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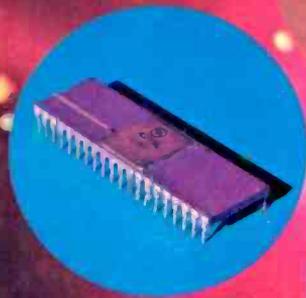
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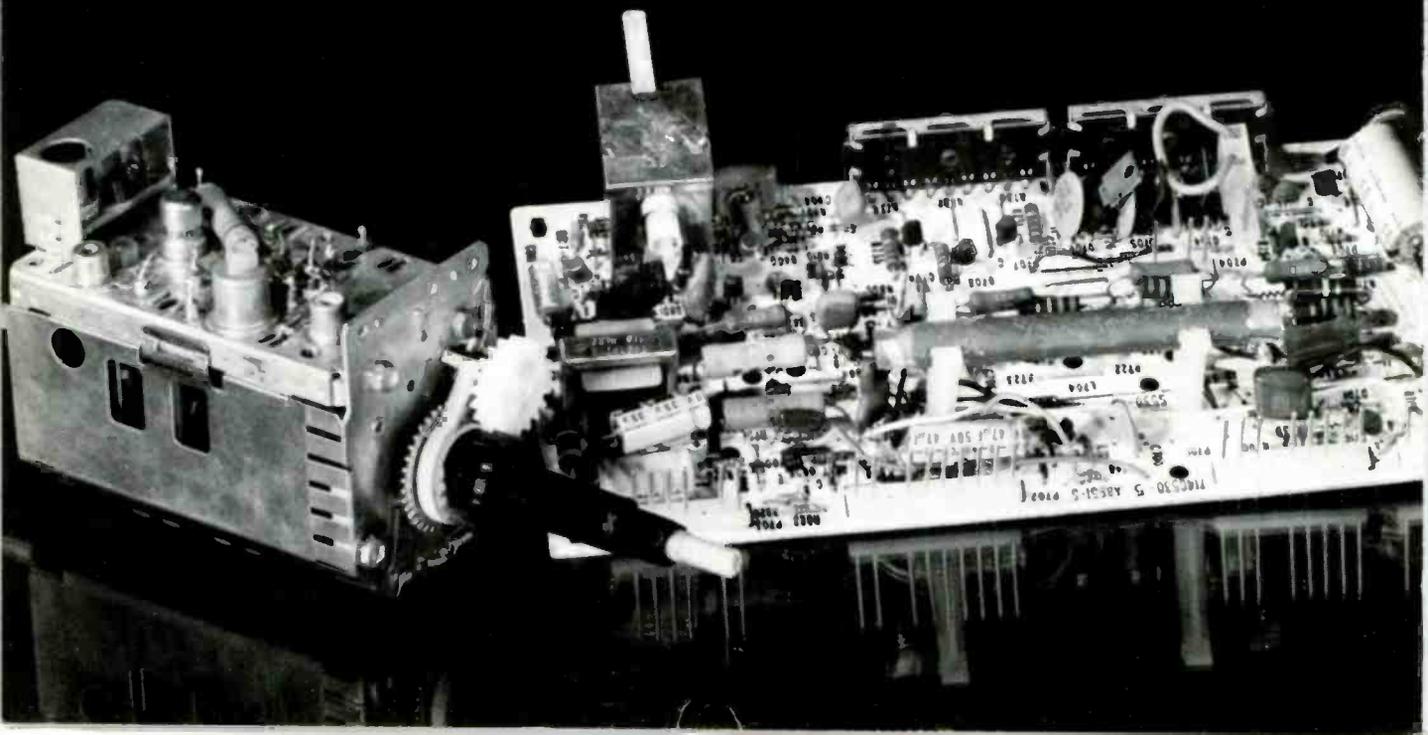
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On the cover:
A symbolic representation of the
Microprocessor Revolution, the
sign of things to come, covered in
"The Microprocessor and You,"
starting on page 14. (MPU
samples, courtesy of Motorola
Semiconductor Products)

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INDUSTRY REPORT

Barreca Named Admiral Chief for Second Time

Vincent Barreca, a 44-year veteran with Admiral, has been named president of the Admiral Group of Rockwell International Corp.—succeeding John J. Henry who has been assigned to other duties.



Vincent Barreca

This is the second time Barreca, Glenview, Ill., has headed Admiral and he is the sixth president of the Admiral Group since Rockwell took control of the firm in 1974.

Barreca, who previously served as president from 1962-69, moves to his second tenure of office from the post of Vice President and General Manager of Admiral International Division.

His career with Admiral has covered virtually every phase of the business in production and sales management. In 1946 he set up Canadian Admiral Corporation, Ltd., Toronto, to produce Canada's first television receivers.

Rockwell International is a multi-industry company involved in aerospace, automotive, consumer electronics, utility and industrial businesses. Just recently it announced it would be agreeable to outside offers concerning its Admiral Group.

Leader Launches Major Marketing Campaign; Announces New Products

Leader Instruments Corp., the privately held Japanese-owned test instrument firm operating in this country for the last nine years, is out to garner a significantly bigger share of the market for itself.

Keys to Leader's expanded program, Corporate Vice President William Brydia told a recent Manhattan news conference, are establishment of regional sales districts in various sections of the country, wider penetration of eight specific market segments in industry, education and service areas, and product packaging and design changes to emphasize compactness, mobility and utility of state-of-the-art electronics.

The eight specific areas Leader is shooting at, Brydia said, are: service, education, industrial, small computer, audio, video, communications, and government-military.

In announcing plans for new products, Brydia revealed five specific units which Leader plans to unveil in the near future.

First will be the introduction of a combo 25MHz, dual trace scope and 80MHz, eight digit frequency counter. Leader's product development plans generally aim at combining separate instruments into sophisticated, multipurpose packages with broad areas of cost-effective applications," Brydia said.

Such a combo instrument, he added, will solve the problem of measuring signal frequency directly from a scope while simultaneously viewing the signal for analysis.

Other new products planned later this year, Brydia said, are an auto-nulling, frequency distortion analyzer for design and maintenance of advanced audio equipment; a 250MHz frequency counter with period function, primarily for use by broadcast stations; a portable, battery powered Color Bar Generator featuring LSI technology and 18 patterns and the composite video signal; and a combination transistor checker/FET multimeter for service and hobby applications.

Brydia said Leader is now at a \$4 million annual sales mark and growth is in "double figures." Brydia also announced the first of several regional manager appointments, that of William D. Hefner, a nine year veteran with Sencore as a field and design engineer, who will head the Midwest office based in Chicago.

Leader also revealed price increases on about one-third of the 50 test instruments they now manufacture. The increases, averaging about 8 per cent, affect one of Leader's four color bar pattern generators; three of the 10 dual and single trace scopes, six of their units in the multimeter/checker category, and seven of their 20-odd signal and sweep generators.

Sony Realigns Marketing Structure

Sony Corporation of America has announced the creation of three marketing groups that will handle consumer, educational, and specialized products which the firm's parent Japanese-owned company manufactures.

The creation of the new units, which came swiftly on the heels of the resignation of Board Chairman Harvey L. Schein a month after the death of Sony of America President Raymond Steiner, will leave Kenji Tamiya as Sony of America's top official in this country.

Assuming the board chairmanship of Sony of America, is the president of the parent company, Kazuo Iwama.

According to Sony, Tamiya will head the first of the newly created units, Sony Consumer Products, responsible for marketing Trinitron color TVs and Betamax. Reporting to him will be the chief executives of the other two special marketing units, Ken Tsunoda the chief of Sony Video Products for industry, and

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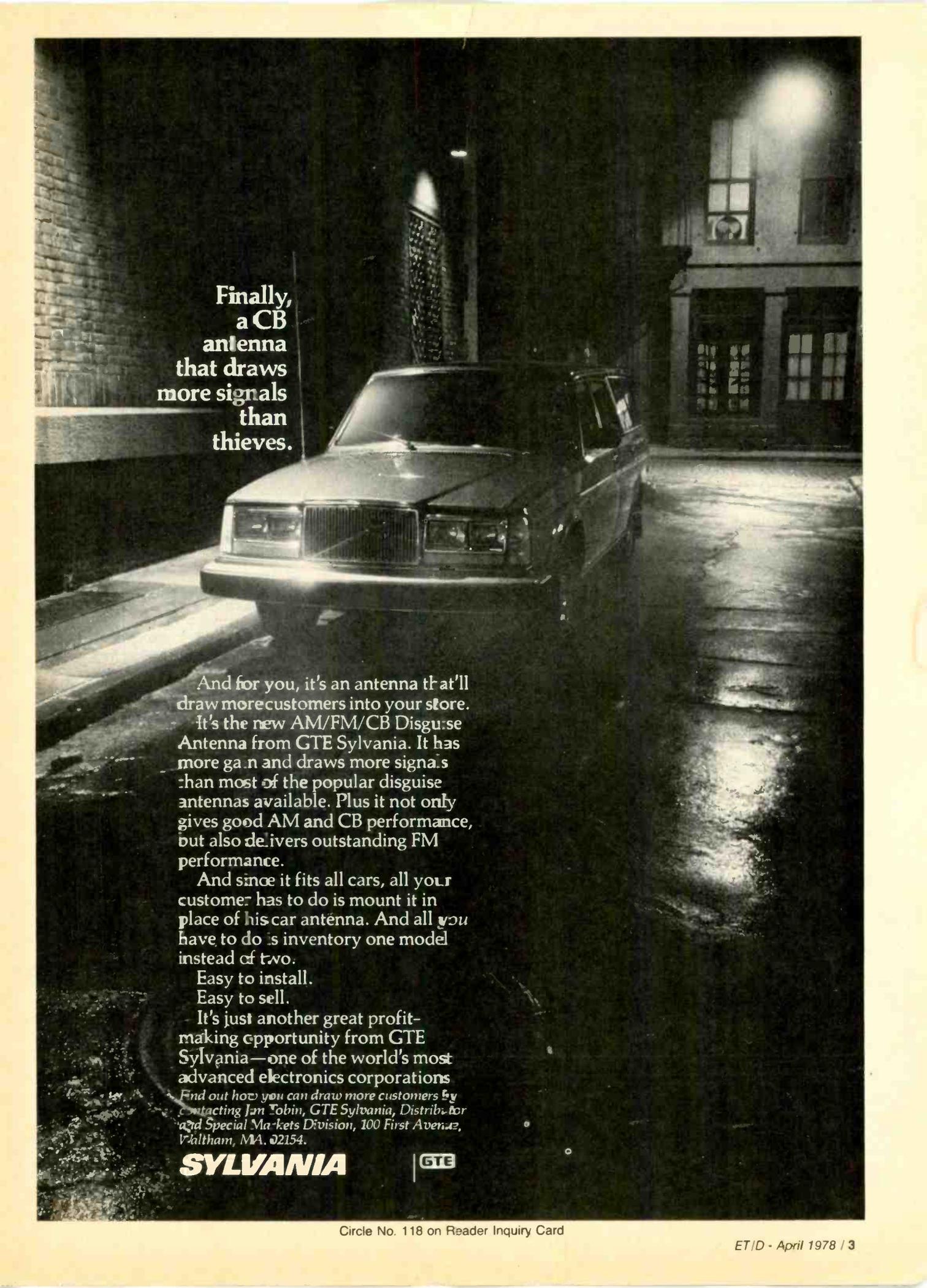
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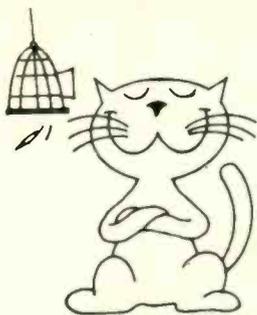
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Michael P. Schulhof head of the new Sony Industries group which will be responsible for special products.

Motorola Eyes Industrial Control Market

Motorola Semiconductor Products of Phoenix, Ariz., has announced it has formed a new group—Subsystem Products—which will attempt to move in on the industrial control market.

According to Bruce McDonald, chief of the new group, Subsystem Products will introduce an industrial control unit, a series of regulated DC power supplies for microcomputer applications, and a series of solid state relays and input/output modules for MPU systems.

Motorola said the industrial control unit is a two-board assembly designed to serve in industrial settings as both a training aid and a functional control system. Power supplies will be +5 volt and + and -12 volt outputs designed primarily for microcomputer applications.

Zenith Gets High Court Hearing

The U.S. Supreme Court has agreed to hear the Zenith Radio Corporation's long-standing feud with Japanese importers of television sets and other home entertainment products.

The case, expected to have far reaching effects on world trade relations between the United States and other countries if the court sides with Zenith, stems from complaints that the Japanese government unfairly subsidizes television sets made in Japan for export by offering a rebate. This, Zenith has contended in various court hearings on the matter, permits the Japanese to sell their "for export" sets some 20 per cent cheaper in the United States than they actually sell for in Japan.

Not only is the case important from the standpoint of the electronics industry, but it also is expected to have repercussions on the Japanese and world steel industries if Zenith's appeal is successful.

Zenith is specifically seeking to have the U.S. Customs Dept. enforce the federal tariff act. That act states that when a foreign country pays or bestows "any bounty or grant" on exports to the U.S., the government must impose a duty - "equal to the net amount of such bounty or grant."

Two U.S. steel giants, U.S. and Bethlehem, have filed 'friend of the court' petitions in support of Zenith. However, the Customs Department and the Carter administration oppose imposition of such counter duties on the grounds it will trigger reactionary responses from foreign governments.

U.S. Steel's brief contends steel manufacturers in Japan, several European Community nations, Sweden, Norway, and Brazil have tax rebate policies on steel for importation to other nations.

The Japanese government's rebate to manufacturing firms in Japan stems from the fact that manufacturers must pay a tax to the government on all products sold in Japan—however, this tax is not due on products manufactured for export.

Zenith to Keep Eastern Plant Open

Zenith Radio Corporation, which last December announced moves to lay off about a quarter of its 23,000 U.S. workforce in order to meet foreign based competition, now says one plant scheduled for closing will remain open.

A spokesman says the Watsontown, Pa., audio and cabinet plant, which employs some 700 persons, will remain open and will manufacture speaker assemblies and install foreign produced audio chassis and record changers.

In another announcement, Zenith said Brian J. Marohnic, national service manager and a veteran of 44 years with the company, has retired. He joined Zenith as a member of the product repair department and in 1963 was appointed national service manager.

He is succeeded by Richard C. Wilson, a Zenith veteran of some 25 years. Wilson joined Zenith in 1952 as a technician and later served in quality control, as an engineering technician, and also as a service engineer.

Imported TVs Show Gain in 1977

Although color television imports for 1977 dropped 10.4 percent, a 13.4 percent increase in black and white sets brought the overall figure for last year to 7.45 million sets, up four percent from a year earlier.

The figures, released by the Electronic Industries Association, showed, however, that the biggest boom in import percentages centered on the rapidly expanding video cassette recorder market in this country. Total imports for video tape units last year jumped more than threefold to 250,450 units, compared with the 69,869 video tape recorder units which were imported the year before.

However, the frantic marketing effort of U.S. manufacturers seeking to enter the video tape market resulted in over 135,000 of those video tape units being imported during the last quarter of 1977.

In other categories, the EIA said that total radio imports into the U.S. in 1977 were some 43.2 million, a gain of 4.5 percent. Imports of audio tape recorder/players reached 13.5 million last year, a 6.4 percent jump over the previous year.

In the export category, EIA said, color television units sent out of the country were up 58 percent to 70,221 in 1977 while U.S. monochrome exports sank 10 percent to 47,496.

