuits

The CTC101 chassis has two ground systems. The main chassis (isolated ground) and a heat sink panel on the right side of the chassis (hot ground). This heat sink panel is ground for the +123V regulator and the horizontal output circuit. (Again, remember, this is always hot to earth ground; *use an isolation transformer.*) The remainder of the supplies are referenced to isolated ground. ET/D

TEST INSTRUMENT REPORT

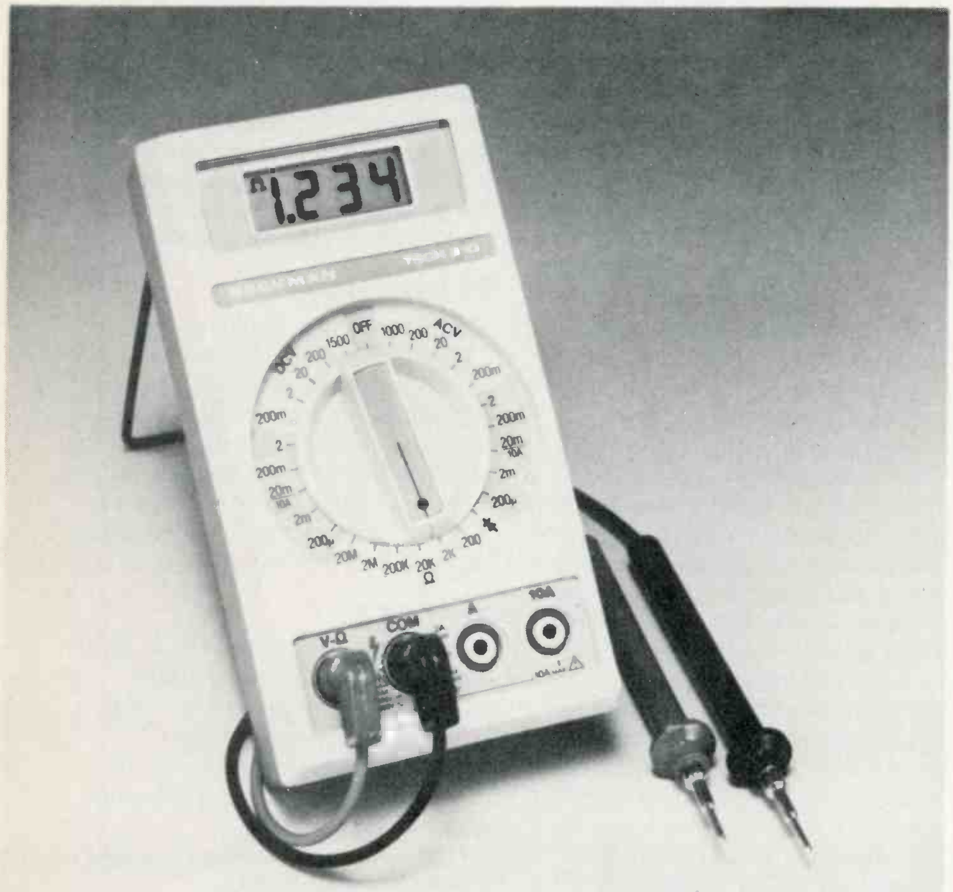
Beckman's Tech 310

Features plus

By Richard W. Lay

Beckman Instruments' first attempt at the consumer electronic test gear market is through a digital multimeter, the Tech 310, which has several features heretofore unavailable in a unit in its $130 price range—including a basic DC accuracy of .25%

in addition to the attributes which have come to be standard on DMMs in this age of microelectronics, that is compact size, light weight, and portability for field as well as bench use, the Tech 310, is a breed apart in that a Beckman designed and manufactured low current drain CMOS integrated circuit contains all of the active circuitry associated with this instrument. The result is a completely portable test instrument capable—the manufacturer says—of up to 2000 hours of continuous operation from one alkaline, 9-volt battery.



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

The Tech 310 is a 3½ digit unit, with liquid crystal display, that carries seven functions in 29 measurement ranges. Special features and capabilities of this unit are the low current ohms setting for in circuit measurements on all ohms ranges, a special diode test setting, and the patented "Insta-Ohms" feature for instantaneous continuity tests.

The latter, until now not available on DMMs due to relatively long response times, permits quick identification when checking for shorts. When a short circuit is encountered, a small ohms symbol on the LCD is displayed instantly.

Four front panel jacks serve as all of the inputs and ground connectors for the 310. Testimony to the ruggedness of the meter is the fact one is for use in measuring AC or DC currents up to 10 amps. However, factory tests indicate the 310 is capable of accepting up to 20 amps for 3 seconds or less without damage, the manufacturer reports.

Basic overload protection is for spikes up to 6kV on voltage and resistance ranges. The unit is rated at 1500VDC or 1000AC (rms). The LCD is capable of a maximum reading of 1999 with an overload indication of "OL" for all out of range measurements.

In the AC mode the 310 provides a basic accuracy on all sine waves of .75% from 45Hz to 2KHz; 1.5% from 2KHz to 5KHz, and 2.5% for frequencies up to 10KHz. For AC current the maximum frequency response is 400Hz.

Beckman's radial dial provides access to all function and range settings. There are seven ohms ranges; six AC amp and six DC amp ranges from 20 ma. to 10 amp; five DCV ranges from 200mV to 1500 VDC; and five AC volts ranges from 200mV to 1000VDC.

A single nine volt alkaline battery is easily accessible by removing four back cover screws. A blinking decimal point serves as the unit's low battery indicator during the last 200 hours of life, approximately. However, Beckman claims the battery should remain operative for about two years under normal usage conditions.

The heart of the unit, as mentioned before, is the LSI chip, which Beckman refers to as the multiprocessor. This chip contains an active input filter, an averaging ac-to-dc converter, the Insta-Ohms detection and resistance measurement circuitry, an analog to digital converter, and all of the necessary digital and LCD display drive circuitry.

The number of discrete components in the 310, due to the use of this "multiprocessor," have been reduced to under 40. Included as part of the discrete circuitry are the function/range switch, three resistor networks, a voltage reference diode, several circuit protection components, the battery and the display.

Beckman says it has designed into the multiprocessor chip a second order Bessel filter to assure broadband normal-mode rejection of 60dB when combined

continued on page 47

NEW PRODUCTS

Half-price Carrying Case

Circle No. 130 on Reader Inquiry Card

A holster type carrying case is being offered at half-price with the purchase of a new *Triplett* Model 30 AC Volt/Ammeter, also called the "Grabber". A coupon packed with each Model 30 can be presented along with $4.50 to any Triplett distributor in payment for the $9 case. This offer is reportedly good until Dec. 31, 1979.

The Model 30 is a clamp-on ac ammeter/voltmeter with ranges to 300 amps and 600 volts with an accuracy of ±3%. The jaw opening is one inch and the meter is diode protected. The price is $65.

Dual Trace Oscilloscope

Circle No. 131 on Reader Inquiry Card

Kikusui, a Japanese manufacturer of electronic test gear, marketing in Japan as well as Europe, has entered the United States test equipment field with its line of products, including the Model 5530, dual trace, oscilloscope shown above.

Designed for both traditional home en-

tertainment service as well as digital work the 5530 will retail in this country for a suggested price of $1,095. With 5mV basic sensitivity, the unit carries a bandwidth rated at 35MHz, has a risetime of 10nS, carries a signal delay line of about 150nS, and is operable in the alternate/chop, add, and X-Y modes.