EIA said the figures were supplied by the U.S. Dept. of Commerce. **ETD**



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25A 489	25A 841	.59	25C		25C 732	.59	25C 1172B	6.50	25C 1730	.59	25D 370		HA 1306W	3.70	TA 8005P	5.80
25A 490	25A 844	.59	25C 183	.59	25C 733	.59	25C 1173	.90	25C 1756	1.40	SUB 25D 427		HA 1312	3.90	TA 8012M	6.60
25A 491	25A 847	.59	25C 184	.59	25C 734	.59	25C 1175	.90	25C 1760	1.90	25D 371S	2.80	HA 1322	4.40	TA 8012P	5.80
25A 495	25A 850	.59	25C 184	.59	25C 735	.59	25C 1177	14.00	25C 1765	8.80	25D 380	7.60	HA 1339	4.40	TA 8015M	6.50
25A 496	25A 872A	.59	25C 187	.59	25C 738	.59	25C 1189	12.00	25C 1775	.45	25D 382	1.40	HA 1339A	4.40	TA 8015P	5.80
25A 497	25A 885	.70	25C 283		25C 756	2.80	25C 1209	.70	25C 1816	3.90	25D 388	3.40	HA 1342A	4.40	T8A 810SH	3.70
25A 505	25A 908	11.00	SUB 25C 458		25C 756A	3.00	25C 1211D	.59	25C 1846	.70	25D 388A	4.40	LA 1111P	2.50	TC 9100P	22.00
25A 509	25A 913	1.20	25C 284	1.20	25C 763	.59	25C 1212A	1.40	25C 1846	.70	25D 389	.90	LA 1201	2.50	TD 3505AP	8.50
25A 525		.70	25C 317	1.20	25C 772	.45	25C 1213	.70	25C 1898	.59	25D 390	1.00	LA 1221	2.80	UPC 41C	3.70
25A 530		1.30	25C 352A	2.50	25C 773	.70	25C 1215	.70	25C 1909	3.90	25D 424	3.50	LA 1264	4.40	UPC 554C	2.80
25A 537A	25B 27	.59	25C 353A	2.50	25C 774	2.00	25C 1222	.45	25C 1913	1.20	25D 425	6.50	LA 1300	3.00	UPC 555H	2.25
25A 539	25B 54	.59	25C 367	.90	25C 775	1.95	25C 1226A	1.00	25C 1945	5.60	25D 426	4.60	LA 1301	3.00	UPC 566H	1.60
25A 545	25B 55	.59	25C 369	.59	25C 776	2.65	25C 1237	4.25	25C 1951	1.10	25D 427	3.00	LA 4030P	3.40	UPC 575C	2.80
25A 561	25B 75	.45	25C 371	.59	25C 777	3.50	25C 1239	3.90	25C 1957	1.20	25D 525	1.60	LA 4031P	3.00	UPC 576	3.70
25A 562	25B 77	.45	25C 372	.45	25C 778	3.60	25C 1279	.70	25C 1969	4.90	25D 526	1.10	LA 4032P	3.40	UPC 577H	2.25
25A 564A	25B 173	.45	25C 373	.45	25C 781	2.65	25C 1306	3.90	25C 1973	1.10	25D 555A	6.60	LA 4032P	3.40	UPC 592H2	1.60
25A 565	25B 175	.45	25C 374	.59	25C 783R	3.60	25C 1307	4.90	25C 1974	1.90	25D 610	1.90	LA 4051P	3.70	UPC 1001H	4.90
25A 566	25B 176	.45	25C 377	.70	25C 784	.59	25C 1310	.59	25C 1975	4.40	SG 613 (TV)	5.95	LA 4400	3.70	UPC 1008C	7.00
25A 606	25B 178	.70	25C 380	.59	25C 785	.59	25C 1312	.59	25C 2028	.90	M 5111AP	2.80	LD 3120	2.50	UPC 1016C	3.00
25A 607	25B 186	.45	25C 381	.59	25C 789	1.00	25C 1313G	.59	25C 2029	3.90	M 5112AP	2.80	M 5111AP	2.80	UPC 1020H	3.70
25A 624	25B 187	.45	25C 382	.59	25C 793	2.80	25C 1317	.45	25C 2076	.59	M 5115PR	4.90	M 5112AP	2.80	UPC 1025	4.40
25A 627	25B 202	1.60	25C 383	.90	25C 799	3.60	25C 1318	.45	25C 2081	2.80	M 51513L	4.90	M 5152L	2.50	UPC 1026C	3.70
25A 628	25B 220	.70	25C 387A	.59	25C 802		25C 1325A	7.60	25C 2082	3.90	M 5152L	2.50	UPC 1032	2.25	UPC 1032	2.25
25A 634	25B 303	.59	25C 388A	1.00	SUB 25C 799		25C 1327	.59	25C 2088	4.90	M 51841P	2.80	UPC 1156	4.25	UPC 1156H	4.25
25A 640	25B 324	.70	25C 394	.59	25C 815	.59	25C 1330	.70	25D		25D 16	5.90	UPC 1152H	3.40	UPC 1152H	3.40
25A 643	25B 337	1.60	25C 403	.59	25C 820	.45	25C 1335	.70	25D 28	2.50	25D 41	1.10	UPC 1001H	4.90	UPC 1001H	4.90
25A 653	25B 346	.70	25C 430	.90	25C 829	.45	25C 1342	.59	25D 72	1.10	25D 58	3.60	UPC 1008C	7.00	UPC 1008C	7.00
25A 659	25B 367	1.50	25C 454	.59	25C 830H	5.90	25C 1344	.59	25D 75	1.40	25D 61	1.40	UPC 1016C	3.00	UPC 1016C	3.00
25A 661	25B 368	2.15	25C 458	.59	25C 838	.59	25C 1345D	.59	25D 77	.90	25D 62	1.30	UPC 1020H	3.70	UPC 1020H	3.70
25A 663	25B 379	1.10	25C 460	.59	25C 839	.59	25C 1346	.70	25D 81	3.00	25D 63	3.60	UPC 1026C	3.70	UPC 1026C	3.70
25A 666	25B 381	.59	25C 461	.59	25C 867	4.25	25C 1347	.70	25D 88	2.50	25D 64	1.40	UPC 1032	2.25	UPC 1032	2.25
25A 672	SUB 25B 415		25C 478	1.10	25C 870	.59	25C 1358	5.90	25D 91	1.60	25D 65	1.30	UPC 1156	4.25	UPC 1156H	4.25
25A 673	25B 400	.59	25C 481	1.60	25C 871	.59	25C 1359	.59	25D 92	1.90	25D 66	1.40	UPC 1152H	3.40	UPC 1152H	3.40
25A 678	25B 405	.59	25C 482	1.50	25C 897	3.40	25C 1360	1.00	25D 93	2.80	25D 67	1.30	UPC 1032	2.25	UPC 1032	2.25
25A 679	25B 407	1.40	25C 484		25C 898	4.40	25C 1362	.59	25D 99	1.60	25D 68	1.40	UPC 1156	4.25	UPC 1156H	4.25
SUB 25A 744	25B 411		SUB 25C 756		25C 900	.45	25C 1364	.70	25D 92	1.90	25D 69	1.40	UPC 1156	4.25	UPC 1156H	4.25
25A 680	DISC. BY MFR.		25C 485	1.60	25C 923	.45	25C 1377	4.90	25D 118	4.40	25D 70	1.30	UPC 1032	2.25	UPC 1032	2.25
SUB 25A 744	25B 415	.59	25C 486	1.60	25C 929	.45	25C 1383	.59	25D 130	1.70	25D 71	1.10	UPC 1156	4.25	UPC 1156H	4.25
25A 682	25B 434	1.20	25C 493	3.90	25C 930	.45	25C 1384	.59	25D 141	1.40	25D 7					

NEWSLINE

CB COMES TO THE RESCUE DURING 1978 BLIZZARD. The useful side of CB radio surfaced during the blizzards and bitter cold that paralyzed much of the country in the first sixty days of 1978. John Sodolski, vice president, Electronic Industries Association, reports that "for many of those stranded in the recent blizzards, CB radio was the only communications device available for emergency rescue." Numerous state police headquarters and emergency officials reported that without the volunteer help of CB'ers rescue work would have taken much longer and many lives might have been lost. Many of the rescue operations were coordinated by CB radio and in the Boston area emergency deliveries of fuel oil were directed via CB.

RCA TO BUILD SPACE SHUTTLE TV CAMERA SYSTEM. A contract of almost \$10.5 million has been awarded by NASA to RCA for construction of a high-quality TV camera system to transmit 'live' color and black-and-white pictures during the manned orbital Space Shuttle flights. The TV system will assist the Shuttle crew in performing complex tasks of deploying, retrieving and servicing spacecraft in orbit. The earth orbital missions are to start in 1979 with subsequent flights scheduled for the 1980s. The RCA contract calls for up to 50 cameras for approximately 500 Shuttle flights. The systems will consist of several cameras, a video control unit, pan and tilt mechanisms, and various monitors. The cameras will employ a 525-line standard compatible with broadcast television.

IESA NAMES NEW EXECUTIVE DIRECTOR. The Indiana Electronic Service Association has selected Leon F. Howland, CET, as executive director to replace Tom Bertrand, CET, who resigned recently to pursue other interests. Howland served as director of IESA in the past and served as chairman of the Indiana TV-radio licensing board. He has been president of IESA and a national officer in NEA.

MATSUSHITA NET INCOME AND SALES BIGGEST EVER. Matsushita Electric, parent company of Quasar and Panasonic, reported that consolidated net income for fiscal year of 1977 set an all-time company high of \$321.1-million, up 19 per cent from 1976. Sales for 1977 also set a company record of \$4.79-billion, 11 per cent higher than 1976. The company also stated that earnings and sales totals for the fourth quarter, ending Nov. 20, 1977, also set records.

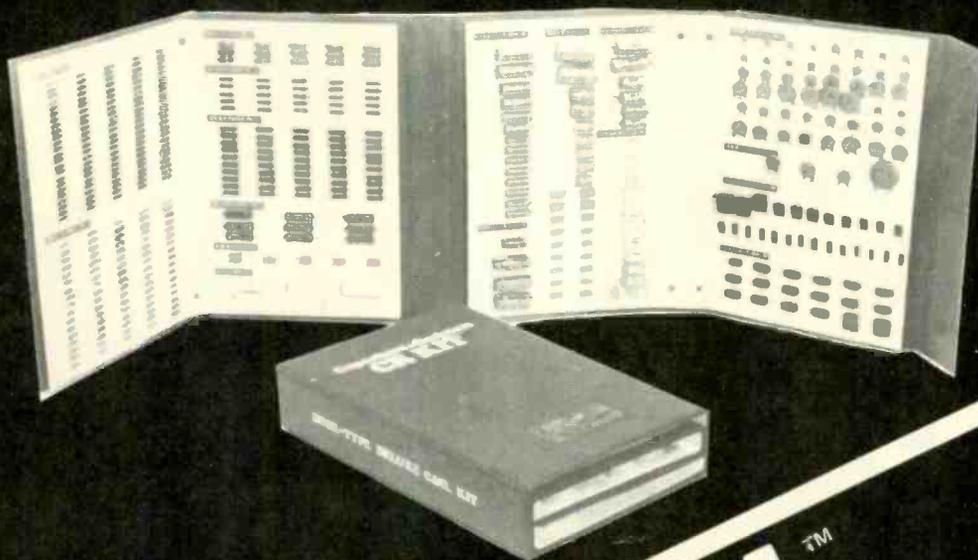
RCA INCREASES CASH DIVIDEND ON COMMON STOCK. For the second time in two consecutive years, after a nine-year period of unchanged dividends, RCA's Board of Directors voted to increase the regular quarterly cash dividend on common stock from 30 cents to 35 cents a share. In 1977, RCA's earnings rose 39 percent over the previous year to \$247 million on a 10 percent gain in sales to \$5.9 billion.

B&W TV SALES TO DEALERS DROPPING. EIA's reports on TV sales to dealers for the first two months of 1978 show color TV topping past records -- but black and white television sales falling behind in 7 of the 8 weeks. Color TV sales were up 11.4 percent through the end of February while B&W showed a 3.4 percent decrease.

NAB SAYS CABLE SHOULD CONTINUE LOCAL TV SIGNALS. The National Association of Broadcasters has urged the FCC to continue to require cable TV systems to carry all local broadcast signals. To do otherwise, NAB says, would undermine concept of local service demanded by the public and envisioned by the Congress and the FCC.

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FROM THE EDITOR'S DESK



There's no doubt about it. The consumer electronics service industry is going portable. LSI technology being what it is, it's possible now to cram into your shirt pockets the VOMs, counters and myriad of small color generators on the market that just a couple of years back were two to three times their present size. And, you're getting all this with accuracy that in many cases exceeds previous standards.

However, portability in today's modern units is not the really newsworthy aspect—nor the only benefit—of the revolution in electronics technology that's now taking place. Portability was, after all, inevitable with smallness.

What you are beginning to see come into the consumer electronics test equipment market in ever growing numbers are the "combos"—those multifunction pieces with two or more individual test instruments, one designed to complement the other, built into a complete "service" package.

Examples of such innovative state-of-the-art advances in test gear design are Sencore's brand new VA48 Video Analyzer, an astounding piece of equipment that puts out over two dozen separate signals; American Technology Corporation's General Television Servicer, another multi-purpose signal-color generator that provides over 15 test signals; and Leader Instruments' "seven-in-one" Audio System Analyzer, which includes a 3-inch, 5MHz oscilloscope.

Now Leader has announced it will be on the market sometime this summer with a "combo" unit that undoubtedly will be a tremendous aid in signal analyzing—a combination 25MHz, dual trace scope and 80MHz frequency counter (alas, no more eyeballing gratitudes into thirds, quarters or tenths).

These are the types of units, the multi-function equipment, that will increasingly be showing up on your servicebench in ever greater numbers as time goes by. This multi-function approach to packaging, so far as the technician is concerned, is the real benefit of LSI technology.

Multi-purpose units too, are the most cost effective from the standpoint that if you tried to match the individual units pricewise with the comparable multi functional unit, you wouldn't even come close.

It's certainly no secret that as the electronic circuitry in new consumer products becomes more sophisticated, you need more sophisticated equipment to service it. Dual trace scopes with faster rise times, counters with greater sensitivity, VOMs and DVMs with RMS readouts on complex waveforms.

In a phrase, as the technology increases in complexity and miniaturization, the accuracy and reliability of the equipment needed to service it will also increase. So will price.

That's why it is becoming ever so important from the standpoint of the service profession, that manufacturers continue to search for new and innovative ways to apply the state-of-the-art technology with which they have to work in order to provide the professional technician with greater versatility in the field or on the bench, and to continue to expand the innovative packaging philosophy to produce more cost-effective test equipment.

The advent of the "combo" test equipment units we see emerging today are really a step in the right direction—both from a servicing standpoint and cost.

Sincerely,

Richard H. Lay

LETTERS

IS IT REALLY 'WHOLESALE'?

Speaking as a one-man operation, new at the game, I'd appreciate reading something about how and where one buys "wholesale."

What constitutes 'wholesale'? Is it necessary to buy in volume to get wholesale prices? Who are the wholesalers?

I've bought parts from so-called wholesale shops at prices identical with those of retail shops. More than once I've held off buying replacement parts till I could get to the wholesaler during business hours—only to find I could have run over to Radio Shack, e.g., or other 'retail' stores open until 9 p.m., bought the parts for the same price, and finished a repair a day or two sooner.

It seems as though there should be somewhere, some kind of guideline for the independent repair shop as to: 1) Advantages, or disadvantages, of buying from local distributors vs. mail orders; 2) Reasonable percentage of price spread between wholesale and retail; 3) How to recognize a bona-fide

wholesaler from one who just advertises wholesale but charges retail, before dealing.

I suppose one would eventually learn the ins and outs of wholesale buying from experience, but, at 53 years of age, my wallet needs a faster route.

Richard W. Dambrun
Hazel Park, Michigan

EDITOR: You ask some very interesting questions that countless other independents have probably wanted to ask. Maybe some of ET/D's readers will have some of the answers.

NO ANSWER FROM SINGER

I have sent letters to the Singer Company with no luck. So maybe your readers can help me.

I am trying to find a PC board No. N919-B and the schematic for a Singer 19-inch portable black and white TV.

W.J. Rice
8821 29th Avenue N.W.
Seattle, Washington 98117

HELP HAS ARRIVED

Per a letter which appeared in your February, 1978, issue, I would like to answer a request from an A.C. Cook of Milford, Ohio, who was looking for in-

formation on a radio called Hanimex.

I have found such a listing in the alphabetical listing of names and addresses in the 1977 edition of Photofact Annual Index, as follows: Hanimex: International Merchandising Associates, Inc., 9950 West Lawrence Ave., Schiller Park, Illinois 60176.

I hope this will help.
W.F. Verona
Brooklyn, N.Y.

EDITOR: Thank you for your assistance. Also, a Bill Clark of Indianapolis phoned in information that placed Hanimex with a Mr. Bernie Wollter, International Merchandising Association, Inc., 1801 West Tuohy, Elk Grove Village, Illinois 60007. However, Mr. Clark said that his address was accurate as of the end of 1976.

WHERE IS HUNTRON?

I am looking for the complete address of Huntron Instruments, Inc., the manufacturer of the solid state tester called the Tracker. Could you or your readers help?

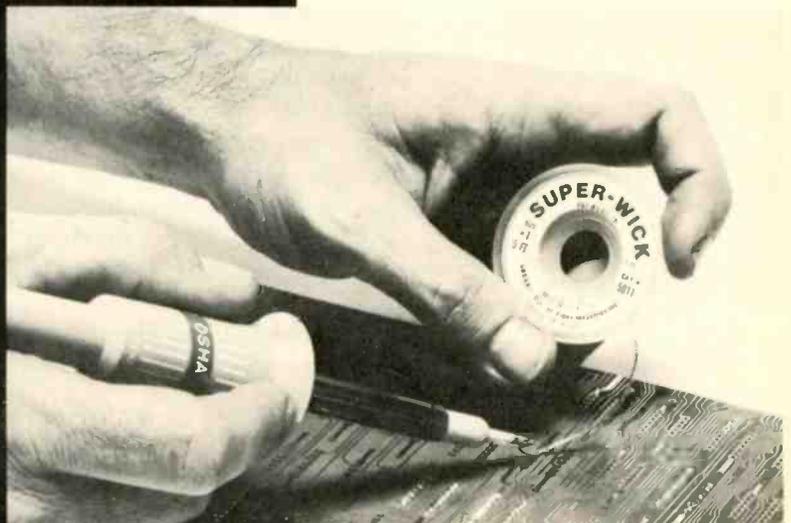
Paul Copito
Erie, Pa.,

EDITOR: We'll help. Huntron Sales, Inc., is located at 15123 Pacific Highway North, Lynwood, WA 98036.

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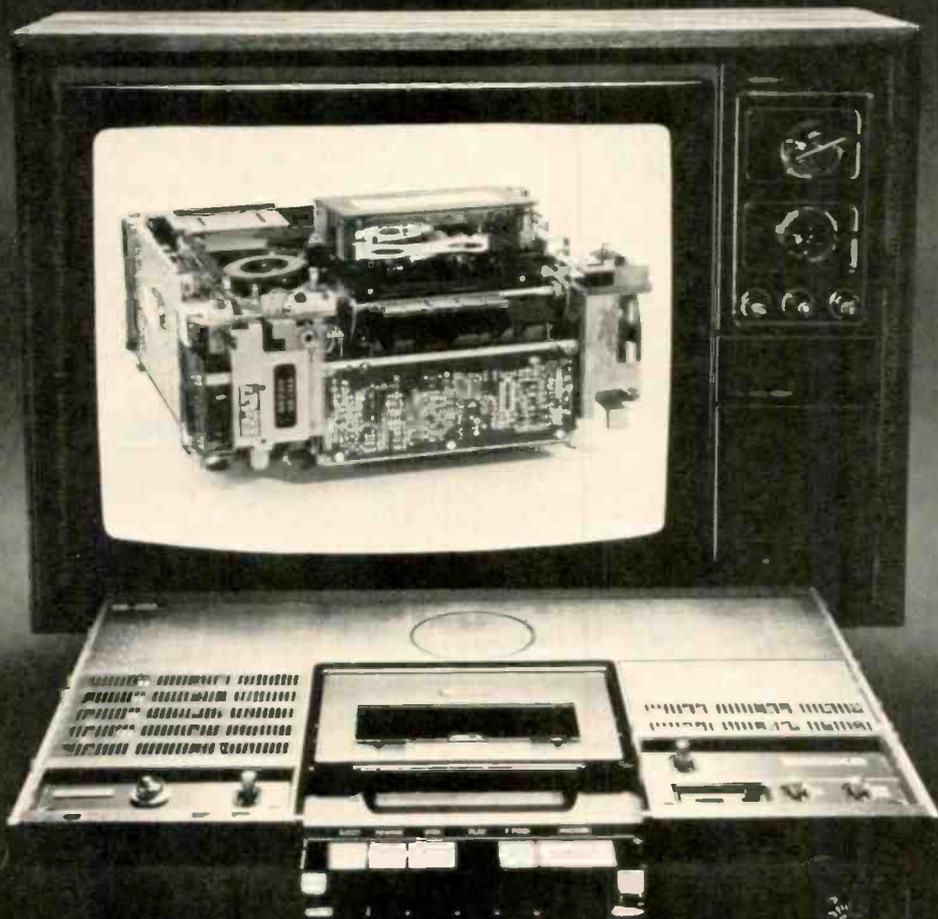
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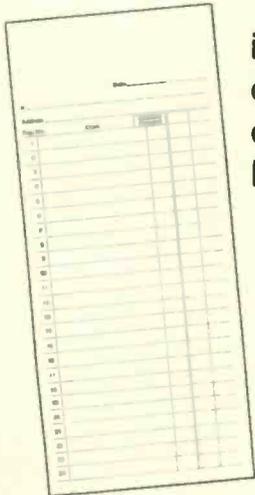
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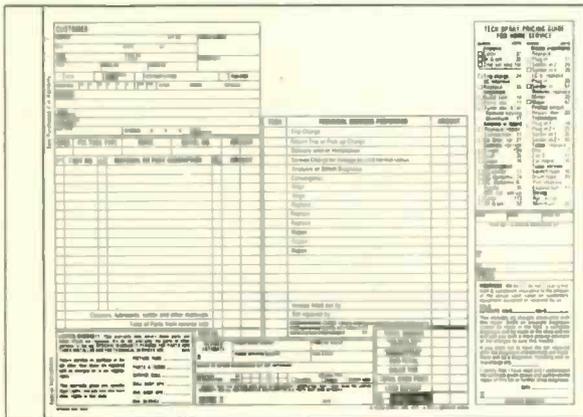
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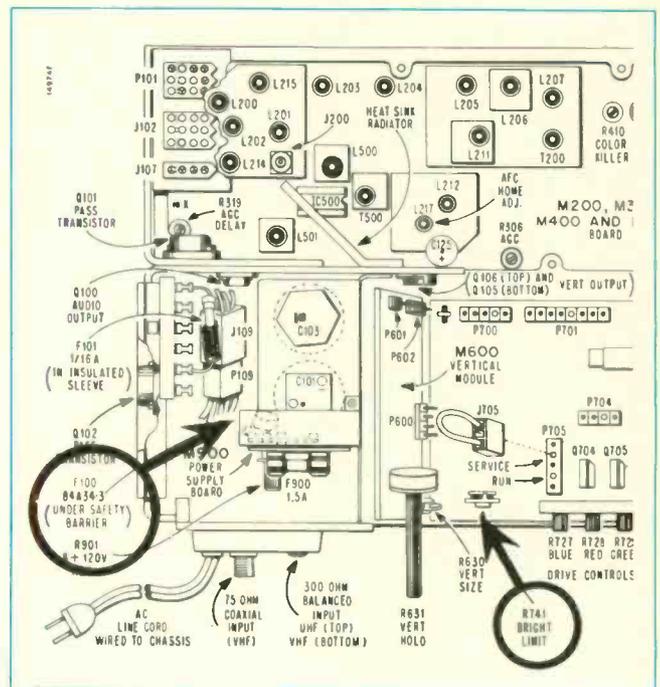
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SERVICE SEMINAR

ADMIRAL

Color TV Chassis 4M10—After set has been on a while, fuse F100 opens for no apparent reason.

To solve problem, monitor input current with a current meter. After about 20 minutes of operation, set the Brightness & Contrast control to maximum and adjust the Brightness Limiter (R741) for a reading of from 1.6 to 1.8 amps. The reduction in current will reduce the brightness. Care must be taken not to reduce the brightness to the point where viewing is objectionable. Current should never be set above 2 amps. If correct setting cannot be obtained, replace Q711 (Brightness Limiter Transistor, 57A192-12) and readjust R741. Also be sure to use correct fuse replacement (84A34-3).



GENERAL ELECTRIC

Color TV Chassis JA—Relocation of 22 volt Zener diode, Y404.

Diode Y404 was mounted on the power supply board in early production receivers. To reduce brightness changes during warm up, it was relocated adjacent to R402. R402 is on a terminal strip at the front, top, or back of the HVT can. Its location varies from model to model. In receivers with this change, Y404 should touch R402 to stabilize the characteristics of Y404. This will stabilize the 22 Volt line and reduce a tendency for brightness to drift.

MAGNAVOX

Videomatic Touch Tune—Low receiver sensitivity.

Unit should operate at up to 30 feet. If not, front panel mike may be shorted to panel: Must be insulated or ground loop occurs. To correct, check mike for proper insulation, square fit and see that the seal is installed between the rubber boot on the mike and the mike cup on the panel.

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The microprocessor and you

A new servicing opportunity

Something you'll see more and more of as LSI makes "home" computers a reality

By Joseph J. Carr, C.E.T.

The microprocessor (uP) is a digital computer in the form of a Large Scale Integrated (LSI) circuit. Most of the currently popular uP chips require at least a few additional support chips to make an actual programmable digital computer, but some of the new additions on the market have all of the required circuitry internally.

But how does the uP revolution in electronics affect you, especially if you intend to remain in the consumer electronics business for the foreseeable future? The answer lies in the very nature of the programmable digital computer: it is very close to a *universal machine*. Clever programming and appropriate external *interface* circuitry allow the uP to do *almost* any conceivable job!

The usual view of a "computer" is that it is a huge megalith that fouls up your warranty checks or gas bill. In actuality a computer could be a 4x5 inch pc board that controls your microwave oven or a desk top device used for inventory control, payroll or other bookkeeping chores in a small business.

It will also affect you because you are an electronic servicer. Major manufacturers of minicomputers and larger mainframes (i.e. "dinosaurs") have difficulty obtaining service technicians; one major firm took five days to run a service call on a machine where this author is employed! With the advent of microcomputers based on the uP chips, a market of many thousands of businesses and possibly hundreds of thousands of homes is opened up.

Realizing that service is always a problem in the computer business, ET/D editor Rich Lay asked a microcomputer manufacturer who they planned to use for servicing their products (a small business/home/hobby line). The reply: "TV servicer shops, appropriately retrained." That's how at least one manufacturer plans to have the uP revolution affect you. Note that uP service may be a sideline to a TV service operation, or a full time endeavor depending upon the local situation.

What is a microprocessor?

A *microprocessor* is an LSI integrated circuit, usually in a 40 pin DIP package, that contains *most* or all of the circuitry required to make a *programmable* digital computer. Many people use the terms microprocessor and microcomputer as synonyms, but they are not. A microcomputer is a digital computer made using microprocessor chips. The uP is just a chip, while the uC is a complete computer with all necessary support chips added.

Neither the uC nor uP is a *calculator* in any sense of the word! A very common mistake is to believe that the uP and the calculator chip are the same beast, they are not! To be sure, they are kissing cousins, but a very significant difference exists. A calculator is a *special purpose* device (even the programmable ones!), while a computer is a *general purpose* device. The calculator receives its very limited instructions from keyboard contact closures that have specific significance, while the computer's instructions are programmed into memory. The principle difference is that the uC program can be changed almost at will, while those of the calculator are fixed.

What can it do?

This question is almost absurd because

it is too broad to answer intelligently! Any job that can be performed by a *sequence* of small steps can probably be done by a cleverly programmed computer. The range of jobs performed *now* by uP/uC machines runs from simple signal light controls to complex numbers crunching in business and scientific applications. Some jobs look like the popular image of computers, while others in no way resemble (on the outside) a computer.

For example, remember all of those video games that were sold last Christmas? Many of them were new models that had replaced the original models that had depended on discreet digital logic circuits. The new models were based on the uP chip, and as such gained simplicity and flexibility. In almost any case where a uP or uC has replaced "old logic" the gain in circuit simplicity is realized by replacing circuit functions with program or "software" functions that do the same job. In the old models, changing the game any significant amount required a major redesign of the logic circuits; tedious and costly. But the new games used a plug-in *read only memory* (ROM) cartridge that contained different game programs. The customer could easily change games by changing the programming with a new and different cartridge.

Besides fun and games, the uP/uC can perform *control* functions. In automotive applications there are already on the market a fuel injection system (European), automatic braking control, and automatic fuel lean/rich burn controller. At least one major sewing machine company stores stitch instructions in a ROM, and implements them by controlling the machine with a uP!

An application that is sure to grow is home and office environmental controls by computer. This is not a new wrinkle,

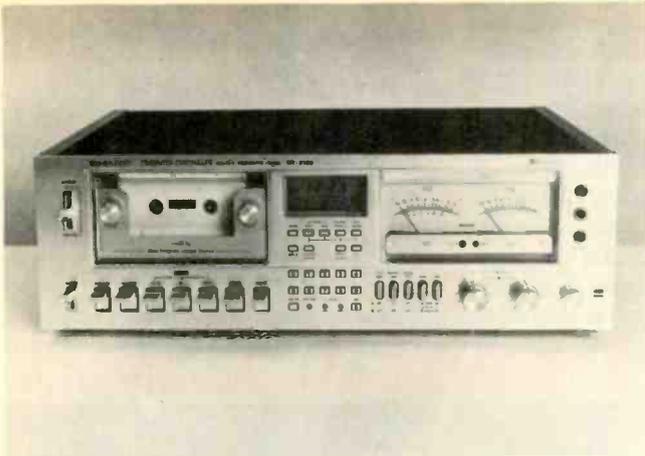


Fig. 1—Computer controlled stereo cassette deck (courtesy of Sharp Electronics).

as several companies including Honeywell already have such systems. But the low cost of the uC makes the technique cost less, sufficiently less to be within the range of the homeowner.

Entertainment applications

Perhaps closer to home for most ET/D readers are certain consumer products in the entertainment electronics area that have built-in microprocessors. One major FM stereo tuner uses a uP to control the phase locked loop FM local oscillator. The uP examines and controls the N-code in the programmable divide-by-N counter that reduces the FM LO to the same frequency as the crystal reference oscillator.

Another consumer application (see Fig. 1) is a high quality (but moderately priced) stereo cassette deck that relies on uP control.

Higher in cost and complexity are machines that most people would think of as a "real" computer. The microcomputer market consists of business-oriented machines and less costly machines for home and hobbyist use. In fact, hobbyists (myself included) have been the largest part of the so-called uC "mainframe" market for several years. But now, business computer companies are beginning to recognize the potential of these devices, so more small business machines are on the market in 1978 than were available in 1977.

There are three general types of microcomputer: process controllers (PC), single board computers (SBC), and mainframe systems. The PC and SBC are very similar to each other, and both are built on a single, and often very small, printed circuit board.

An example of an SBC is shown in Fig. 2. It contains everything needed to enter and run programs, except the power

supplies. External devices can be interfaced with the SBC through the card edge connectors along the rim of the board. Some SBCs have the ability to interface with a standard 20 ma loop Teletype machine, or to store and load programs onto *audio* cassettes. Most SBCs have an on-board LED readout and touch-pad keyboard. Recent models of several SBCs have been made available in plastic or simulated wood cases, but most are sold "bare."

A process controller is very much like an SBC except that it does not usually contain the on-board keypad and LED readout. The PC is used by equipment manufacturers as a subassembly inside of other products such as scientific instruments, medical instruments, machinery, control systems, etc. The National Semiconductor SC/MP board is actually a cross-breed between the SBC and PC classes.

Memory limitations

The typical SBC and PC has limited memory (usually 1 or 2k 8-bit words), so can only support limited applications. Additionally, the low memory capacity forces us to communicate with the uC in *machine language*, which consists of numerical instruction codes that tell the uC/uP what to do. Machine language instructions are tedious to enter, even for relatively simple programs, so we find SBCs mostly in training and hobbyist settings.

Serious hobbyists and all business users require higher level features than can be provided on an SBC. For example, they may require alphanumeric keyboard data and programming entry, TV or CRT readout, teletypewriter or printer to provide hard copy, tape or floppy disc bulk data storage, and the ability to operate any of a wide variety of peripheral devices. These users also require ease of

operation, and will not tolerate setting individual instructions by flipping front panel bit switches.

Figure 3 shows a complete business computer system based on a microprocessor chip. This system, manufactured by The Digital Group, Inc. of Denver, sells for less than \$5000, while less complex versions can be purchased for as little as \$1,000, *not* in kit form!

The actual computer in this system is the central processing unit (CPU) cabinet in the center of the photo. It contains a power supply plus all of the essential computer electronic circuits. A view of the circuits is shown in Fig. 4. They are on individual printed circuit boards that are, in turn, plugged into a "mother board" that contains the printed circuit interconnection bus. Figure 4 contains three memory cards, a CPU card, TV(video)/cassette(audio) interface card, and several 4-port I/O cards. The entire assembly of Fig. 4 fits inside of the CPU cabinet of Fig. 3.

Basic mainframes

The most basic mainframe system consists of only the CPU cabinet, a video monitor, and an ASCII-encoded keyboard for programming and data entry.

This level of system will support *high level languages* that allow the programmer to communicate directly with the computer in a language that is a subset of English. In machine language, several steps are required to add together a pair of numbers, but in a high level language such as the BASIC that is used in most uCs, the job reduces to writing "C = A+B", or something similar.

The internal CPU memory can support up to 65,536 (i.e. 2^{16}) 8-bit digital words, although in most cases this number is not required. Most uCs have

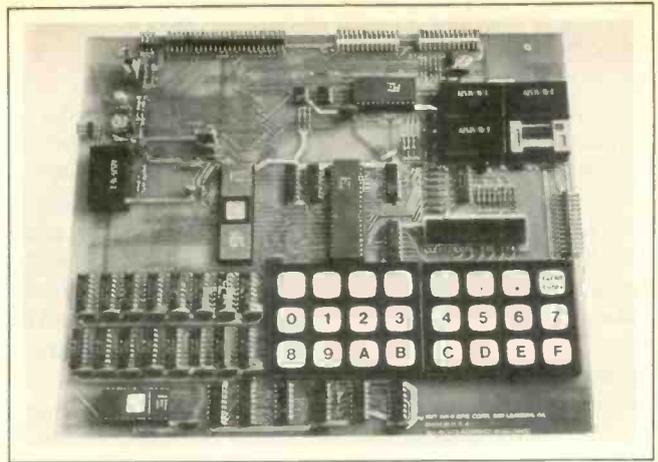


Fig. 2—Example of a self-contained single board computer (courtesy of Imsai Mfg. Corp., San Leandro, Ca.).

only 10k to 32k 8-bit words of memory. The CPU shown in figures 3 and 4 can support up to 26 k words without additional motherboard space.

Most hobbyists use ordinary *audio cassettes* for long term storage of programming and data. The digital words are converted to audio tones (i.e. like AFSK teletype), and these are recorded in what has been described as "almost any 'over \$80' audio cassette recorder."

Although low in cost, audio cassette players cannot store a large amount of data, and are too slow in relocating data. In fact, many hobbyist machines allow only program storage on audio cassettes, but must have a digital cassette machine for data storage.

A self-contained desk model uC is shown in Fig. 5. This Imsai VDP-80/1000 is a small business system containing a CRT monitor, keyboard, floppy disc, and all necessary computer electronics in a single cabinet that is small enough to sit on a desktop. Such systems are low enough in cost to be useful to small businesses that could not even hope for computerization in years past.

How does a computer work?

The very first thing which I am going to do in this section is to cop-out. The subject would take several articles at least. But we will give a brief generic description, and point you to some standard textbooks. Two that I have bought, and recommend, are *Microprocessor/Microprogramming Handbook* by Brice Ward (TAB Books 785), and *The 8080a Bugbook* by Rony, Larsen and Titus (Sams 21447). I most heartily recommend that these and other uP/uC books be read.

A simplified programmable digital computer is shown in Fig. 6. The arithmetic logic unit (ALU) performs the arithmetic and logic functions (!?), while the *control section* controls the operation of the CPU and generates *status flags* that indicate what is happening. There are also several registers.

The *accumulator* is the main register. All data entering or leaving the CPU via the 8-bit data bus (pathway) pass through the accumulator. There are also several general purpose registers that will temporarily hold data.

The program counter

The *Instruction register* will contain the last instruction fetched from memory, while the *Instruction Decode* examines the register contents, and determines

what the computer is supposed to do.

The *program counter* is a special register. It will initially be loaded with the *address* of the first instruction in the program. In most computers the *reset* button will enter a predetermined starting address (usually 00000000 in uPs) into the program counter. When the computer is told to *run*, the computer goes to the memory location specified by the program counter and fetches the first instruction.

Memory locations

The power of the programmable computer is that *all* instructions and data can be stored in the same *memory*. The memory of a computer is like the pigeon holes used by the mail carrier at your local post office. The letters represent *data*, while each pigeon hole represents one household with a unique street *address*. The sorter will store the *data* in the location specified by the address.



Fig. 3—Complete computer system based on a microprocessor CPU (courtesy of The Digital Group, Inc., Denver, Co.).

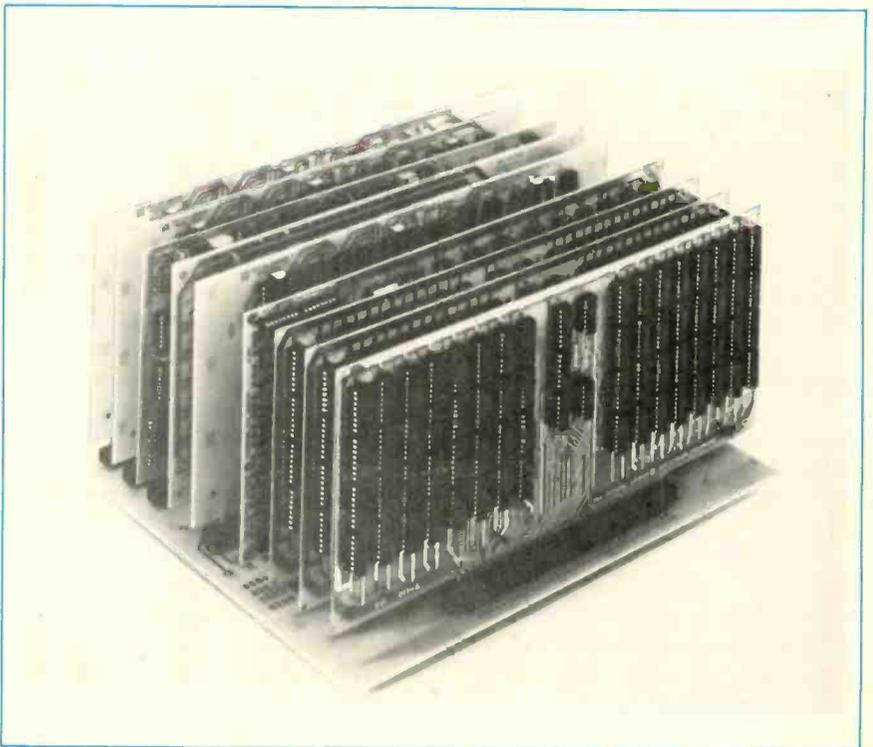


Fig. 4—Most computers use a mother board interconnection bus with plug-in cards (courtesy, The Digital Group, Inc.).

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In a computer, the pigeon holes are actually arrays of ordinary flip-flops. The condition of the FF (i.e. "1" or "0") is set according to the data to be stored. A single FF represents a 1-bit memory. To make an eight-bit memory location requires eight FFs that are all turned on when the location they represent is turned on, or "enabled."

Besides the bulk magnetic memory mentioned earlier, we have two other kinds of memory, ROM and RAM. Both

are available in the form of integrated circuits.

ROM means *read only memory*. These devices are special ICs that can be programmed with a permanent bit pattern at each location. The computer cannot write data into ROM, it can only *read* the data stored.

Read-write memories

RAM is a form of read/write memory, or *random access memory*. These ICs

contain arrays of FFs that can be programmed at will. The computer can write new data into RAM, or read data from RAM.

Computers operate from coded numerical commands called *instructions* that tell the control section what must be done. Each different computer has its own unique list of instructions, and the "power" of a computer is often expressed as the number of different instructions it will recognize.

The computer must be able to distinguish whether an 8-bit word entering the accumulator via the data bus is an *instruction* or *data*. There is no function reason why the same bit pattern cannot represent both! To overcome this problem of recognition, the computer operates in cycles, and at least *two* are required: *instruction fetch* and *execution*. During the *fetch* cycle the computer will go to the memory location specified by the digital word loaded into the program counter and enter the word found there into the accumulator, which then transfers it to the instruction register. This instruction is decoded and carried out during the execution cycle. Following execution, the program counter increments by one, or a new word that was determined in the execution, is entered into the PC. The new word in the register specifies the location in memory of the *next* instruction, and so on. **ETD**



Fig. 5—Complete, self-contained, desk-top computer system intended for small business applications (courtesy Imsai Mfg. Corp.).