The 5530 is capable of Z-axis modulation with an input sensitivity of 3Vpp and bandwidth of DC to 1MHz. With a 5-inch CRT, it has an acceleration voltage of approximately 6.6Kv and is equipped with a 5-times magnifier for close inspection work.

Miniature Soldering Iron

Circle No. 132 on Reader Inquiry Card

The *Antex Soldering Station's* 35 watt iron provides temperatures from 350 to 800° F with temperature control reportedly to ±2%. Heat up time is stated to be less than 30 seconds. The soldering iron is positively grounded and weighs less than one ounce. It accepts more than 40 slide on tips from 0.012 to 3/16 inch diameter. The price is $115.

Capacitance Meter

Circle No. 133 on Reader Inquiry Card

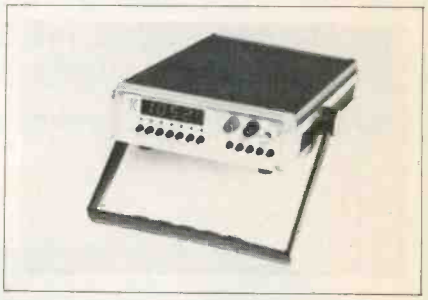
Companion products, a new .1% accuracy capacitance meter, and a tri-mode comparator, have been introduced by *Continental Specalties Corporation*. The capcitance meter, Model 3001 is a 3½ digit, AC powered unit with LED readout that carries a rated accurancy of .1% on all but the two highest ranges, where it is .5%, according to the manufacturer. The 3001 carries a zero calibra-

tion control to cancel out stray or lead capacitance. And, the manufactuterer reports, a special dual threshold measurement scheme eliminates inaccuracies found in single threhold measurement devices when used on capacitors which have not been completely discharged. The 3001 retails at $190. Its companion accessory, the Model 333 Tri-Mode Comparator, is a $290 instrument for use basically in production settings. This unit contains a rear panel connector to provide dual threshold "high," "good," and "low" readings.

4½ Digit DMM

Circle No. 134 on Reader Inquiry Card

Kontron Electronics, Inc. has just introduced a new five-function automatic or manual ranging digital multimeter, Model DMM4030. The DMM4030 offers a resolution of 1 μV in its lowest ac and dc voltage ranges, reportedly resulting in a

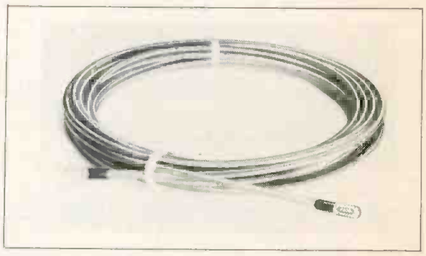


basic accuracy of ±0.02% of reading ± 1 digit. Other features include six ranges on each volt/ohms/milliamperes, true RMS ac voltage and current readings, automatic decimal point and polarity indication and the DMM4030 is stated to have high overload protection.

An available option is a reading hold function controlled from the probe.

Fishtapes

Circle No. 135 on Reader Inquiry Card



Klein Tools has a new series of round flexible fish tapes which they call Klein-Flex. Reportedly extremely flexible these tapes are made of braided spring steel music wire and have pull loops on both ends. They are available in 25, 35, 50, 75 and 100 foot lengths; special lengths on special order. ET/D

BIOMEDICAL

continued from page 42

outsider—looking in." There are possibilities for on-the-job training at some hospitals, but you will have to call around and see. Some hospitals are actually beginning to set up their own schools to train personnel for their immediate needs. Again this is going to vary from location to location and your best source of information will be your local hospitals—try their Personnel Departments and see.

This is not a field for the careless. A person's, maybe one day a loved one's, life may hang in the balance on a device that you have repaired. You can only work one way—as if your own life depended on the results! There is no room in this field for the fly-by-nighters. He has literally been forced out of the home entertainment field by certification and, likewise, we in the biomedical field have certification: ISCET offers a CET (m) (medical) and the Association for the Advancement of the Medical Instrumentation (AAMI) has a program and exam series leading to a CBET (Certified Biomedical Technician). Many firms, including opportunities available with the VA hospitals, require the CBET as a condition of employment.

All in all it's a growth field and guaranteed not to be dull or bore you. The question is, are you up to the standards it demands? ET/D

TEST INSTR. REPORT

continued from page 37

with the 6dB per octave rejection of the chip's integrating converter.

The low current mode for all resistance range settings permits use of the Tech 310 for in circuit measurements without forward biasing transistors or diodes. The maximum voltage that can be developed across an unknown resistance is .25 volts, Beckman says. On the other hand, the special diode test function operates on the ±2 volt full scale DC measurement range with a 5mA constant current source. This is scaled to ±200mV and converted in the multiprocessor chip and displayed.

The Tech 310 is available with a number of accessories at additional cost. Included are the high voltage probe allowing DC measurements up to 50Kv; a special RF probe for working in high frequency circuits up to 200MHz; and an AC current clamp, which permits its use in circuits with up to 200 amps without breaking the circuit.

The basic DC input impedance is 22 Megohms. For AC volts it is 2.2 megohms shunted by 75pF. ET/D

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Dealer Specials while they last 100-450v, 80-450v, 200-300v, all at 99¢, original boxed ECG 500a Sylvania Tripler $12.99, 50 pcs. Electrolytic kit assorted Axial Jap types $7.50 (15¢ each) 212-261-9479 Redcoat Electronics, 66-15 Thornton Pl., Forest Hills, NY 11374.

LINEAR AMPLIFIER, 2-30 MHz, 100 or 200 watt solid state. 300 MHz COUNTER. Modulation BOOSTER. Omnidirectional BASE ANTENNA. Plans $3.00 each. $10.00/all. Catalog of others. **Panaxis** Box 130-ET11 Paradise, CA 95969

For Sale: All new picture tube Rebuilding Equipment. First class professional Grade. 2 ovens, Litton sealing machine, etc. $5800 or offer. Call or write: T&C Services, Inc., 37 W. Quincy, Westmont, IL. 60559. 312-963-4020. 12/79

Automobile radio and tape replacement parts: Delco, Chrysler, Philco-Ford, Motorola, Panasonic and many others. Large inventory. **Laran Electronics Inc.** 3768 Boston Road, Bronx, NY 10469 (212) 881-9600 out of New York state (800) 223-8314. TF

VIDEO MOVIES G/PG/R/X: Beta or Vhs, bought, sold, rented. Blank tapes, Video recorders, supplies: Cat $1.00, refundable. Astro Electronics, 160 Woodbridge Ave., Highland Park, NJ 08904. 11/79

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

AM RADIO reception systems for interiors of buildings, ships, tunnels, etc. Receiver connection not required. Catalog A, Extronix, Inc. 64 Gough Ave., Ivyland, PA. 18974. 12/79

VIDEO TAPE 4 hr., Vhs $15.99, 2 hr. Sony $12.25, 3 hr. Sony $16.95. Video recorders, cameras. Entertainment Electronics, 8-B Centre Ave., East Rockaway, NY 11518, 516-887-2550. 12/79

For Sale: Picture Tube Rebuilding Equipment. Everything you need $3,000. Paul Hermanson, Route 1, Chassell MI 49916, Phone 906-482-7361.