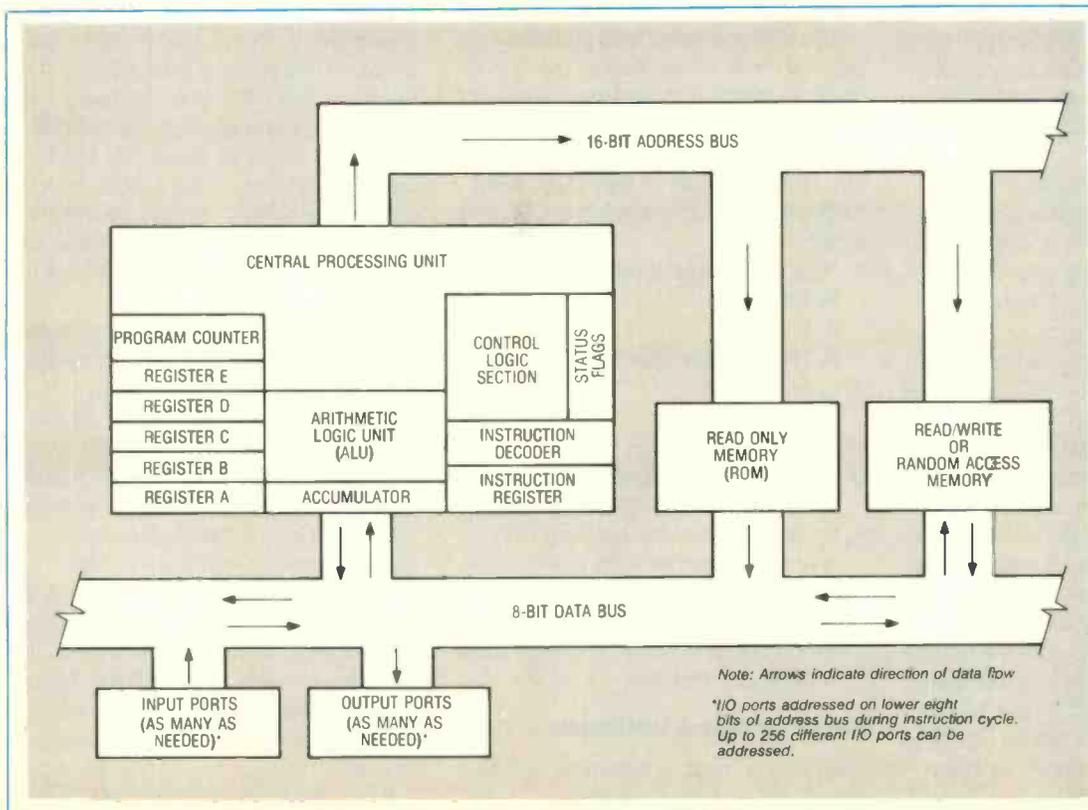


Fig. 6—Block diagram of a typical programmable digital computer.

Sony and the G.C.S.

A member of the SCR family

Proper care and feeding of these sensitive devices will save time and money

By John S. Hanson, C.E.T.

Sony's innovative, original Trinitron, introduced in 1968, utilized Bi-Polar transistors in a rather unusual configuration. The task of horizontal sweep and high voltage generation was divided, affording the most efficient operation of solid state devices available at that time. The advantage gained was principally in the horizontal converter where the high peak inverse voltage remained the prime cause of device failure. With separate devices, the converter could pulse the flyback with a lower amplitude pulse with a longer duty cycle.

There was no problem with deflection as a separate output transformer assured the correct timing for horizontal yoke operation. This circuit served Sony well, through all of its 90° deflection product and the reliability was phenomenal.

In 1973 Sony developed an 114' deflection Trinitron heralding a whole family of slim profile TV's. With the advantages of a wide angle Trinitron, came the requirement of more yoke power.

SCR's seemed to provide the answer. Witness: RCA's first XL-100, the EP-506 with an 110' deflection CRT. The power was there, but the circuit seemed overly complex with redundant components for both the retrace and trace functions.

The difficulty with SCR's is that they can only be turned on by gate current and they must have a decayed anode current in order to turn off. This in itself dictated separate devices for the retrace and trace functions. Precise switching and conduction time of 4 devices, (2) SCR's and (2) damper diodes, required a rather complicated circuit. Bi-Polar transistors do not perform well under

wide-deflection angle applications as their inherent resistance as a switch requires large and expensive devices requiring extensive heat sinking.

The gate controlled switch

Sony found their device in the G.C.S. The remainder of this text will address the theory of operation and the care and feeding of the device as it affects the service industry. The G.C.S. is of the S.C.R. family constructed as a four layer device. It is best understood as a PNP sitting on top of an NPN (See Fig. 1).

This configuration permits the gate to toggle the anode current both on and off; all the advantages of a Bi-Polar device, except one. Lose drive in a Bi-Polar and the device cuts off. Lose drive in a G.C.S. and the device will gate on as long as anode current is available. An interesting analogy is our old friend the vacuum tube. Did it not take plate current when horizontal drive failed to produce bias?

The same precautions you know so well can now be applied to the G.C.S. Respect for drive and load requirements are mandatory to servicing G.C.S. sweep. An important rule of thumb is that G.C.S.'s rarely fail of their own doing. Largest contributors are in the following order:

1. High voltage arcs (Momentary load increase).
 - A. C.R.T.
 - B. High voltage block.
2. Loss of drive.
 - A. Oscillator
 - B. Driver
3. Open ringing components or ripple current preventing proper gating.
4. Solder connections causing high resistance connections at sensitive, high R.F. current paths.
5. Internal breakdown of capacitors used in D.C. Isolation and high peak voltage applications.

Scan derived voltages

With this in mind, a defective G.C.S. should be replaced, carefully

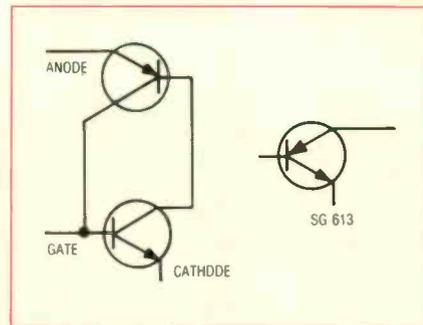


Fig. 1—Schematic representations of the Gate Controlled Switch.

investigating those areas that in all likelihood were responsible for the original failure. One area of concern to the technician is the fact that Sony likes to develop its oscillator B+ from the horizontal output transformer. The consequence of all this takes us back to the old chicken and egg story.

The obvious answer is a start circuit; and, incidentally, a good place to start our dissertation. Sony does not use power transformers, preferring to use a full wave bridge across the AC line. The resultant 155 volts of B+ passes through a series regulator to provide a stiff 135v supply of some 700 MA's. Double line fuses, rated at both 4 and 5 amps. respectfully, isolate the circuit from the power line. A G.C.S. short will usually take the 4 amp. fuse and, often, the series regulator.

The start circuit is a simple transistor switch that provides start-up current for the horizontal oscillator (known affectionately as a kick-start). As the horizontal oscillator commences to produce square waves every 63.5 μ s the horizontal output transformer and the flyback go about their business of developing yoke current and high voltage. One of the scan B+ voltages comes back from the output transformer as +18 volts which reverse biases the start circuit, cutting it off until the 18 volt line drops below about 9 volts; when it once again will conduct, as in the case of turn-off.

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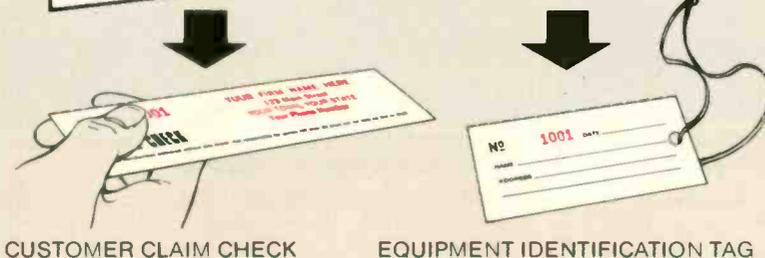
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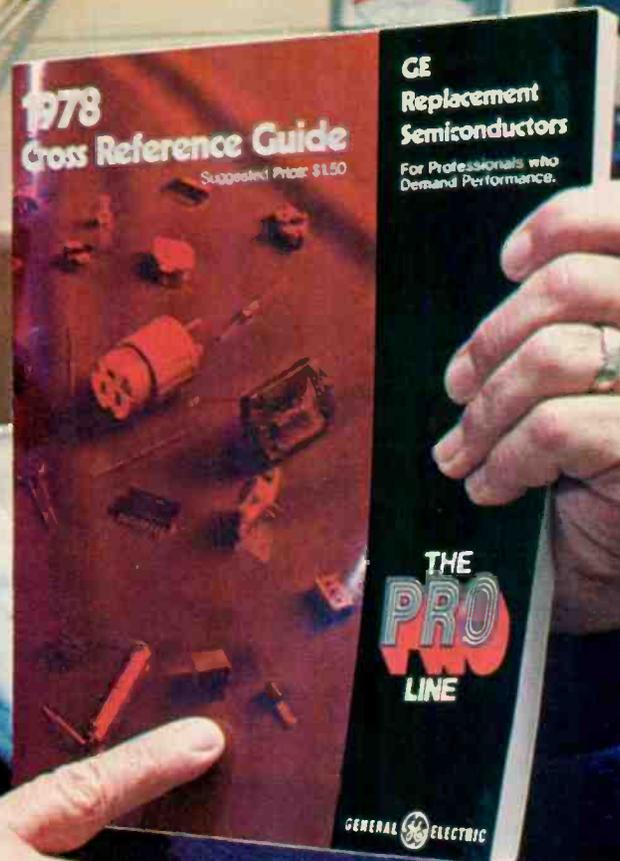
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GENERAL  ELECTRIC

The non-linear look

As used in industrial electronics

There are two sides to every coin. Now learn the good things about non-linearity

By Bernard B. Daien

Most technicians have been conditioned to "think linear." (By "linear" we mean circuits other than digital, or non-linear). For example, ... we seek ultra linearity in high fidelity audio amplifiers.

Non-linearity has become associated with distortion, or other undesirable effects ... something to be avoided. This is not true. Sometimes we need non-linear circuits, as in signal processing, or even to improve overall linearity.

You know that automatic gain control is built into every TV set, in order to prevent signal overload with resulting sync clipping, sound buzz, and other side effects. But, if you think about it, AGC-controlled signals are non-linear, because the signal is held constant at the video detector, even though it may be increasing at the antenna terminals. As a matter of fact, most simple AGC circuits are logarithmic, and if plotted on logarithmic graph paper, will look linear!

Let's look at some other common non-linear circuits that you are familiar with, and which produce desirable results. Sync clippers are non linear ... so are audio speech compressors used to increase transmitter intelligibility—and then there are

compressor-expanders used in audio recording and playback to put a wider range of volume levels on a record. How about the I.F. limiters used in F.M. high quality receivers? So you see, you have been using non-linear circuits, without always being aware of them. In industrial electronics we make wider use of such circuits, and we are very much aware of

them. That's what this article is about.

Non-linear devices

In order to build a non-linear circuit we need a non-linear device. A diode is a good example of such a device. If we apply several different voltages across a diode, and measure the resulting current, then plot the results on a graph we get the typical curve of Figure 1. Inspection of the curve reveals the fact that doubling the applied voltage does *not* double the current, as it would in a resistive circuit. (Conversely, if we apply the current shown on the graph, we will get the voltage drops indicated.) Either way, the diode is certainly not linear, which is precisely why it makes a good mixer in tuners.

If it were linear, with two frequencies at the input, (signal and local oscillator), there would only be the same two frequencies at the output of the mixer ... but in fact we know that we get *four* output frequencies, (signal, local oscillator, signal plus local oscillator, and signal minus local oscillator). In audio, this would be called "intermodulation distortion" which is the result of NON-LINEARITY in the amplifier.

As a matter of fact, the voltage scale on the graph is linear, but the current scale is logarithmic, with each division *ten times* the value of the preceding division. When plotted on this logarithmic scale, the diode curve is a straight line, indicating the diode current versus voltage curve is logarithmic.

Transistors as non-linear

Since the base-emitter junction of a transistor is a forward biased diode, we can also use a transistor as a non-linear element. This may puzzle you for a moment, since transistors can be quite linear as amplifiers ... but remember, a transistor amplifies *current*, that's why a

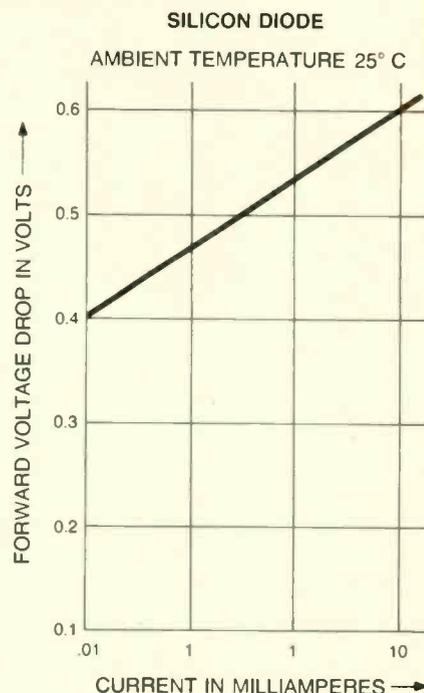


Fig. 1 - The graph of a silicon diode.

transistor's amplification is given in terms of "Beta" (the ratio of the base current to the collector current). If you attempt to drive a transistor with voltage you discover very quickly that nothing happens until you apply a little over a half a volt, and then the collector current zooms up suddenly, till a bit over 0.6 volts the transistor saturates and current is limited only by the load resistance. If you examine the curve of Figure 1 again, you will see why this happens (We are talking about a silicon bipolar transistor).

While we are looking at the graph, notice that each time we increase the applied voltage a small amount, the current increases an ever larger amount. Since Resistance = $\frac{\text{Voltage}}{\text{Current}}$ the resistance of the diode must be *decreasing* as the current through it increases. If you don't believe this, measure the resistance of a diode on an

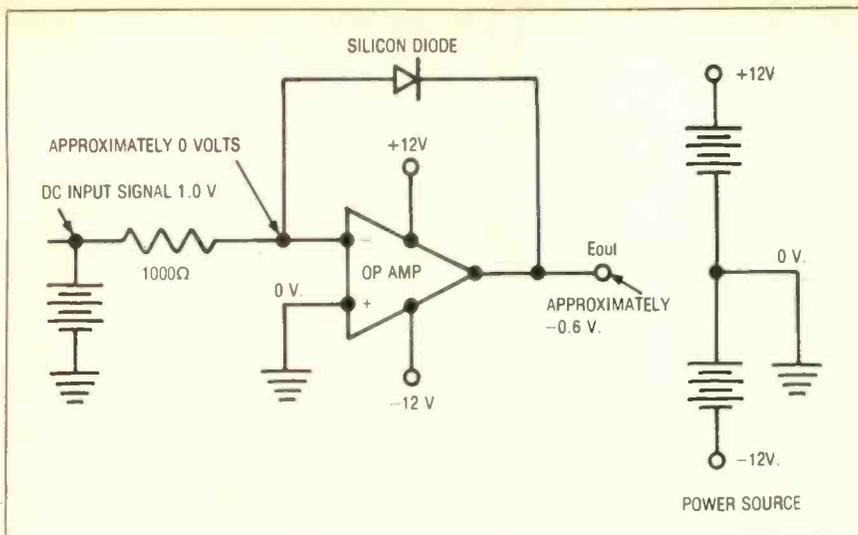


Fig. 2 – A silicon diode is used in the feedback path in this circuit of a logarithmic amplifier.

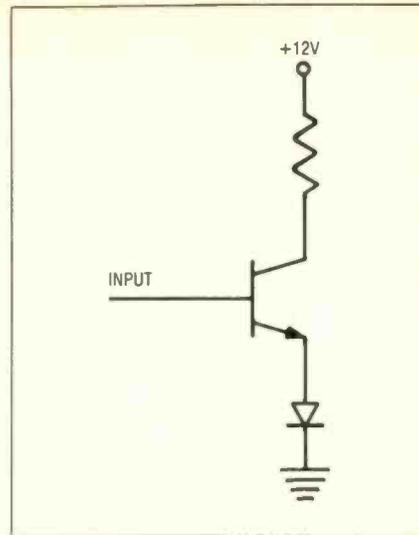


Fig. 4 – This signal expansion circuit behaves in a reverse manner from an AGC system. Diode resistance falls as input signal increases (emitter current increases).

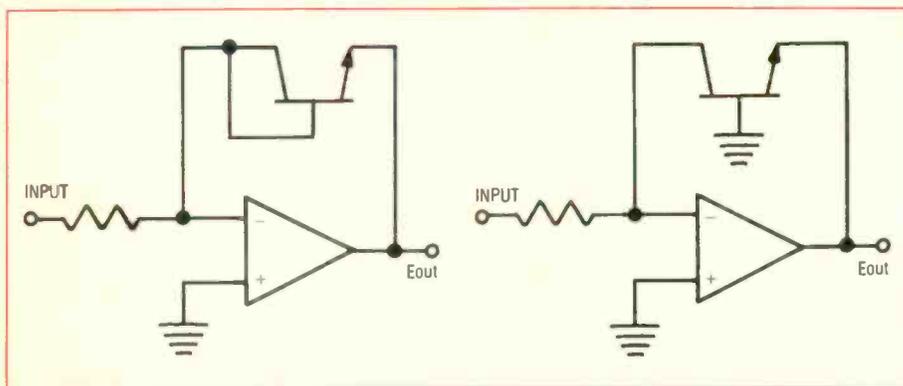


Fig. 3 – (A) Transistor connected as a diode. (B) Used as a transconductance device in the feedback path.

ordinary volt/ohmmeter (not a VTVM or DVM). On the low resistance range, where the current is high, you will get a low reading. Using the high ohms range, where the current is low, you will get a much higher resistance reading. This proves that the resistance of a diode is also non-linear. We can put these qualities to work for us in many ways.

Using op-amps

In actual practice we try to use the diode on the best part of its log curve. At higher currents the curve departs from the ideal shape because of the ohmic voltage drops across the internal connections, welds, solder joints, etc. By keeping the current range low, these side effects are minimized. Thus we usually use our friend from article 1 in this series (ETD, January, 1978), the op-amp, in conjunction with the log diode. The gain, and high input impedance of the op-amp enable us to use the log diode in its most effective range ... microamperes to milliamperes.

(Let's review some important characteristics of op-amps:

1. Op-amps have two inputs, the

inverting input (–) which is out of phase with the output...and the non-inverting input (+) which is in phase with the output.

2. With inverse feedback between the output and the inverting input, the voltage difference between the two input terminals is practically zero.

3. The gain of the amplifier with feedback is determined by the amount of feedback).

The amplitude of the signal fed back into the inverting input is very small, yet it determines the gain, and thus determines the amplitude of the output. For example: with ten volts peak to peak output, and a gain of 200, the voltage fed back would be only 50 millivolts $\left(\frac{10}{200}\right)$ peak to peak. Similarly, if we use an op-amp with current feedback, the current fed back could be quite small, depending on the circuit design. Since the feedback signal is so small, we can use non-linear devices in the feedback path, to control large signals, without subjecting the non-linear device itself to large signals.