BUSINESS OPPORTUNITIES

Established T.V. and Antenna Service Business available in small city location on beautiful Lake Michigan. Easily expandable to county wide operation, residence included. Schools and shopping near by. Interested? Call Stevensville T.V. 616-429-7349. 1/80

TV Servicing Business, $25,000 takes all. Low overhead. Contact Stan Listzwan, 9909 E. Creek St., Tucson AZ 85730. 602-889-4910 or 885-3137. 11/79

TV Sales and Service for sale. Well established dealership. Excellent location on 5 acres of prime commercial property in Alpena, Mich. Good gross sales. Business showroom and shop attached to a 4 bedroom house. (Now has many commercial accounts). McGirr Reality, 1020 W. Chisholm, Alpena, MI (517) 354-3482. 11/79

MECHANICALLY INCLINED INDIVIDUALS Assemble electronic devices in your home. Knowledge or experience not necessary. Get started in spare time. Above average profits. $300-$600/wk. possible. Sales handled by others. No investment-Write for free details. ELECTRONIC DEVELOPMENT LAB, Box 1560B, Pinellas Park, FL 33565. TF

T.V. Stereo And Sales Service. Business For Sale. Warranty Service Center. For Soundesign Stereo Systems. Also T.V. Sales. Established over 20 years in south Jersey. Includes all stock and merchandise, new modern equipment. Has fantastic potential. Must sell business due to health problems. Cherry Hill T.V. Service. 11 West Main Street. Maple Shade, NJ 08052 (609) 667-8881. 11/79

BROADCAST STATION. Start your own any type! Unique Cable FM station operation-investments/experience unnecessary! Receive free tapes, records. Get your FCC license! Much more. Free details. "Broadcasting:", Box 130 ET11, Paradise, CA 95969

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HELP WANTED

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

WANTED

Wanted: Audio Recording Equipment of all ages and varieties. (415) 232-2933.

AD INDEX

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

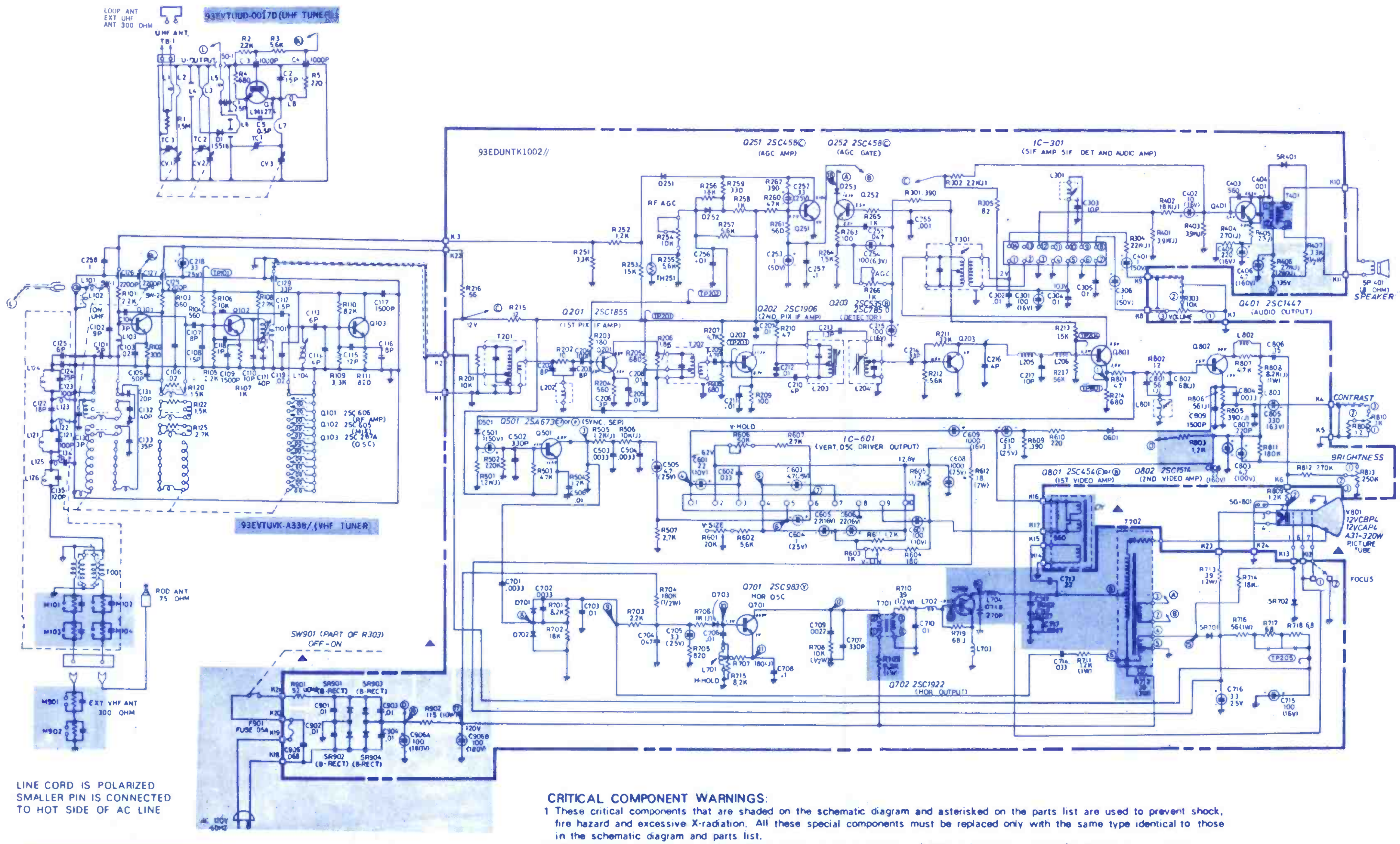
1818

SHARP
B&W TV Model
3K-82A

ET/D TEKFAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

NOVEMBER • 1979



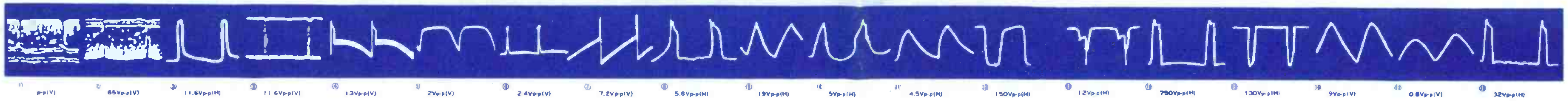
CRITICAL COMPONENT WARNINGS:

1. These critical components that are shaded on the schematic diagram and asterisked on the parts list are used to prevent shock, fire hazard and excessive X-radiation. All these special components must be replaced only with the same type identical to those in the schematic diagram and parts list.
2. The operating specification of high voltage of this model is 13KV ± 0.5KV at zero beam and 120V AC input line voltage. Serviceman should adjust the high voltage to the specified value as follows:
   (1). Examine if the power supply voltage at positive terminal of C906B is 120V±5%
   (2). Adjust Horizontal Drive Oscillator L701 to get a usable picture.
   (3). Examine all the critical components to see whether these are the same type as those in the schematic diagram and parts list.

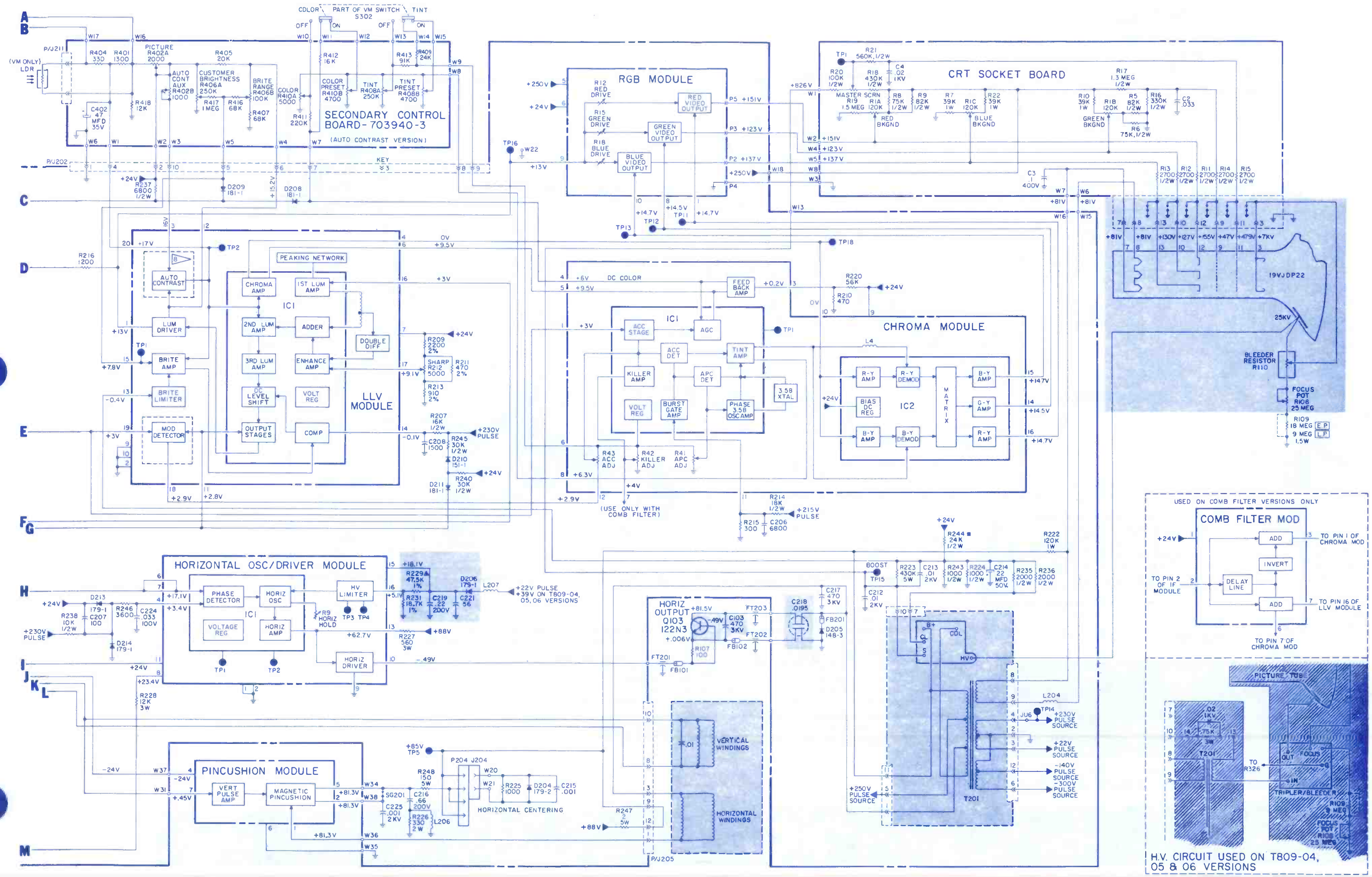
CAUTION: This circuit diagram is original one. Therefore there may be a slight difference from your set. Do not remove back of television. No user serviceable parts inside. Refer servicing to qualified service personnel.

IMPORTANT SAFETY NOTICE:
SHADED AND MARKED ▲ COMPONENTS HAVE SPECIAL CHARACTERISTICS IMPORTANT TO SAFETY. FOR CONTINUED PROTECTION, REPLACEMENT PARTS MUST BE IDENTICAL TO THOSE USED IN THE ORIGINAL CIRCUIT. SEE THIS PART LIST FOR SPECIFIED REPLACEMENT PARTS.