A basic logarithmic amplifier using this principle is shown in Figure 2. A

silicon diode is used as the non-linear element in the feedback path between output and inverting input.

As shown, op-amps usually use a dual power supply: therefore, ground, which is at zero volts, is in the middle of the output swing, which can go either positive or negative. The non-inverting input is grounded, and the signal, along with the negative feedback, is applied to the inverting input. You remember from article one, that was used in this manner, the input impedance is close to zero.

Since the low input impedance would short circuit the signal source, we will use a series input resistance, R, as shown. If we apply a one volt positive input signal through R, we will measure virtually zero volts at the inverting input terminal. This is in accordance with our previously stated characteristics, since the input terminals will now both be at the same potential, (i.e., there will be close to zero voltage difference between the input terminals). The one volt signal is "voltage dropped" across the input resistor.

"clamping" the amplifier

Now let's determine what is happening by "inspection" of Figure 2, a procedure service technicians use in trouble shooting very frequently.

Since the input is at zero volts, and there is only a diode between the input and the output, then there must be a voltage equal to one diode's voltage drop between the output and the input. Due to the polarity of the diode, the output must be more negative than the input, by about 0.6 volts. Further, if the input signal changes, the output signal will tend to change in the

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opposite direction since we are using the inverting input. So far, so good, it checks, a positive input signal, a negative output signal ... but the negative output signal cannot change much because it is "clamped" to the input through the diode. If the output tends to change the voltage fed back into the inverting input through the diode will also change, tending to hold the output rate of rise down.

Now, *how much* will the output increase? Go back and look at the diode curve in Figure 1 again. As the output tries to change, it causes more current to flow through the diode, and the diode drop changes logarithmically. Since the anode is at zero volts, the cathode, which is tied to the output terminal, produces the same curve as shown in Figure 1. This small output voltage can now be amplified further by another op-amp connected as a linear amplifier, and can also be used to drive a power amplifier if required.

Thus we have demonstrated the generation of large logarithmic signals from linear inputs, by means of non-linear devices which, by themselves, cannot handle large signals. In actual practice, the diode used is generally selected for its accuracy of log curve, and there are diodes sold for this purpose which are good for a very wide range of inputs. Several types of small signal rectifiers commonly available are suitable for less critical applications however.

Transconductance

A better arrangement is the use of a bipolar transistor diode connected, or used as a transconductance device. Since you are familiar with tubes (and FETS) which have a *voltage input* but a *current output*, you will recall that tube manuals rate tubes for transconductance, ("trans" means "across," and conductance is the ratio of voltage and current). The base/emitter forms a "forward diode," hence the output current is logarithmic when the emitter is drive by a *voltage input*. (The base-emitter diode current is simply amplified by the beta of the bipolar transistor.) Thus if we drive a transistor with voltage in, and use the output current, we have to rate it for transconductance, and the transconductance is as logarithmic as a good diode.

Figure 3 shows both configurations ... diode connection, and "transconductance" transistor connection. They work very well. Often additional circuitry is employed to

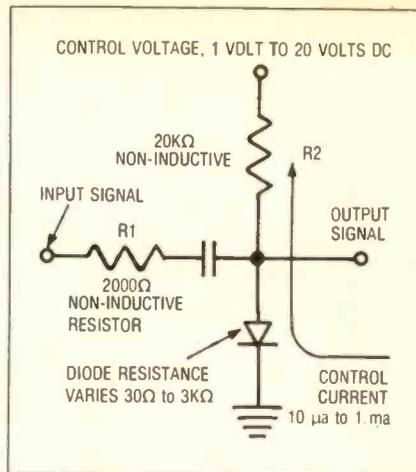


Fig. 5-RF signal attenuation may be achieved through an arrangement where the diode passes a varying DC current in conjunction with the RF signal.

increase the accuracy of the log curve by cancelling small errors due to temperature changes and ohmic resistance, but the basic principle is the same.

Signal expansion

The diode, or the diode connected bipolar transistor, can be used in other ways. As pointed out earlier, since the E/I relationship is non-linear, the resistance must also be non-linear. If we put a diode in series with the emitter of a common emitter amplifier, we can achieve signal expansion, (Fig. 4), the bigger the input signal, the higher the amplifier gain, and the signal becomes even larger. This is the opposite of AGC action, and can be used in signal processing. The principle is quite simple.

You know that putting a resistance in series with the emitter produces degeneration. This is why we use a bypass capacitor across emitter bypass resistors ... if the bypass opens the gain falls ... if the resistor increases the gain falls. Sometimes in video amplifiers a small bypass is used across the emitter resistor, which is effective only at the higher frequencies, thus achieving high end peaking.

The diode is a non-linear resistor, and as the signal level increases the diode resistance falls, reducing the degeneration, thus increasing the gain. The positive going half of a sine wave would therefore become larger than the negative half in the circuit shown. (Using a PNP transistor, the negative half of the input wave would be expanded.) Unlike thermistors, which are also non-linear resistors, depending upon heating action, the diode is fast enough to follow

continued to page 54



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Intermittents I have found

And how I solved them

Troubleshooting tips on the toughest of all problems—the intermittent

By Robert L. Goodman

No doubt about it, intermittent electronic circuit faults cause the technician more loss of income and frustration than any other one item in the service business. So, let's look at some ways to isolate the intermittents or make them occur so that the problem can be solved. We will also look at some actual color TV case history intermittent troubles and give a "blow-by-blow" description of how they were solved. However, I have to "fess-up" and admit that there are some intermittent electronic equipment faults I have never found, plus others that have cured themselves and never acted up again. You cannot win them all.

Any electronic circuit faults have to be "caught in the act" before you can get a handle on them in order to know where to look for the defect. Thus, you will have more than half of the intermittent problems whipped, when you can get them to act up. And from many years of past experience I can also state that some intermittent faults are a figment of the set viewers imagination.

Follow along as we now look at ways to get the defect to appear.

For a start you must ever be alert as to which component break down will cause what type picture or sound intermittent symptom. Then use logical, commonsense procedures to isolate the faulty item.

Generally, intermittents are caused by faulty connections—opens, shorts or poor solder connection. Voltages that go out of tolerance—too high or too low will cause all kinds of intermittent problems. And then component temperature changes are a big headache to the

service technician.

The next step is to isolate the fault to a specific section of—in this case—a color TV receiver. For loss of color, start in the color circuit systems and look for intermittent audio in the speaker and sound circuits. For loss of picture and sound, but with a raster, you go to the IF amplifiers, AGC control circuits and also try a tuner-subber. For loss of high voltage, the horizontal sweep and HV section would be given the most attention. The power supply circuits should be looked at very closely if the set goes completely off and on or many symptoms occur at the same time.

Catching them in the act

The following techniques can be used to make intermittent troubles "show-up".

Many intermittents are caused by loose connections, poor solder joints and PC board cracks. Many times these faults will develop when the cabinet or chassis is bumped. We all know a sharp rap to the right hand corner of the cabinet will do wonders. When the set is jarred, note what symptom appears and then start tapping around very lightly in that circuit area. The eraser end of a lead pencil or a small plastic screwdriver works very well for intermittent trouble location. The spot where the very light tap makes the fault occur is where the fault is located. It's best to resolder all connections in the area to eliminate the problem.

For thermal related intermittents use a heat-gun with a blower to make a hot-spot on the suspected component to help speed-up its break down. A solid-state device fault will usually show up in the first few minutes of set operation. A resistor value drift takes from 10 to 15 minutes and a capacitor usually takes 15 to 20 minutes to act up.

Of course, the old stand-by, a can of freeze-spray can be used to spot-cool a component or area and can quickly

isolate the culprit. This is good for detecting a drift of a resistance value.

Another trick is to raise the AC line voltage to the set with an adjustable transformer (variac) to help break down a marginal component fault. And some times a lower line voltage will help detect a circuit trouble. We will look at one such case a little later.

To locate hair-line cracks or poor solder connections use a larger size combination magnifying lense and light.

Many intermittent problems can be eliminated from a color chassis that utilizes plug-in modules by just removing each of the modules and cleaning or tightening all pin contacts.

The dual-trace scope can be used to help locate intermittent troubles. In this case, two probes are better than one. In essence you can monitor two points in the circuit simultaneously and can thus speed up the process of isolating the intermittent fault very rapidly.

Another use of the scope is to monitor points where no signal should be found, such as B+ supply circuits, AGC control lines, and points that have bypass capacitor filters. Just hook the scope to these points and when the intermittent trouble occurs note if a signal appears on the scope. If it does, then look for an intermittent open filter capacitor in that section.

Actual intermittent

We will lead off with an intermittent horizontal drive problem that was found in an 19FC45 Zenith color chassis. The set would operate from 10 to 20 minutes and then the screen would go dark—some white lines would streak across at times—and then a high pitched squeal could be heard emitting from the horizontal sweep output transformer. This appeared to be a loss of high voltage caused by the horizontal oscillator going off frequency. This condition would exist for a few minutes

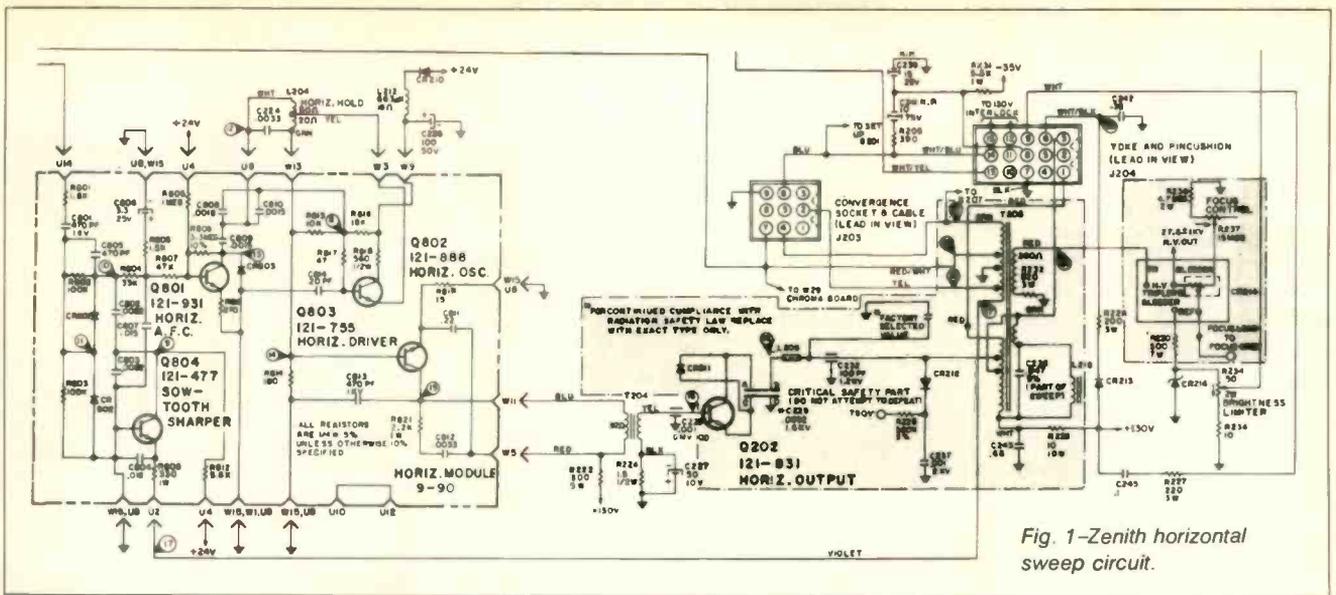


Fig. 1—Zenith horizontal sweep circuit.

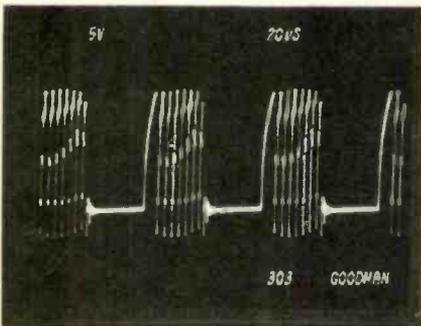


Fig. 2—Abnormal scope trace found at base of Q202 caused by open filter capacitor.



Fig. 3—Top and bottom criss-cross pattern.

and then the set would go back to working normally. The set would then operate normally for several hours.

The scope was then connected to the base of the horizontal output transistor (Q202)—note circuit diagram in (Fig. 1)—and the waiting game had begun. When the problem occurred the weird scope trace shown in (Fig. 2) was observed. This looked like very high frequency pulses modulated at the horizontal drive pulse rate. As a check the scope probe was moved to the 130 volt B+ line and these same narrow pulses were seen. More checks indicated that C214B, a 400 MFD filter capacitor, was opening up intermittently and was causing this problem. Thus, for

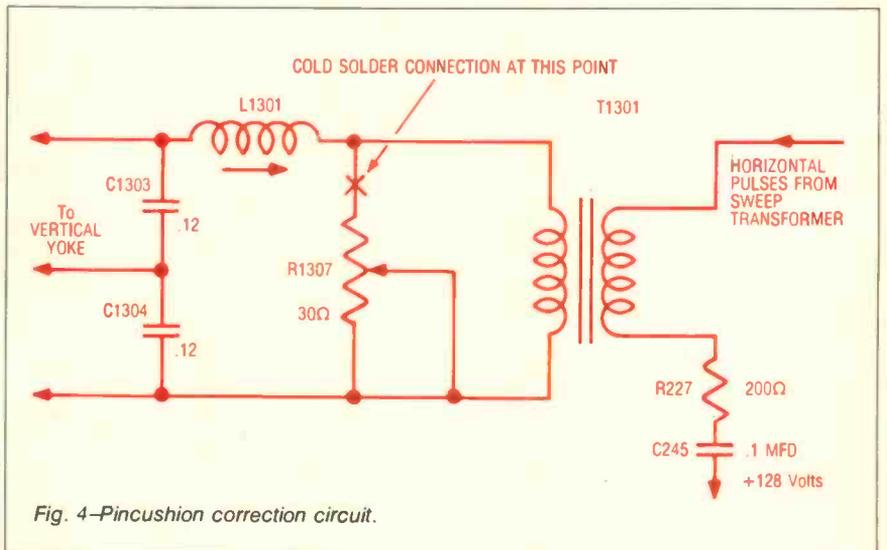


Fig. 4—Pincushion correction circuit.

any odd-ball problems do not over-look the B+ supply and filtering components.

The "Double Cross"

Some of my TV customers have blamed the criss-cross pattern shown in (Fig. 3) on a near-by CB'er but this was not the case. On a first "look-see" it does appear to be some type of RF interference. This pattern would usually show-up two or three times per hour and then would not appear for another week.

Lines that run obliquely across the screen are a good "tip-off" that the fault will be found in the pincushion correction circuits. This diagnosis was correct as the problem was located in the top and bottom pincushion printed circuit board that is mounted on top of the deflection yoke.

The top and bottom pincushion circuitry—(refer to Fig. 4)—consists primarily of transformer T1301, coil L1301, and capacitors C1303 and C1304. Also top and bottom adjustment

control, R1307 which is a 30 ohm wire wound pot.

The criss-cross picture symptom—which is usually intermittent—was caused by a cold solder connection where control R1307 is mounted on the PC board. Also, the R1307 wire-wound control may open up and cause the same picture symptoms. The deflection yoke must be pulled out of the plastic yoke housing in order to repair the pincushion correction circuit board or replace R1307.

Zener regulation troubles

A GE MA color chassis developed an intermittent weave—note photo symptom in (Fig. 5)—picture fade out, at times loss of color and also some sound distortion. With this many troubles, it's a good idea to check out the supply voltages first.

A few checks revealed that the +23 volt regulated DC supply was about 3 to 4 volts low plus, it varied erratically. A

scope look on the +23 volt line revealed a 70 mV ripple with a few spikes as can be seen in the (Fig. 6) waveform.

The +23 volt supply was fed from a series-type zener regulator as shown in the power supply circuit. The control device was a power transistor that was in series with the load and which carried most of the current. A change in current flow via the transistor tends to cause a voltage change at the collector. Since the base is biased at a constant voltage by a zener, the change in potential from the base to the collector will affect the current flow through the transistor. This, in turn, automatically restores the emitter output voltage to +24 volts. Because the transistor is used as an emitter follower, the emitter will remain very close to the zener rating, provided the load does not draw excessive current or the zener is not defective. If a short occurred on the +23 volt line, the power transistor would be damaged if it were not for a limiting resistor. All of these set troubles were caused by the tiny zener diode.

Intermittent remote control

These symptoms will all pertain to the Zenith "E" series chassis and later models that use a TRIAC in the remote control system to turn the color set on and off.

Let's take a brief look at this remote off/on circuit in (Fig. 7) and see how it should operate. When the remote or manual on/off button on the set is activated, a driver transistor will conduct and current will flow in the lamp. This current flow will light-up the lamp located within the photo-optical isolator unit. Note that later model sets may have a reed relay and coil in place of the photo-optical isolator. The light from the lamp will lower the resistance of the light dependent resistor—LDR—which then triggers the triac into conduction. The triac acts as an AC switch to turn on the TV receiver. When the remote on/off button is pushed again this turns off the driver transistor the lamp and the triac gate current. The triac then shuts down the TV set.

Now let's look at some of the ways this system may fail. As you might guess, a shorted triac will not let the set be turned off, except for unplugging the set from the AC power line. A defective photo-optical isolator may cause the set to turn off and on intermittently. Leakage in the push button on/off manual switch located on the sets front panel will cause

the set to turn off—then back on—in an erratic manner. This can be tough to locate. To check, just unsolder both leads from the switch and if the set works, normally the switch is faulty.

Should the set operate all right in the "on mode" but trip out the circuit breaker in the off mode suspect a faulty triac. The triac when defective wants to act like a rectifier and the pulsating DC voltage causes more current to flow in the primary of the power transformer resulting in a tripped circuit breaker. The picture and sound may pulse off and on a few times—picture goes down to a small size before the breaker opens.

A positive way to check out this remote system for a defective triac and/or photo-optical isolator that has an intermittent off and on symptom is to use a variable AC line transformer (variac) to manipulate the AC line voltage to the set. To do this, lower the line voltage down from a normal 125 volts—with set on—to about 65 or 75 volts. The set should stay on down to about a 65 or 75 volt AC line level. If the set shuts down at say 100 volts the triac or isolator is defective. It is advisable to change both these units at the same time.

This on/off trouble will not occur until the AC line voltage drops lower than normal, thus the set cuts off and then back on as the line voltage jumps up and down or may go completely off during a brown out.

Out of focus picture

This focus problem comes and goes and has been found in two or three brands of color receivers the past few years. When this occurs you will find that the focus control has no effect and the picture will be out of focus. The focus voltage on pin 9 of the CRT socket will measure high, from 7 to 10 KV. After a few checks the focus control, divider resistor and HV tripler can be cleared. Well, what's left? You guessed it, the CRT. However, the CRT may be repaired and not have to be replaced. Note the leakage path in Figure 8. This type of focus fault is due to internal second anode to focus element leakage within the picture tube.