SHADED COMPONENTS: SAFETY RELATED PARTS
MARKED ▲ COMPONENTS: X-RAY RELATED PARTS



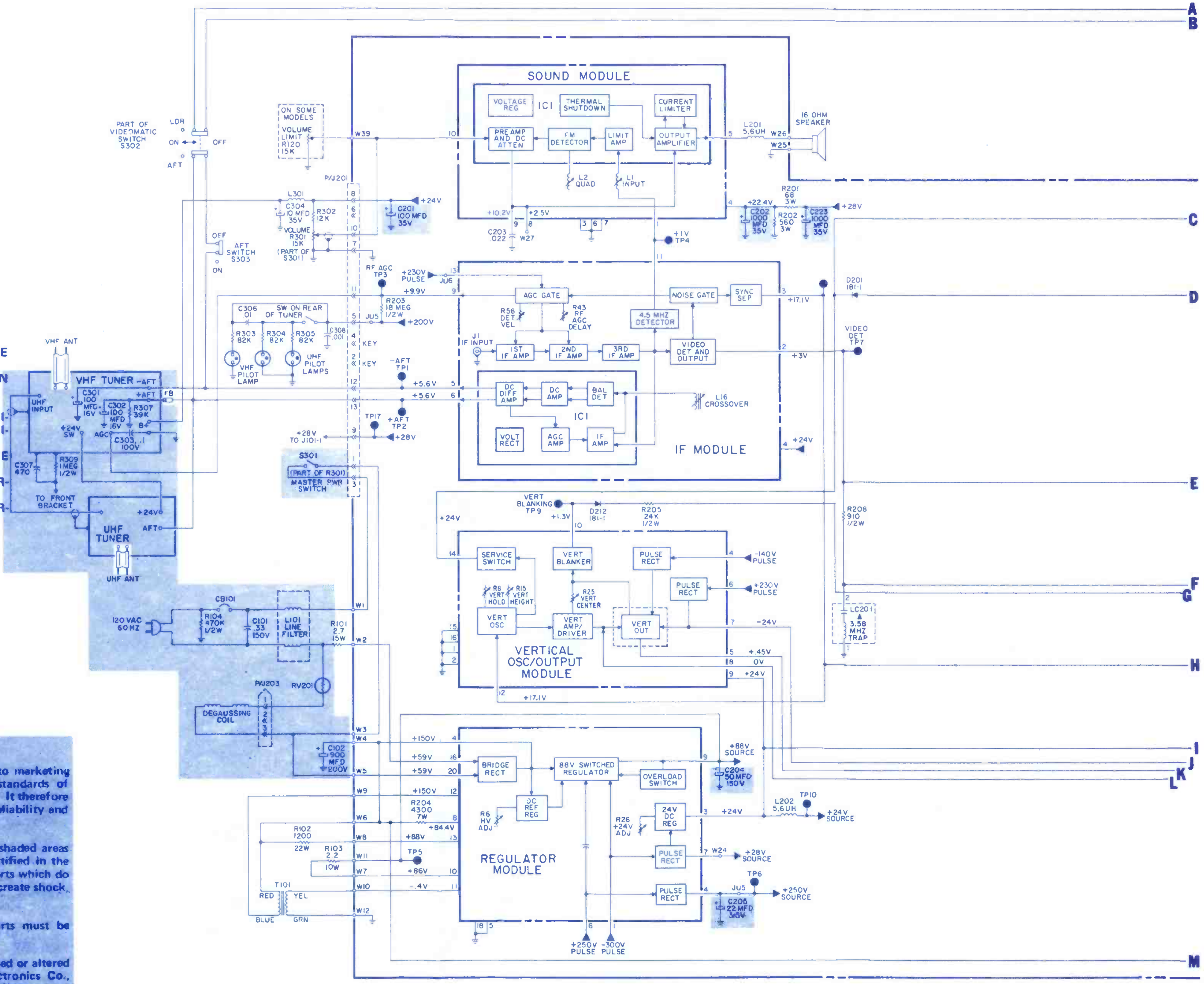
MAGNAVOX
Color TV Chassis
T809-01-06



MAGNAVOX
Color TV Chassis
T809-01-06

NOVEMBER • 1979

ET/D TEKFAX
COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS



NOTES:
UNLESS OTHERWISE SPECIFIED:
1. CAPACITANCE VALUES OF 1 OR GREATER ARE IN PICOFARADS.
2. CAPACITANCE VALUES LESS THAN 1 ARE IN MICROFARADS.
3. RESISTORS ARE ¼ WATT, 5%.
4. DC VOLTAGES TAKEN IN A NO SIGNAL CONDITION WITH CUSTOMER CONTROLS IN MID-POSITION AND VOLUME SET TO MINIMUM.
5. DC VOLTAGES MEASURED WITH A DVM, LINE VOLTAGE MAINTAINED AT 120V, 60 Hz.
6. ■ R244 IS 30K OHM ON T809-04,05 & 06 VERSIONS.
7. ▲ R229 IS 97.5K OHM ON T809-04,05 & 06 VERSIONS.

WARNING

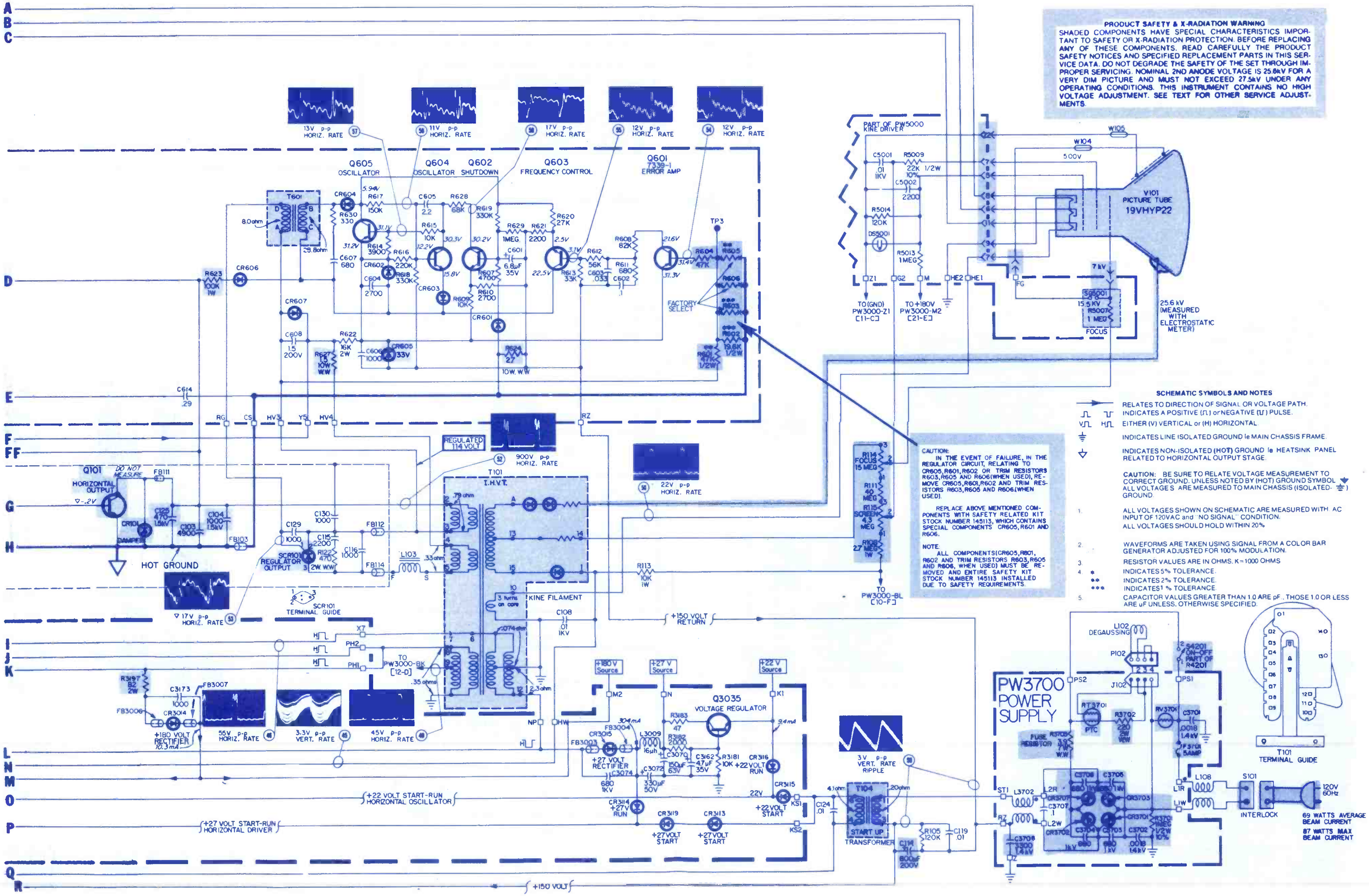
Magnavox Consumer Electronics Company is committed to marketing safe products which meet or exceed applicable safety standards of industry, government agencies and independent laboratories. It therefore uses parts in its products designed for maximum safety, reliability and performance.

For continued safety of this product, parts shown in the shaded areas of the schematic must be replaced with only those identified in the Parts List of this manual. Use of substitute replacement parts which do not have the same safety characteristics as specified, may create shock, fire or other hazards.

For maximum reliability and performance, all other parts must be replaced by those having identical specifications.

Under no circumstances may the original design be modified or altered without permission from the Magnavox Consumer Electronics Co., otherwise the consumer may be exposed to fire and/or shock hazards.

RCA
Color TV Chassis
CTC 88



PRODUCT SAFETY & X-RADIATION WARNING

SHADED COMPONENTS HAVE SPECIAL CHARACTERISTICS IMPORTANT TO SAFETY OR X-RADIATION PROTECTION. BEFORE REPLACING ANY OF THESE COMPONENTS, READ CAREFULLY THE PRODUCT SAFETY NOTICES AND SPECIFIED REPLACEMENT PARTS IN THIS SERVICE DATA. DO NOT DEGRADE THE SAFETY OF THE SET THROUGH IMPROPER SERVICING. NOMINAL 2ND ANODE VOLTAGE IS 25.6kV FOR A VERY DIM PICTURE AND MUST NOT EXCEED 27.5kV UNDER ANY OPERATING CONDITIONS. THIS INSTRUMENT CONTAINS NO HIGH VOLTAGE ADJUSTMENT. SEE TEXT FOR OTHER SERVICE ADJUSTMENTS.

CAUTION:

IN THE EVENT OF FAILURE, IN THE REGULATOR CIRCUIT, RELATING TO CR605, R601, R602 OR TRIM RESISTORS R603, R605 AND R606 (WHEN USED), REMOVE CR605, R601, R602 AND TRIM RESISTORS R603, R605 AND R606 (WHEN USED).

REPLACE ABOVE MENTIONED COMPONENTS WITH SAFETY RELATED KIT STOCK NUMBER 145113, WHICH CONTAINS SPECIAL COMPONENTS CR605, R601 AND R606.

NOTE:

ALL COMPONENTS (CR605, R601, R602 AND TRIM RESISTORS R603, R605 AND R606, WHEN USED) MUST BE REMOVED AND ENTIRE SAFETY KIT STOCK NUMBER 145113 INSTALLED DUE TO SAFETY REQUIREMENTS.

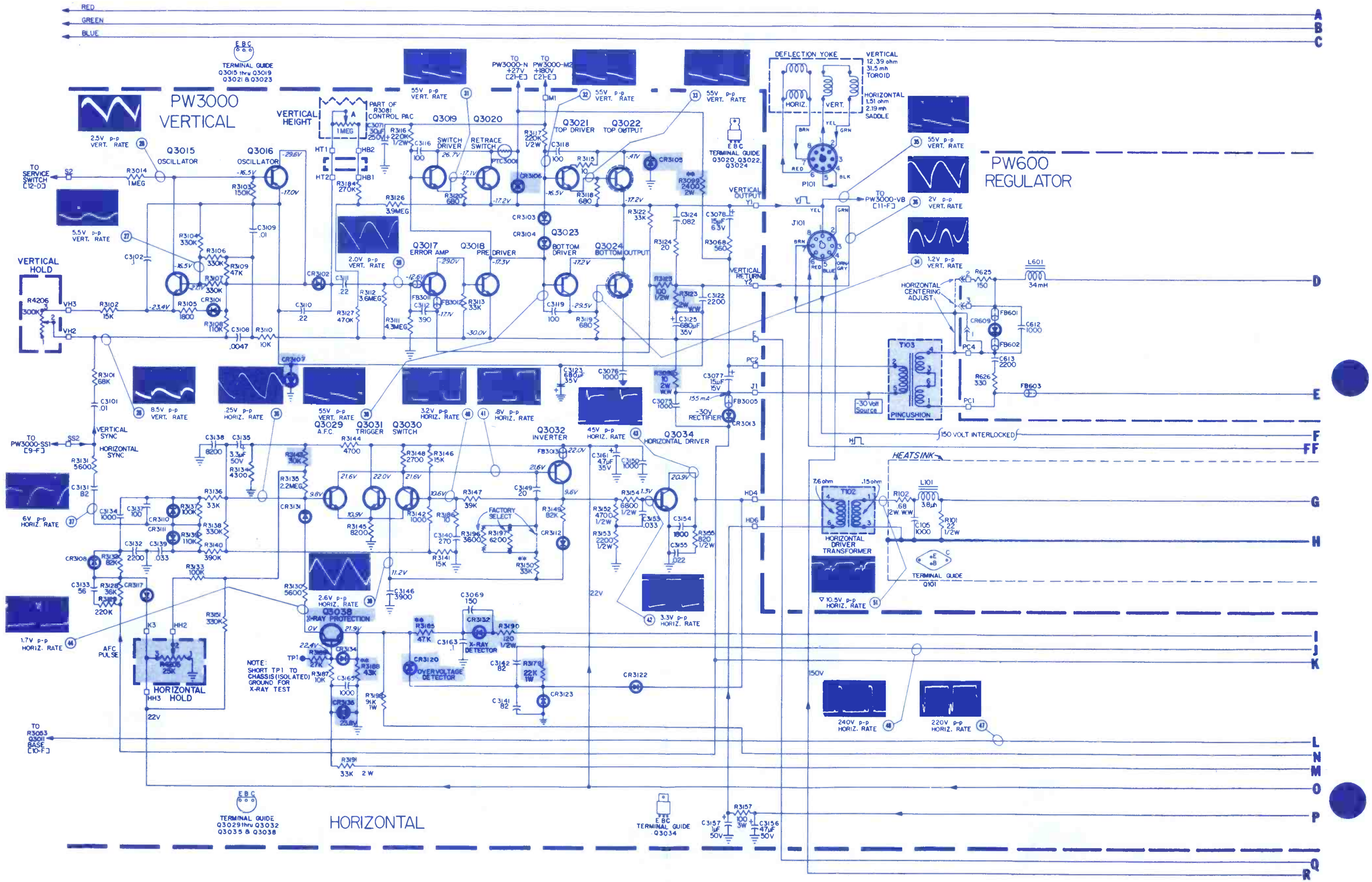
SCHEMATIC SYMBOLS AND NOTES

RELATES TO DIRECTION OF SIGNAL OR VOLTAGE PATH.
INDICATES A POSITIVE (⎍) or NEGATIVE (⊔) PULSE.
EITHER (V) VERTICAL or (H) HORIZONTAL.
INDICATES LINE ISOLATED GROUND ie MAIN CHASSIS FRAME.
INDICATES NON-ISOLATED (HOT) GROUND ie HEATSINK PANEL RELATED TO HORIZONTAL OUTPUT STAGE.