To positively confirm this CRT leakage condition turn the set off, remove the socket from the CRT, then turn on the set and check the voltage level with a HV meter at pin 9 on the CRT tube base connections. The voltage should be less than 500 volts. If the voltage is higher than this the internal leakage condition may be removed by



Fig. 5—Picture weave.

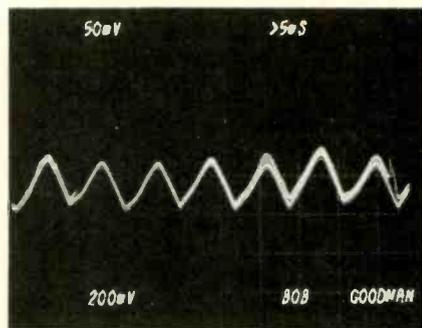


Fig. 6—Ripple voltage found on +23 volt supply line that should be a smooth scope trace.

the following technique:

Turn the set off and remove the CRT socket. Now connect a short clip lead to the CRT ground strap and the other end to pin 9 of the CRT (not the CRT socket). Now turn the set on for about 30 seconds and then recheck the voltage. Do this three or four times if voltage still is high.

With luck, this method should clear the internal leakage in most instances, and a reoccurrence of leakage to focus anode, although possible, is usually rare. If not cleared, a new picture tube will have to be installed.

An intermittent that wasn't

A service call on a new model RCA-XL100 color chassis claimed that the color would go off and on for short durations. The technician on call could find no color fade out problem, but changed the color module in hopes of correcting the problem.

In about one week the same customer complaint was registered with the service center. I went out on this call and watched the set for about one hour without seeing one second of color drop out.

At this point a decision was made to interrogate the customer in order to track down this color problem. The set owner

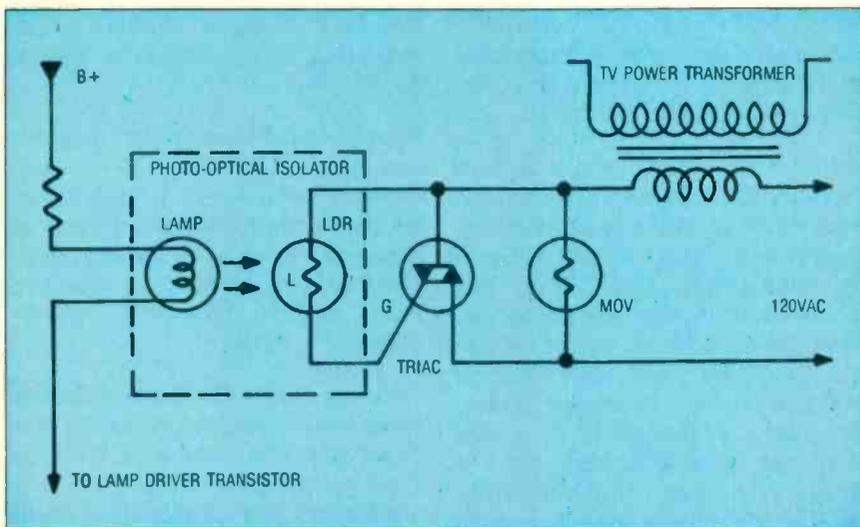


Fig. 7—Zenith on/off remote control circuit.

said that the color fade-out only occurred at night and for about 3 to 5 seconds. She added that this happened 3 or 4 times during an evening of viewing. These were two good clues. I then asked if they noticed any small criss-cross lines that looked like screen wire over the TV screen and did the volume level change any. Yes, it did she

said and also, at times, they may have heard some low level voices in the background that did not go with the TV program. It was also more noticeable on some channels than on others. I then informed the customer that it was very probably VHF two-way police radio interference as they usually only transmitted a few seconds and checked

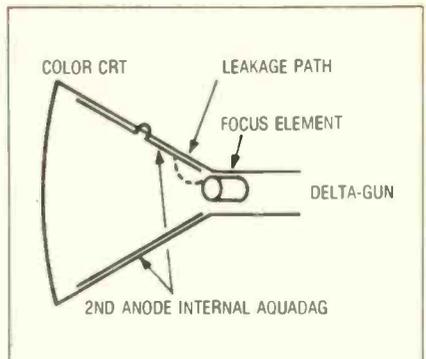


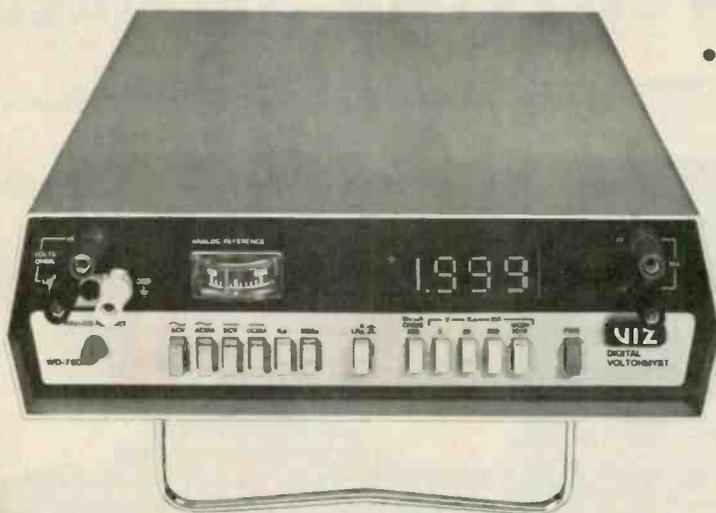
Fig. 8—Picture tube diagram illustrating second anode internal leakage to focus element.

in near this location 4 or 5 times during the evening. Ham radio and CB transmissions usually last much longer. The customer then agreed that this was very likely the color fade-out problem.

As you know any good story or joke has a punch line or kicker. Now for the kicker. As I was about to leave the room the customer said to me, you know our old set did the same thing. Of course, the customer is right, a new set should correct everything—as I have been told a million times. **ET/D**

Built to last

Our new 3½-digit LED autopolarity digital VoltOhmyst® is quality-constructed for long, hard service.



WD-750A
\$267.00

- Fast and accurate measurement of ac and dc volts, current, and resistance.
- Built-in analog panel meter for peaking and nulling.
- Hi- or Lo-power ohms selector.
- 120V/240V ac or battery operation with built-in charger.
- RF shielded, with rugged vinyl-clad case.

**VIZ Test
Instruments Group**

of VIZ Mfg. Co.

335 E. Price St.
Phila. PA 19144

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Formerly
RCA
Instruments

Circle No. 135 on Reader Inquiry Card

BULLETIN BOARD

Dual-trace Oscilloscopes are described in a new 4-page, full-color short-form catalog from Gould, Inc. Key performance features, specifications and pricing are given for: the Gould OS 4000, a 10 MHz, dual-trace digital storage scope; the OS 3300 B, a 50 MHz dual-trace, dual-timebase scope; the OS 1100, a 30 MHz dual-trace scope; the OS 260, a dual-beam, 15 MHz scope; and the OS 245A, a dual-trace scope with 10 MHz response. Available free from Marketing Services, *Gould, Inc.*, Instruments Div., 3631 Perkins Avenue, Cleveland, Ohio 44114.

Formation of a Business Consultant Group, aimed primarily at smaller home entertainment electronic service shops interested in expanding into TV sales and rentals, has been announced. According to A.G. Gaudette, a spokesman for the firm—Alltronsics TV—the service consists of a marketing program designed to increase gross business from

\$5,000 to \$75,000 for the small shop which is not presently selling or renting new and used televisions, or the shop which is only engaged in sales and rentals in a small way. Further information is available from A.G. Gaudette, 11709 N. Marjory, Tampa, Fla. 33612.

Original Japanese Replacement Parts are fully illustrated, explained and priced in the new 1978 catalog from Ora Electronics. Included are over 400 original Japanese IC's, transistors, tape heads, ceramic filters and special devices, as well as repair kits for the service on television and other electronic products. Pricing, it is reported, is up to 70% below 'market prices'. The parts listed can be ordered via a toll free number and will be shipped the same day. Catalog is free for service personnel from *Ora Electronics*, 7235 Canby Avenue, Reseda, CA 91335.

Semiconductor Cross Reference Guide and Technical Manual is now available from Workman Electronics. The new publication, designated X78, features almost 138,000 crosses plus full technical specifications. A full range of solid state products including RF power types, zeners, SCR's, FET's, rectifiers, VCC's, Diacs, SBS's, as well as

replacement silicon and germanium devices are included in the some 900 newly announced numbers. Available free from Workman Electronics, Inc., P.O. Box 3828, Sarasota, Florida 33578.

Popular LED Prices are contained in a new price list, No. 7821, from Chicago Miniature Lamp Works. In the new price list, prices on popular LEDs have been reduced as much as 40 per cent. Available free from *Chicago Miniature Lamp Works*, 4433 N. Ravenswood Avenue, Chicago, IL 60640.

Two-way Radio FM Service Technicians can learn some time-saving hints on servicing with a new book, "Test and Troubleshooting Handbook" from General Electric Mobile Radio Department. The book is applicable to mobiles, stations, and personal/portable equipment and shows how to focus efforts in directions which are most productive. Available for \$2.50 from *General Electric Mobile Radio Dept.*, P.O. Box 4197, Lynchburg, Virginia 24502.

Sylvania's TV test jig is described and illustrated in a new brochure that's now available. The new six-page booklet explains how the CK3000 Chek-A-Color

RCA pays you to win!

Enter our fabulous **RCA SK Rebate/Contest** that pays you cash for every time you enter.



- Win one of ten RCA SelectaVision Video Cassette Recorders.
- Get cash rebates from RCA for 20, or more, RCA SK bags.

WIN!

RCA
SelectaVision
VIDEO CASSETTE RECORDER

Contest starts April 1, and expires June 30, 1978.

test jig can be used to test 62 brands and over 10,000 color television models. It contains information on such features of the jig as diagnostic time, non-obsolence, 13V in-line picture tube, available accessories including adapter kits and individual adapters, and a cross reference chart. Free at GTE Sylvania distributors.

Electronic Test Equipment from most major manufacturers is contained in the latest 76-page 1978 catalog from North American Electronics. Test equipment is from such manufacturers as B & K-Precision, Continental Specialties, Hickok and Simpson. Shipment of items is said to be prompt, from stock, always freight prepaid and without handling charges on orders over \$200. Available free from Dept. AA 78, *North American Electronics*, 1468 West 25th St., Cleveland, Ohio 44113.

Hard-to-find Tools For Electronics are the subject of the new 152-page catalog from Jensen Tools. Contents included over 3,000 tools of interest to technicians, field engineers, instrument mechanics, and electronic hobbyists. Categories covered include: Micro-tools, test equipment, soldering equipment, tweezers, screwdrivers, cutters,

drafting supplies, power tools and tool kits and cases. Full-color photography is used. Available free from *Jensen Tools and Alloys*, 1230 South Priest Drive, Tempe, AZ 85281.

Electronic Components and Assemblies are covered in the latest 4-page file folder brochure from Multi Products International. The new literature presents an overview of MPI's products and capabilities. The cover illustrates a variety of electronic components available. Also included is a description of the firm's manufacturing operations and quality control procedures. Additional data sheets to be published later can be inserted into the new folder. For a free copy, write to *Multi Products International*, P.O. Box 684, Clifton, N.J. 07012.

Computer-related Products from over 170 different vendors are included in the latest catalog from American Used Computer Corporation. Over 1500 computer related products ranging in price from \$99 to over \$1 million are included from such vendors as DEC, IBM, Motorola, National Semiconductor and others. The 84-page catalog covers products new and used, for commercial businesses, engineers and researchers,

and hobbyists. Available for \$1 from American Used Computer Corporation, P.O. Box 68, Kenmore Station, Boston, Mass., 02215.

Electronic Test Instruments available for monthly rental are listed and described in a new 56-page illustrated catalog available from Continental Resources. Contained in the new 1978 catalog are full specifications and monthly rates for over 1,000 late model test and measurement instruments, including oscilloscopes, recorders, logic analyzers, microprocessor test systems, power meters, function generators and frequency synthesizers. Available free from *Continental Resources, Inc.*, 175 Middlesex Turnpike, Bedford, Mass. 01730.

Frequency Counters and Accessories are described in the newest brochure from B&K-Precision. In six pages of full-color, the brochure provides detailed information on four of the firm's frequency counters plus applications and important features. In addition, all specifications are grouped on a common page. Available free from *B&K-Precision*, 460 W. Cortland Ave., Chicago, IL 60635. Ask for brochure BK-1800. **ETD**



Here's a contest where you can't lose!

Because you earn generous cash rebates for RCA SK bags, and you can enter every time you send in at least 20 RCA SK bags. Your entry can win one of *ten* RCA SelectaVisions we are awarding. All you have to do is complete this statement, in 25 words or less: "I prefer RCA SK's because . . ." *It's that easy!*



You can win an unsurpassed home video recording system.

RCA SelectaVision gives you 4 full hours of record/playback in a

single cassette. A built-in digital timer. A remote pause for chair-side editing. Record one channel while you watch another, or record while you're asleep or away. You and your family will love it.

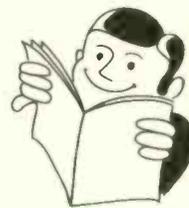


You get generous cash rebates.

Save your RCA SK plastic bags for cash rebates, as follows:

- \$2 rebate for 20 bags
- \$5 rebate for 45 bags
- \$10 rebate for 80 bags
- \$15 rebate for 115 bags
- 13¢ rebate for each bag over 115

With each purchase of RCA SKs from your RCA Distributor you get an official entry blank. All entries will be judged by a panel of independent judges. Prizes will be awarded on the basis of dealer's expression of demonstrated and proven usefulness of RCA SKs.



See your RCA Distributor for full information.

He will have all the details on RCA's complete line of replacement semiconductors and RCA SK Rebate/Contest rules. Or write to: RCA Distributor and Special Products Division, PO Box 250, Deptford, NJ 08096.

This contest is open to all electronic service technicians except RCA employees or members of their immediate families, RCA's affiliates or subsidiaries, its advertising agencies, and the judging organization. Void where prohibited or restricted by law. This contest subject to all federal, state and local laws. All prizes will be awarded.

RCA
SK Replacement
Solid State

TEST INSTRUMENT REPORT

Triplet's recently introduced "pocket size" 3 1/2 digit Model 3300 VOM is a really ruggedly designed, lightweight, and automated unit that provides just about all of the functions and accuracy you will need for working in low energy industrial, maintenance and most consumer electronics circuits.

Encased in a "high impact" thermo-

which is included in the purchase price.

Mode and function selection on the 3300 is made easy with a color code system: volts, red; milliamps, blue; and low and high power ohms, green and black respectively.

The five voltage ranges are .2, 2, 20, 200, and 600. Ohms ranges are 200 (low power), 2K (High power), 20K (1p), 200K, (hp), 2Meg (1p) and 20 Meg (hp). On the green, low power setting the 3300 places 200 millivolts across the resistor under test if you're getting a full scale reading. In the high power mode a full scale reading will result in a two volt drop.

Automatic polarity indication on the DC volts and current functions make this specific unit easy to use. Thus there is no provision for switching leads. Automatic overrange indications make it easy for you to know when to switch to a higher range, i.e. a flashing 1999 indication.

The basic overload protection for this portable Triplet unit is 600 volts on volts and ohms ranges. On current ranges it is fuse protected. (Two fuses located in the probe handle are rated 2 amp, 600 volt and 1 amp, 250 volts).

The 5-by-3-by-1-inch meter features relatively large 3-tenths-inch LED readouts easily visible in the brightest light and a special zero adjust control on the front panel allows you to knock out the fuse and lead resistance when using the 200 ohm range, although you will have to reset this adjust for other ranges.

All things considered, portability, versatility and ease of use, the Triplet Model 3300 is definitely worthy of consideration for either field or bench service work.

SPECIFICATIONS

Triplet Model 3300 digital V-O-M

DC VOLTS

Ranges .2, 2, 20, 200, 600
Accuracy: +5% of reading +1 digit
Automatic polarity indication
Input resistance 10 Megohms
Step response: 1 second typical
Overload protection: to 600VDC

AC VOLTS

Ranges .2, 2, 20, 200, 600 calibrated in RMS on sine wave
accuracy (at 60Hz)
1% of reading +2 digits through 200 volts
1.5% of reading +2 digits on 600 volts
Input resistance: 10 Megohms shunted by 100 pf
Step response: 3 seconds typical
Overload protection: 600 volts maximum

OHMS

Low ohms ranges (green color code)
200, 20K, 2M
High ohms ranges (black color code)

continued to page 54



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

Triplet's Digital Volt-ohm Meter Model 3300

A "pocket-sized" meter

plastic case, the 3300 is another in the growing list of electronic hardware that seems to be making the consumer electronics service shop a truly portable operation nowadays. With digital VOMS, pocket sized counters and color generators, about all we need now is a pocket sized scope.

Getting back to the 3300, this unit retails at \$175 and is a five function, 22 range meter designed for battery operation. Manufacturer's specifications say the unit can be powered between 4.4 and 5.7 volts and these parameters give the four rechargeable NiCad batteries an average life of 6 to 8 hours.

One handy feature of the 3300 is the built in battery check. Just set the DC range on 20 volts and put the probe end into a special test point and you read the battery power. In case you are running low on voltage, the 3300 can be used with the AC 5.8VDC adapter charger

Test semiconductors without testing your patience.

The real value of using a semiconductor tester should be time savings. B&K-PRECISION semiconductor testers are designed for maximum speed and reliability to save you more time than any other testers.

B&K-PRECISION semiconductor testers are proved as highly cost effective answers to

the needs of testing discrete semiconductor devices. Recently, they were evaluated by America's best known manufacturer of expensive test instruments and the \$310 Model 530 compared favorably with a \$30,000 custom test system! B&K-PRECISION has a model for most every application.



Model 530 Semiconductor Tester

- Measures unity gain (f_T) to 1500MHz instantly
- Nondestructive breakdown voltage testing

Model 520B Semiconductor Tester

- Tests diodes, FET's, transistors, SCR's and Darlington's in-circuit or out
- Works in-circuit where others won't

Model 510 Transistor Tester

- Completely portable for field testing of transistors, FET's and SCR's
- Fast good/bad test indications

Model 501A Curve Tracer

- Display characteristic curves on most any scope
- Complete with unique Dynaflex probe

The B&K-PRECISION Model 530 is one of the most versatile semiconductor testers available and can actually perform more tests on more devices than any instrument in its price class. Features include: Exclusive patented f_T measurement circuit... Non-destructive breakdown voltage testing... Automatic lead and polarity identification, in- or out-of circuit... Measurement of beta and gm... Aural and visual test indications... Testing of new power FET's. CSA listed. **\$310**

For value, the Model 520B industrial semiconductor tester is tough to beat. Dynapeak™ circuitry with high/low drive allows the 520B to work in-circuit where others won't... A complete test takes about 9 seconds... Identifies all leads of transistors and SCR's and polarity... CSA-listed version available... "Good device" indicated visually and aurally. **\$175**

At only **\$97**, the Model 510 offers Dynapeak™ test method reliability with pocket-size portability... LED test result indicators... Tests all types of transistors, FET's and SCR's... Digital stability never needs calibration... Complete with case and leads. **\$97**

When applications demand analysis of the characteristic curves of semiconductor devices, the B&K-PRECISION Model 501A is the cost-effective answer... Displays characteristic curves for all semiconductor devices on most any scope... Non-destructive breakdown voltage tests... Simulates actual operating conditions... Internal calibration source... Current limiting protects device under test. **\$198**

Start testing semiconductors faster now. See your local distributor for immediate delivery.

B&K PRECISION **DYNASCAN CORPORATION**

6460 W. Cortland Avenue, Chicago, IL 60635 312/889-9087

In Canada: Atlas Electronics, Ontario • International Sales: Empire Exporters, Inc., 270 Newtown Road, Plainville, L.I., NY 11803
Circle No. 101 on Reader Inquiry Card

DEALER'S SHOWCASE



Car stereo speaker

Circle No. 146 on Reader Inquiry Card

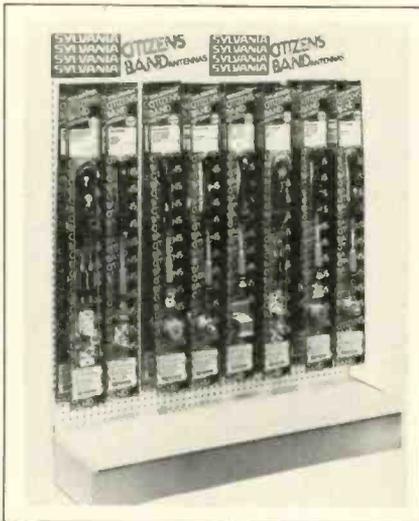
A new trunk mount speaker enclosure for stereo separation and speaker protection in vehicles is new from *Kriket*. Designated Model 4060, the new system snugs up around any sized speaker which becomes air sealed in its urethane foam seat. Cross laminated tubular acoustic fiberboard stops the sound from the back of the speakers, neutralizes it and eliminates the distortion produced by rebounding sound waves common to all unenclosed speaker

systems. Road noise is also said to be eliminated. Easily installed with two flexible mounting straps and two clamps, included. Suggested retail, \$17.95 per pair.

CB Accessory Display

Circle No. 147 on Reader Inquiry Card

Attractive display racks to merchandise CB antennas, microphones and accessories are now available from *GTE Sylvania*. Designed to save space, the displays are 48 inches wide, 54 inches



high, and 14 inches deep and can be used against any wall or counter. They are furnished with hooks which can be moved freely to accommodate different size products. Products shown on the displays are highly visible and readily accessible to customers. A header on top identifies the brand name and product line.



Dynamic microphones

Circle No. 148 on Reader Inquiry Card

Two new professional quality dynamic microphones designed for studio, public address and tape recording applications have been introduced by *Robins Industries*. Model No. 48-020 is a 'top-of-the-line' microphone engineered for uni-directional cardioid polar response with

Another reason to join RCA's QT Parts Program! You get four free information packages every year.



RCA's QT-150 Parts Program is better than ever!

Registered dealers receive four free information mailings per year through RCA's Direct Information Service program.

Quarterly mailings include:

- Complete Dealer Price Book — RCA Consumer Parts • Latest Price Supplement • RCA Drawing Number to Stock Number Cross Reference • Color TV Module Cross Reference • B&W TV Module Cross Reference • Dealer QT Inventory Control Form; and many other useful publications.

To join, contact your RCA Distributor and register as a QT Dealer. You will receive your package of 150 of the most-needed, fastest-moving parts to repair older TV sets. You will also receive your first quarterly information package. Every information mailing will include the latest price publication, plus additional information about RCA Parts required in your servicing business.

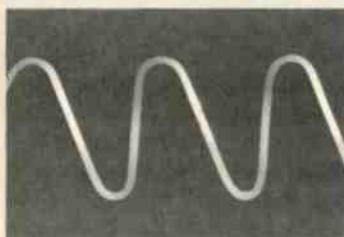
Don't forget, your QT Parts inventory program has automated annual drop-ship updating for your convenience. A special QT Parts Rack is also available to save time and space.

Call your RCA Distributor or write to RCA Distributor and Special Products Division, Deptford, N.J. 08096.

RCA QT Parts

Circle No. 129 on Reader Inquiry Card

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



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

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

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

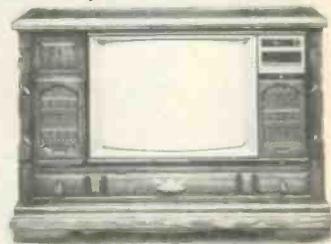
With the VIR signal system established, the next challenge was to design a TV set that could use it. So General Electric developed the VIR Broadcast Controlled Color System. And won an Emmy of our own.

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

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

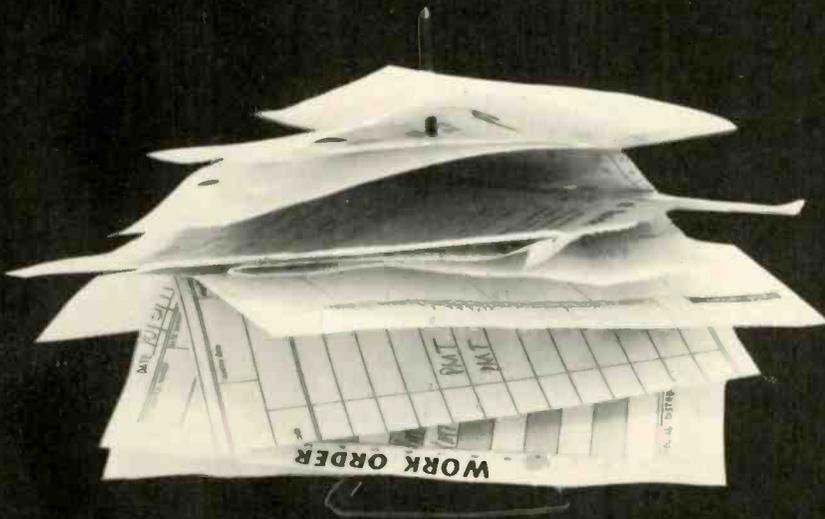
Too bad they don't give an Emmy for trying to make your servicing job easier. We think we'd win it hands down.

THIS IS GE PERFORMANCE TELEVISION.



GENERAL  ELECTRIC

No Back Orders!



With Workman's WEP Semiconductor Line.

You don't have to be concerned about back orders with Workman's all new WEP semiconductor line as it affords the broadest coverage of entertainment semi-conductors, yet minimizes inventory requirements while insuring very liberal and uniform profit margins to all steps of distribution.

To make sure a complete stock of components are on the shelf Workman keeps a daily monitored inventory assuring immediate availability.

What's more, Workman's new WEP Semiconductor Catalog and Cross Reference Guide is the most complete and up-to-date reference work in the industry.

Packaged in either attractive space-saving stock boxes or blister hanger cards carrying complete cross reference and technical specifications, the new WEP line is available through the nationwide chain of Workman distributors.

Your business card or letterhead will bring immediate response from one of our factory representatives. Ask for Catalog X78.

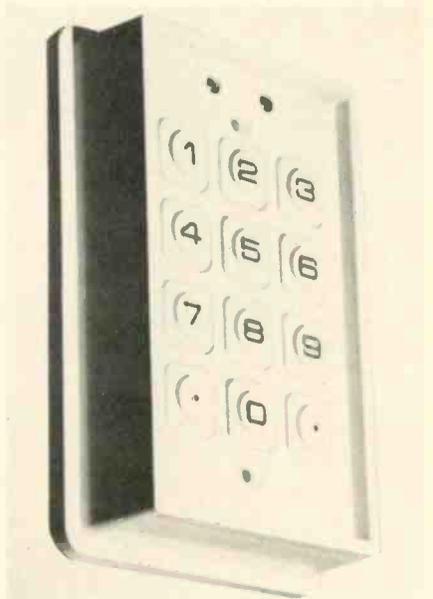
WEP Semiconductors From
The Parts Specialists

WORKMAN
ELECTRONIC PRODUCTS, INC.

SARASOTA, FLA. 33578
P.O. Box 3828 (813) 371-4242
TWX 810-864-0401 Workman Sara

Circle No. 138 on Reader Inquiry Card

dual high/low impedance facility. It features a ball type head with heavy chrome plate, wire mesh grill with built-in wind screen to reduce hisses and pops. Priced at \$32.95. Model No. 48-019 is an omni-directional, dynamic mike with high/low impedance and "off" switch. Priced at \$20.95.



Pushbutton Alarm Remote

Circle No. 149 on Reader Inquiry Card

Of special interest to alarm installers and electronic technicians is the new coded pushbutton remote control burglar alarm station being introduced by *Mountain West Alarm*. The unit operates momentary contact controls and is usable without complicated wiring hookups or special power arrangements. It is said to eliminate the use of keys and the risk of lock picking. It features a replaceable, pre-programmed code key which is field changeable. Each time correct code is entered on keyboard, solid state momentary switch operates. Low input power—less than 2MA standby at 6 to 24 VAC or DC. Priced at \$53.00 each.

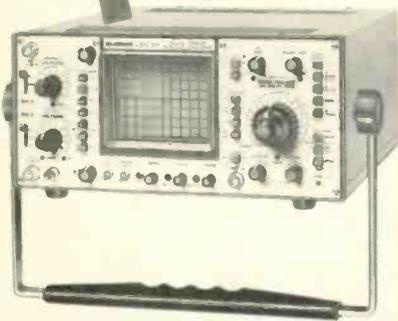


Rechargeable Battery

Circle No. 150 on Reader Inquiry Card

A new nickel cadmium transistor type 9-volt battery which is reported to be capable of 1,000 recharges is new from *Dynamic Instrument*. The new cell,

APPROVED FOR VTR SERVICE



The Leader Scope

LBO-515 25MHz, Delayed Sweep, Dual Trace

- Built-in variable delay circuitry — 1 μ Sec to 5Sec.
- 5mV/Div Vertical Sensitivity.
- Rectangular, 8x10Div CRT with internal graticule.
- 14nSec rise time.
- Trigger CH-1 or CH-2.
- H.F. filter plus TV sync. assures stable displays.
- Selectable synchronization, automatic, normal, single trace and reset modes.

\$1395.
with accessories.



The Leader Generator

LCG-396 NTSC Color Bar Pattern Generator

- NTSC color bars and staircase.
- 75 Ω Video (1 Volt fixed) and RF output for TV and VTR equipment.
- Equalizing pulse phase locked to color sub-carrier.
- Provides full-field for IQW insertion, plus on-off control of chroma and luminance.
- Better checking and adjusting of purity and white balance via red, blue, green, white rasters.
- Dots and single crossbars for convergence, raster and all other alignment requirements.
- Progressive or Interlaced scanning.

\$999.95



The Leader Counter

LDC-822 7-Digit Freq'y Counter with Period Function

- 20mV RMS Sensitivity — Variable.
- Period Function determines precise pulse width.
- 5ppm Accuracy.
- Bright 1/2" Display.
- High Reliability, LSI Circuitry.
- Gatetime Indicator.
- 1M Ω Input Impedance.
- Overrange Indicator.

\$299.95
with accessories

*For Leader's complete line of "VTR Approved" Test Instruments,
See your distributor or write for details.*

When Quality Counts . . .

**LEADER
Instruments Corp.**

151 Dupont Street, Plainview, N.Y. 11803
(516) 822-9300

Circle No. 121 on Reader Inquiry Card

which can be used anywhere conventional throwaway 9-volt batteries are used, has a capacity of .80ma, as compared to the .65 usually found. Called the Dynacharge Energy Cell, the battery will charge to full capacity in as short a period of time as 8 hours.

VCR Maintenance Kit

Circle No. 151 on Reader Inquiry Card

A new maintenance kit designed to keep VCR's at peak audio and video reproduction quality is new from *Nortronics*. Called the Model QM-95, the kit contains products required to keep delicate



heads free of dust, dirt and accumulated tape oxide debris that can cause snow pictures and possibly damage pre-recorded tapes. Included are: QM-103

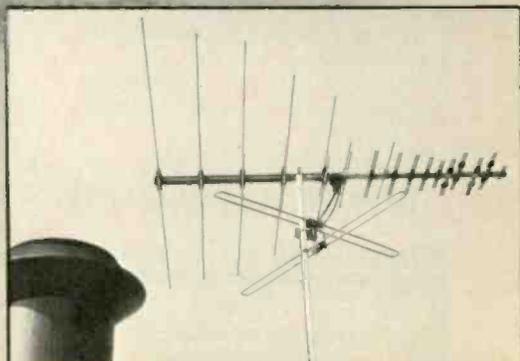
spray tape head cleaner; an anti-static dust cloth; cellular foam swabs and a special screwdriver for removing head-cover screws on the recorders. With instructions.

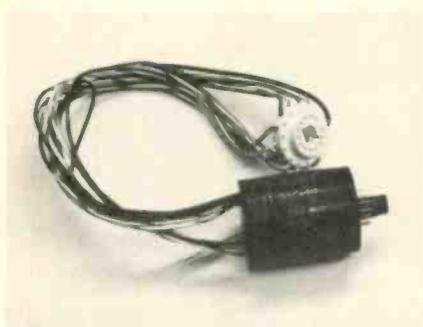
Color TV Brightener

Circle No. 152 on Reader Inquiry Card

A new color picture tube brightener that is 100% solid state and operates without the conventional step-down auto-transformer has been announced by *Workman Electronics*. Designated Model W35, the new brightener features circuitry that is said to provide more sta-

WINEGARD WORKS...





ble filament boost voltages and a minimum of power loss/heat dissipation. The W35 has extra long leads to facilitate installation in even the largest console combinations. Priced at \$11.75.

Projection television

Circle No. 153 on Reader Inquiry Card

A new self-contained projection television system featuring a 60 inch diagonal screen has been introduced by Panasonic. A maximum 50 foot lambert brightness characteristic is achieved through the integration of a Matsushita-developed projection tube and high efficiency screen. A three-tube configuration with Schmidt optics arranged horizontally in-line is utilized to eliminate hue distortion caused by a change in vertical viewing angles. The entire system folds into a 64.2 inch high by 49.2 inch wide by 28.4 inch deep compact cabinet.



on the Mississippi Queen!



**Captain Shelton,
Master of The Mississippi Queen.**

Mark Twain never had it so good!

In his time, steamboatin' was only a way to travel. But today many people will tell you it's a great way to spend a vacation.

Since 1811, steamboating has been both practical and romantic—a way to visit the heartland of America on the Ohio and Mississippi rivers. Riverboat vacation travel, especially aboard the luxurious new Mississippi Queen operated by the Delta Queen Steamboat Company of Cincinnati,

Ohio, offers pleasures and amenities Mark Twain never dreamed of. It features a swimming pool, movie theater, beauty salon, sauna, gym, elevators and air conditioning throughout—all showcased in the high ceilinged public rooms, tall twin stacks, wedding cake superstructure, steam calliope, great red stern paddlewheel, and the nostalgic touch of mirrors and brass.

What more could be wanted or needed? The 140-person crew that works the vessel likes to get its entertainment and news from television, just like land-lubbers. Unlike at home, the boat is constantly moving away from or toward tv transmitters that are varying distances from the river, and signal strength fluctuates greatly. To assure maximum quality tv reception, Winegard equipment, including an all-channel CH-7080 Chromstar antenna, and DA-825B distribution amplifier were selected by installer Larry Virgin, owner of National Electronics, Louisville, Ky. And, according to Pat Wingerter, Operations Officer of the Mis-

issippi Queen, "The Winegard equipment does a good job and has been in use for well over a year, with no problems. It serves 3 tv sets, one in the officers mess, and two in the crew's quarters. With three shifts, the sets run 24 hours a day."



Larry Virgin, Winegard Dealer.

The installer chose Winegard equipment because he considers it "superior to all others." "Performance was very important," Larry Virgin says, "but so is construction and I don't think you can beat Winegard on either score."

WINEGARD WORKS... Everywhere!

Circle No. 137 on Reader Inquiry Card

WINEGARD
The Winegard Company • 3000 Kirkwood Street • Burlington, Iowa 52601

NEWCOM'78

BOOTHS K30-32



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

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

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

The Model 6000 comes with a "Hold" feature to retain the LCD reading after the probe is removed. This allows measurements to be made in crowded circuitry or high voltage areas with greater safety. The meter is housed in a high impact molded plastic case to isolate inputs and to provide greater ruggedness and durability. The inside of the 6000 is coated with a conductive paint to shield the circuits

from industrial radio frequency interference noise and insure more accurate readings. A sturdy, patented plastic handle makes the meter easy to carry, acts as a tilt stand during bench operation, and folds down to protect the display face during storage.

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

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

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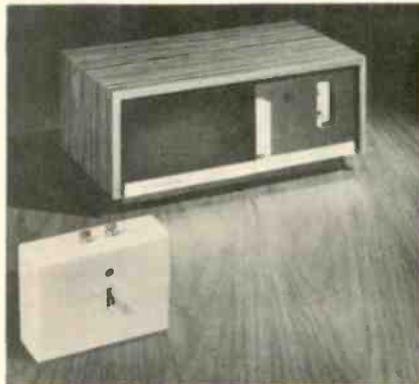
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Circle No. 139 on Reader Inquiry Card

NEW PRODUCTS



Dual channel security

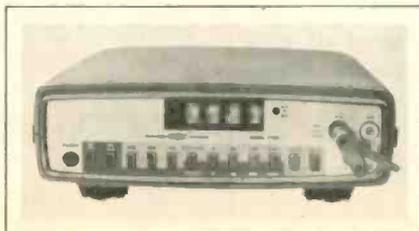
Circle No. 154 on Reader Inquiry Card

A new wireless dual channel security system for use with intrusion and smoke detectors is now available from *Chamberlain Manufacturing*. Designed for professional security installers, the new UHF radio-controlled alarms are reported to eliminate the need for lengthy and complex hard wiring from point of detection to point of alarm. The transmitter and receiver feature a digital coding technique that is said to be immune to false radio signals. The receiver can monitor any number of security sensors and smoke detectors, and any number of detection devices can be wired in series to a single transmitter. The system is designed for residential use. Net price for receiver console is \$160 and \$18 per transmitter.

Portable digital multimeters

Circle No. 155 on Reader Inquiry Card

A new series of 4½-digit multimeters for bench and portable field use is new from *Systron-Donner*. The new series consists of four models available with a choice of current or dBm measuring modes. All models feature auto and manual range selection. DC voltages from + 10 microvolts to + 1000V are measured in 5 ranges. AC voltage measurements can be made from 10 microvolts to 750 V in 5 ranges. A true RMS



AC converter permits accurate measurements of triangles, pulses, square waves or distorted sinewaves up to 20 kHz. Prices range from \$395 to \$500.

Releasable Cable Ties

Circle No. 156 on Reader Inquiry Card

Two new releasable cable ties, which can be hand installed for easy release and reuse, are announced by *Panduit Corporation*. The new ties, 6-¾ inches and 14½ inches long, accommodate bundle diameters up to 1½ inches and 4 inches, respectively. They both have standard cross-section and a minimum loop tensile strength of 50 pounds. They are made of fungus alert, self-extinguishing and chlorine-free 6/6nylon. Called Pan-Ty cable ties, they feature a tab end design that permits easy release and reuse even after the tie has been pulled up snug by hand. The tie is released by simply deflecting the release tab and pulling the tie away from the bundle. Available in 13 colors in packages of 100 or 1000 ties.