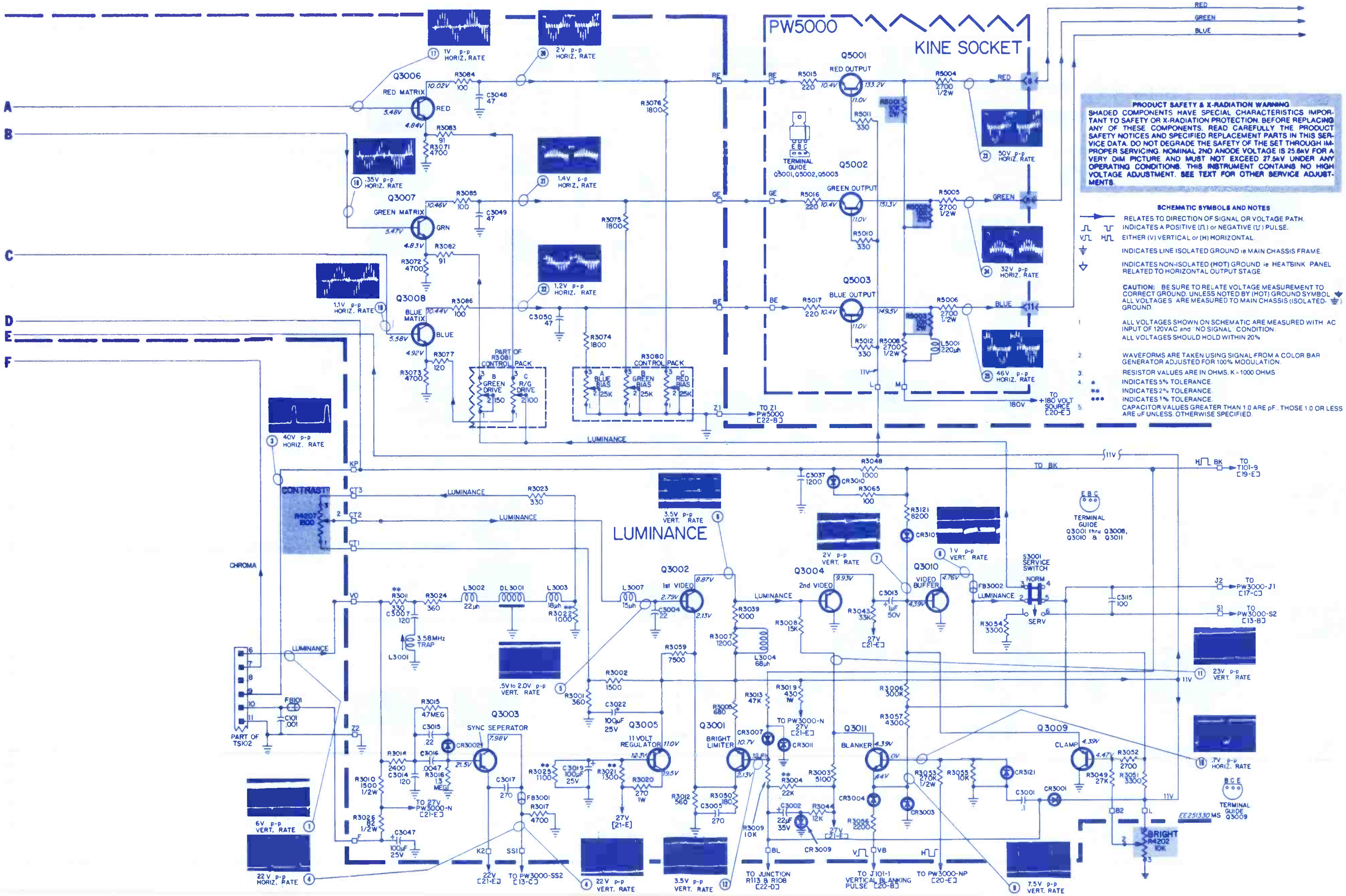
CAUTION: BE SURE TO RELATE VOLTAGE MEASUREMENT TO CORRECT GROUND. UNLESS NOTED BY (HOT) GROUND SYMBOL ALL VOLTAGES ARE MEASURED TO MAIN CHASSIS (ISOLATED-) GROUND.

1. ALL VOLTAGES SHOWN ON SCHEMATIC ARE MEASURED WITH AC INPUT OF 120VAC and "NO SIGNAL" CONDITION. ALL VOLTAGES SHOULD HOLD WITHIN 20%
2. WAVEFORMS ARE TAKEN USING SIGNAL FROM A COLOR BAR GENERATOR ADJUSTED FOR 100% MODULATION.
3. RESISTOR VALUES ARE IN OHMS. K=1000 OHMS
4. * INDICATES 5% TOLERANCE.
   ** INDICATES 2% TOLERANCE.
   *** INDICATES 1 % TOLERANCE.
5. CAPACITOR VALUES GREATER THAN 1.0 ARE pF., THOSE 1.0 OR LESS ARE uF UNLESS. OTHERWISE SPECIFIED.

RCA
Color TV Chassis
CTC 88



ADDITIONAL INFORMATION NEXT PAGE



PRODUCT SAFETY & X-RADIATION WARNING

SHADED COMPONENTS HAVE SPECIAL CHARACTERISTICS IMPORTANT TO SAFETY OR X-RADIATION PROTECTION. BEFORE REPLACING ANY OF THESE COMPONENTS, READ CAREFULLY THE PRODUCT SAFETY NOTICES AND SPECIFIED REPLACEMENT PARTS IN THIS SERVICE DATA. DO NOT DEGRADE THE SAFETY OF THE SET THROUGH IMPROPER SERVICING. NOMINAL 2ND ANODE VOLTAGE IS 25.6kV FOR A VERY DIM PICTURE AND MUST NOT EXCEED 27.5kV UNDER ANY OPERATING CONDITIONS. THIS INSTRUMENT CONTAINS NO HIGH VOLTAGE ADJUSTMENT. SEE TEXT FOR OTHER SERVICE ADJUSTMENTS.

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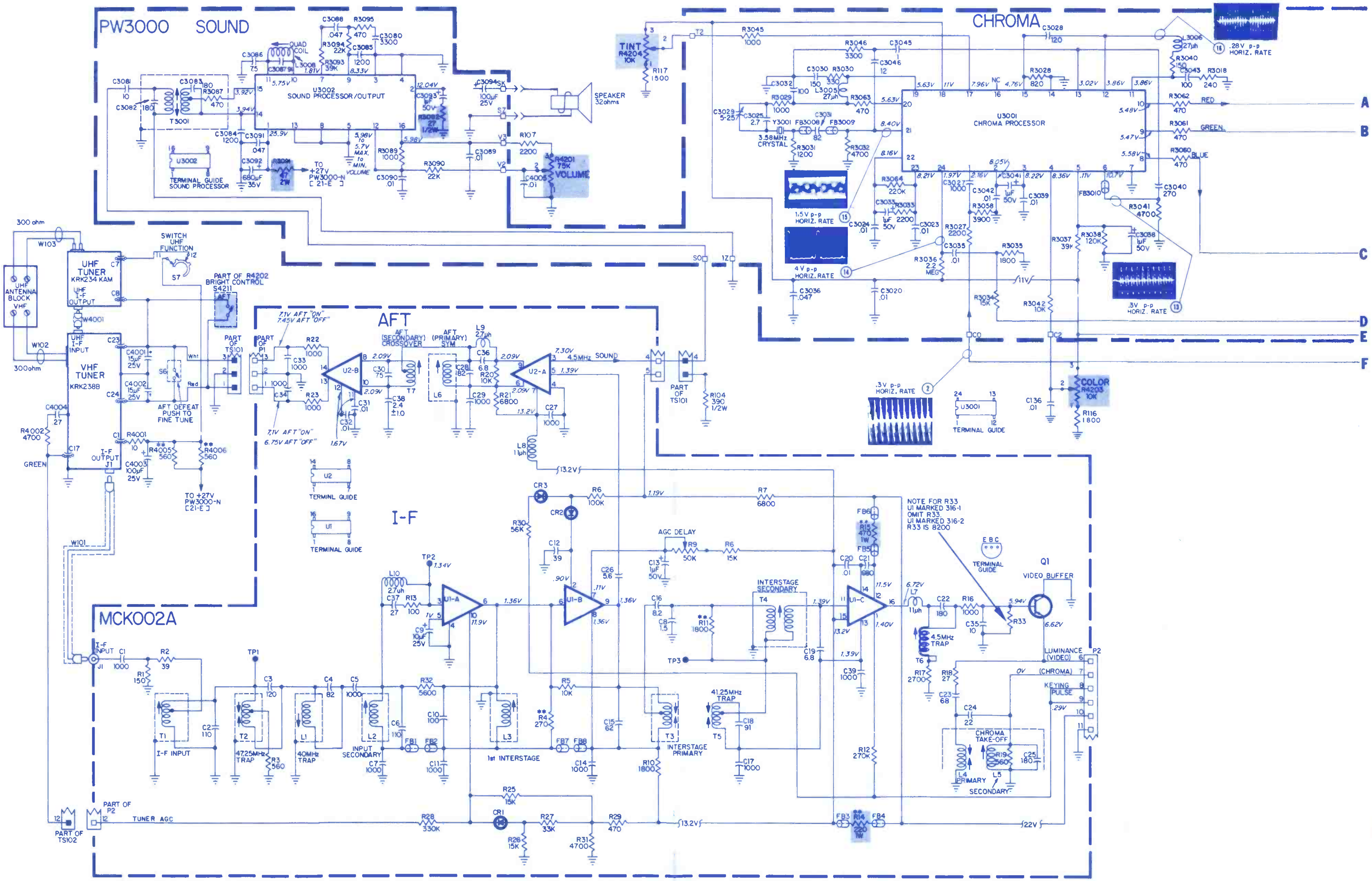
1816

RCA
Color TV Chassis
CTC 88

NOVEMBER • 1979

ET/D TEKFAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

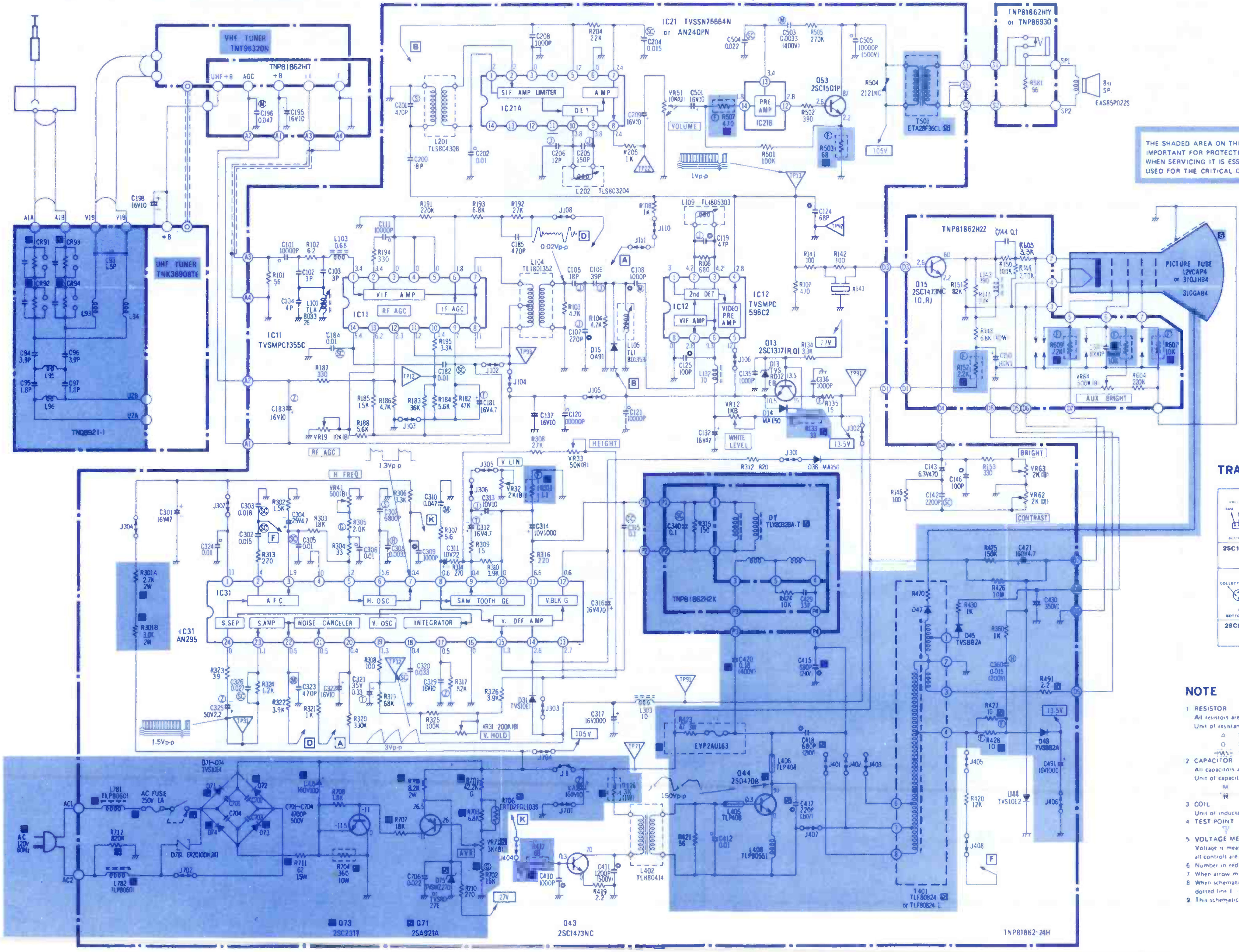


ET/D TEKFAX
COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

	SCHEMATIC NO.		SCHEMATIC NO.
PANASONIC B&W TV Chassis K-01	1815	MAGNAVOX Color TV Chassis T809-01-06	1817
RCA Color TV Chassis CTC-88 Series	1816	SHARP B&W TV Model 3K-82A	1818

PANASONIC
B&W TV Chassis K-01

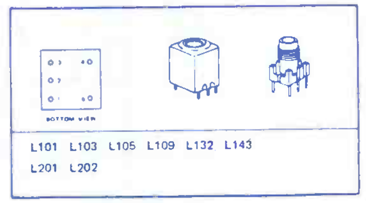
NOVEMBER • 1979



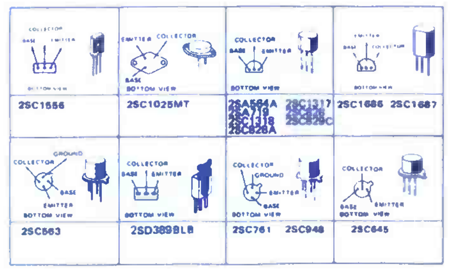
IMPORTANT SAFETY NOTICE

THE SHADED AREA ON THIS SCHEMATIC DIAGRAM INCORPORATES SPECIAL FEATURES IMPORTANT FOR PROTECTION FROM X-RADIATION, FIRE AND ELECTRICAL SHOCK HAZARDS. WHEN SERVICING IT IS ESSENTIAL THAT ONLY MANUFACTURER'S SPECIFIED PARTS BE USED FOR THE CRITICAL COMPONENTS IN THE SHADED AREAS ON THE SCHEMATIC.

TRANSFORMER TERMINAL INFORMATION



TRANSISTOR BASE INFORMATION



NOTE

1. RESISTOR
   All resistors are carbon 1/4W resistor, unless otherwise noted the following marks.
   Unit of resistance is OHM (Ω) (K=1,000, M=1,000,000)
   Δ : Solid resistor ● : Metal oxide resistor
   ◻ : Wire wound resistor : Thermistor
   : Fuse resistor
2. CAPACITOR
   All capacitors are ceramic 50V capacitor, unless otherwise noted, the following marks.
   Unit of capacitance is μF, unless otherwise noted.
   M Polyester capacitor S Polystylene capacitor
   Electrolytic capacitor
3. COIL
   Unit of inductance is μH
4. TEST POINT
   Test point position
5. VOLTAGE MEASUREMENT
   Voltage is measured by a volt ohm meter with DC 20K OHM/V receiving normal signal, when all controls are set to the maximum position.
6. Number in red circle indicates waveform number.
7. When arrow mark (↗) is found, connection is easily found along with the direction of an arrow.
8. When schematic diagram of a board is described in more than two places, they are encircled with dotted line.
9. This schematic diagram is the latest at the time of printing and subject to change without notice.

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