Lab Power Supply

Circle No. 157 on Reader Inquiry Card

A new low-cost, three-in-one bench power supply for use with integrated circuits is being introduced by *Hewlett-Packard*. Designated Model 6235A, the new power supply delivers three adjustable dc output voltages: 0 to 6V at 1A, 0 to +18V at 0.2A and 0 to -18V at 0.2A. A single 0 to 36V output at 0.2A can also be obtained by connecting across the -18V and +18V terminals. Controls, meter and binding posts are all arranged on the front panel with one voltage control simultaneously adjusting the +18V and -18V outputs. The dual outputs track one another to power operational

amplifiers and other circuits requiring balanced positive and negative voltages. The supply is of the constant voltage/current limit type with each output voltage continuously adjustable over its range. It weighs only 5 lbs. and is priced at \$195.



Non-aerosol Cleaner

Circle No. 158 on Reader Inquiry Card

A silicone contact cleaner for electronic work is now available in a non-aerosol container from GC Electronics. Called Liqui-Kleen, the new container utilizes an environmentally safe spray pump with a pinpoint extension for a confined powerful stream. Without the pinpoint extension, you get an adjustable fine mist. The cleaner is non-flammable, safe for plastics and will clean, degrease



and protect electrical contacts with silicone. Liqui-Kleen is available in 16 ounce and 1 gallon refills.

Wireless Remote Control

Circle No. 159 on Reader Inquiry Card

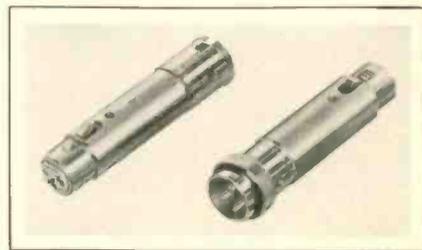
A new wireless remote control system that is reported to work with any television on the market has been introduced by GP Electronics. Designated Model GP-500, the new system utilizes ultrasonic control and a modulated pulse



code. It works off a carrier frequency of 40 KHz and has an LED display with single digit counts from 0 to 9. The unit is equipped with ten channel capacity tunable to either VHF or UHF. Each channel can be preset to the user's selection. The remote can be moved forward and/or backward in channel selection, eliminating the need for a complete rotation of the control. It has a built-in pre-amplifier that is said to provide a power gain of 30 dB. Maximum noise figures are 90 dB for VHF and 12 dB for UHF.

Audio Adapters

Circle No. 160 on Reader Inquiry Card



A new series of audio adapters that allows conversion of microphones and other audio equipment from threaded-coupling connectors to the firm's line of "Q-G" and QGP connectors has been developed by Switchcraft. At one end,

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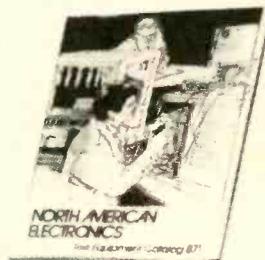
Guide. Remember, these are top quality, no culls, no seconds. Orders over \$25.00 shipped free. Orders up to \$25.00 add \$1 UPS. All orders over \$100.00 receive 5% discount. To approximate amount of your order, deduct 40% from dealers cost of ECG, SK or GE types. All orders shipped within 24 hours. Also, send or call for our free catalog of original Japanese transistors at substantial savings.

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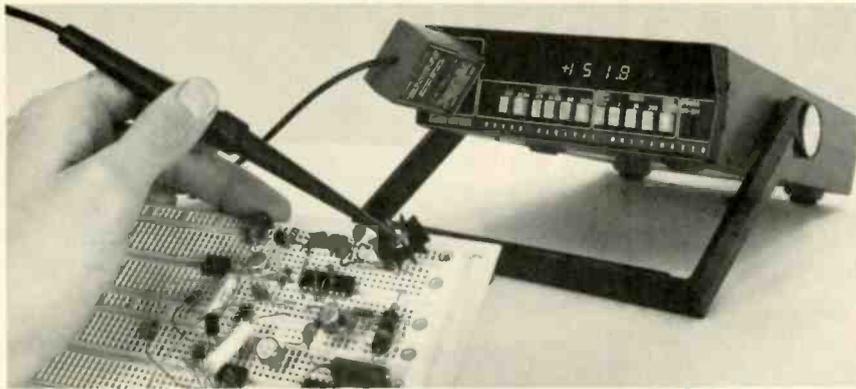
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The 80T-150 Temperature Probe can be used with any voltmeter to quickly locate malfunctioning and overstressed components, or to confirm difficult thermal calculations.

The Fluke 80T-150 Temperature Probe easily converts any DVM to a direct reading thermometer (1mV/degree). Range is -50°C to $+150^{\circ}\text{C}$ (or -58°F to $+302^{\circ}\text{F}$), and the probe can be used in surface, air or liquid

applications. Additionally, a 350V standoff allows measurement of live circuits. It is fast responding and battery powered. \$99.*

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AB-28 for information on other ways to make thermal measurements with the 80T-150. Or, write: John Fluke Manufacturing Co., Inc., P.O. Box 43210, Mountlake Terrace, WA 98043.

*U.S. Price Only



For more details Circle #113
For demonstration Circle #114

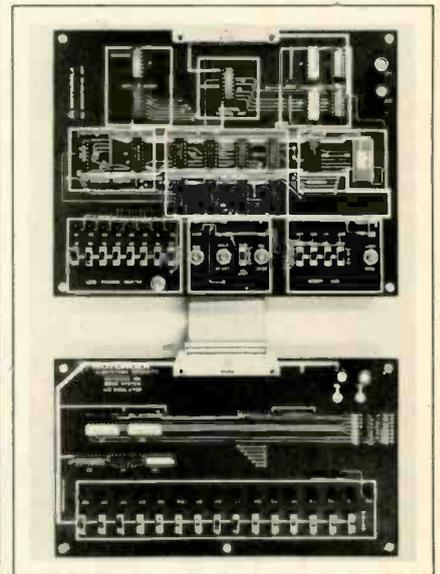
1806-7014

the adapters mate with Switchcraft 3-pin male connectors, and at the opposite end with the configuration of one of the four Amphenol inserts. Shielded connections are featured along with a positive 'Ground Terminal'. Q-G connectors and adapters are polarized to prevent incorrect mating. Adapters are of die-cast zinc with a satin-nickel finish on the housing. Prices range from \$7.50 to \$8.55

Programmable Control

Circle No. 161 on Reader Inquiry Card

A new 2-board industrial control system that combines a highly functional, pre-wired programmable logic controller (PLC) with an ancillary input/output simulator has been introduced by Motorola. The new system serves as a system development tool and demon-



stration unit. Based on the company's recently introduced single-bit microprocessor—the MC14500B ICU—the system has 15 inputs and 16 outputs, and incorporates a RAM capable of holding 128 ICU program instructions. The user is able to examine or change the contents of any memory location and has the option of single stepping or running his program. The system operates from a 5-volt power supply, and is priced at \$295.

Equalizer/Amplifiers

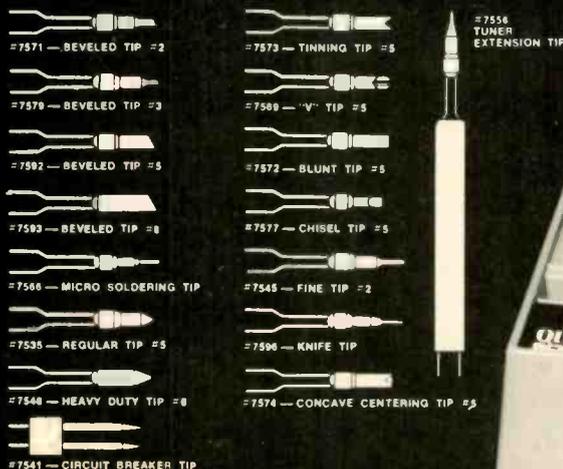
Circle No. 162 on Reader Inquiry Card

Two new mobile audio products—an equalizer/amplifier and a 7-band EQ/preamplifier (pictured)—have been introduced by Jandy International. The Car-Fi Model 310 is a 5-band graphic equalizer/amplifier with 60 watts of power. Up to 12dB is featured, boost or

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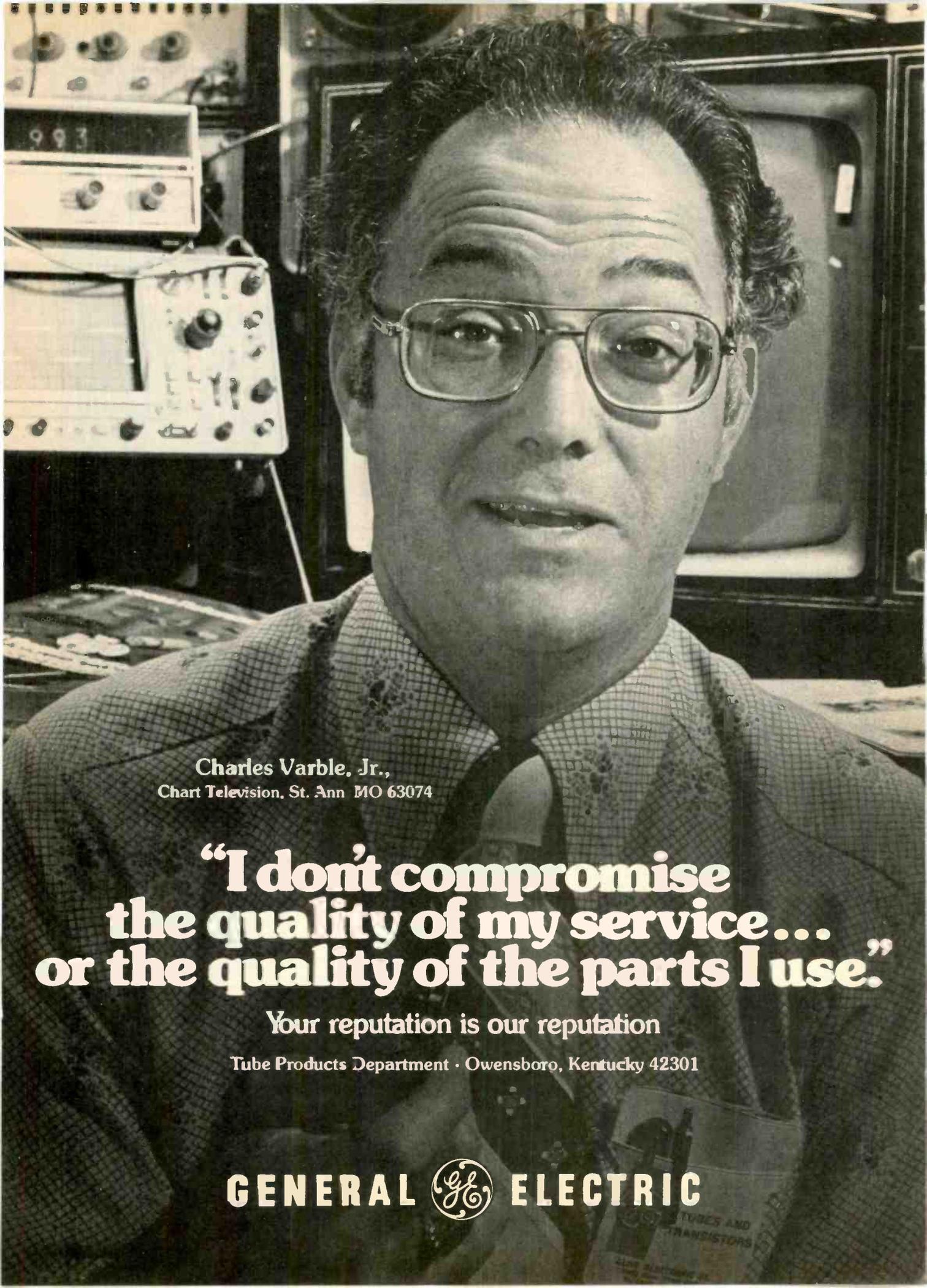
Low voltage, battery powered, ground free isolated tip design.



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boost or cut at 60, 150, 400, 1000, 2500, 6000, and 15,000 Hz. Model 310 is priced at \$135, and Model 4200 is priced at \$89.95.

Stereo Combination

Circle No. 163 on Reader Inquiry Card

cut, at 60, 250, 1000, 3500, and 10,000 Hz. Amplifier power output is 30 watts RMS per channel. Model 4200 is a 7-band graphic equalizer/preamp unit with hi and lo level inputs, balance control, level control, power switch, and input level controls. Range is + 12dB

A new combination stereo receiver and automatic record changer has been introduced by *Sharp Electronics*. Designated Model SD-121, the new unit has a sensitive FET front end, phase locked loop multiplex circuitry, and low distortion amplifiers. Also featured in the new

stereo is an LED indicator on the dial pointer for precise tuning, an FM stereo LED indicator, individual rotary volume, balance, bass and treble controls, push button function selector switches, a speaker selector switch for main and remote speaker pairs, built-in AFC and a headphone jack. The automatic record changer is full-size with cue control and automatic shut-off. Retail price is \$199.95.



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Dual-Trace 5"-15MHz Triggered Sweep

- 24nSEC rise time permits display of high-speed square wave pulses
- Dual trace display • Individual vertical sensitivity and positioning controls
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- Front-panel Vectorscope operation with matched-sensitivity inputs
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- Intensity modulation (Z-axis) input for time or frequency markers
- Internal calibration source
- 100% solid state (except CRT)
- Compact, lightweight and rugged
- Protective carrying case and accessory probes optional

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3"-5MHz Solid State Oscilloscope

- High sensitivity • CB modulation monitor
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- New high brightness CRT and smoked-glass graticule
- Can be externally triggered
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Dual-Trace 5"-10MHz Triggered Sweep

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- 35nSEC rise time permits accurate display of high-speed square wave pulses
- Large 8 x 10cm rectangular viewing area
- Front-panel Vectorscope operation with matched-sensitivity inputs
- TTL compatible intensity modulation (Z-axis) input for time or frequency markers and character displays
- Internal calibration source
- 100% solid state (except CRT)
- Compact, light-weight and rugged
- Protective carrying case and accessory probes optional

Model 1471B



Dual-Trace 5"-30 MHz Triggered Scope

- 11.7 nS rise time • 30 MHz dual trace operation
- Internal signal delay line
- 21 position sweep switch
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Capacitance Box

Circle No. 164 on Reader Inquiry Card

A new portable decade capacitance box with five decades of thumbwheel settings is now available from *Zi-Tech*. Designated Model TE9000, the new unit provides a range of capacitance from 100 picofarads to 10 microfarads in 100 picofarad steps. Color coding of digital switch values gives additional clarity on the reading settings. Mid scale accuracy is 1% with stray capacitance reported to be less than 50pF. Maximum operating voltage is 100V. Priced at \$195.



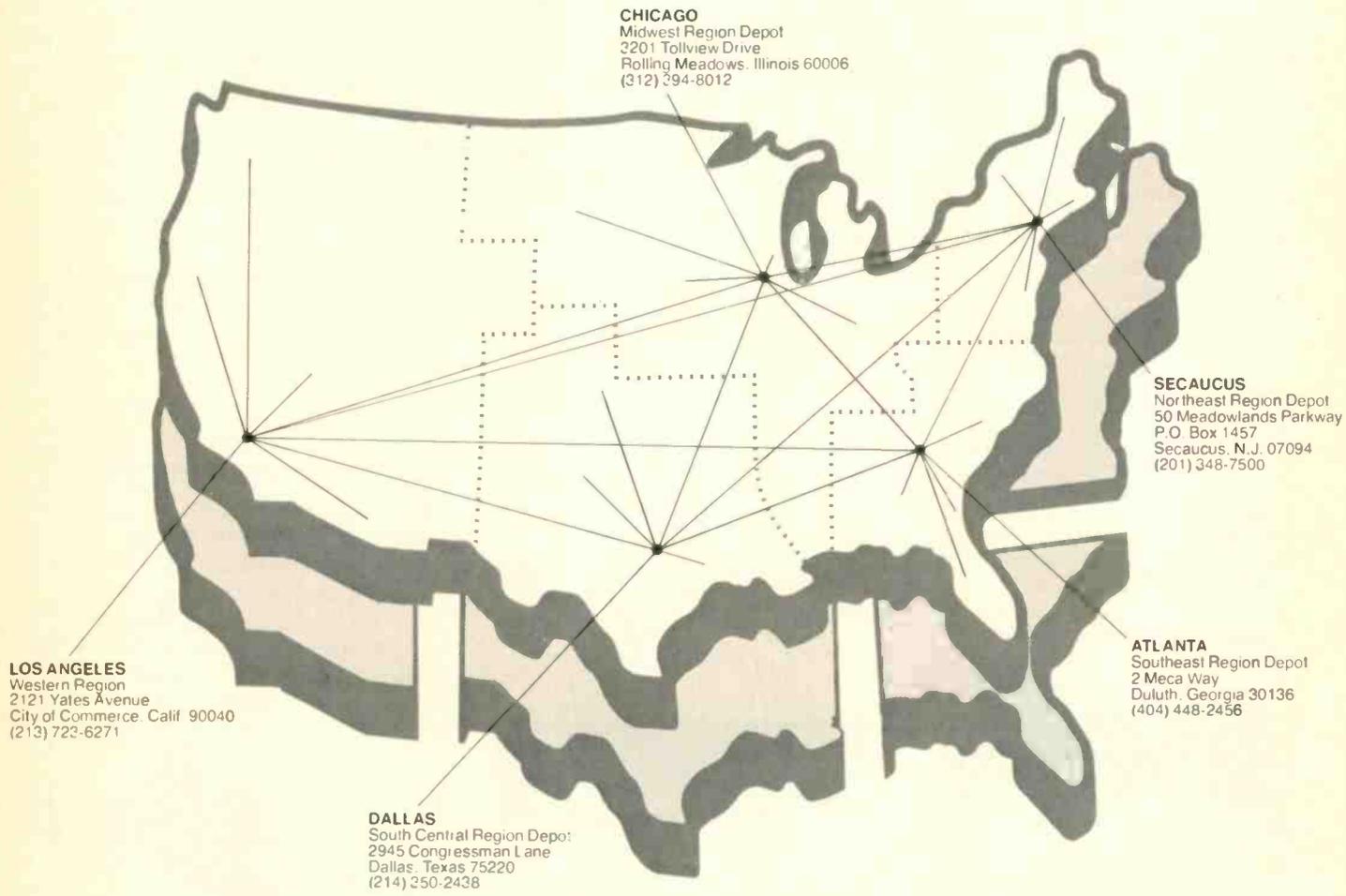
Microcomputer

Circle No. 165 on Reader Inquiry Card

A new microcomputer, designed to teach the basic concepts of computer technology, including the execution of functions by combining your instructions with input signals, has been introduced by *Energy Electronics*. Called the KX-33B, the new unit is also designed to

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A "prime" standard at your fingertips for measurements you can trust. Auto-ranging for extended low-level range and ease of operation. 15 Megohm input impedance assures .1% reading accuracy is maintained in solid state circuits. Highly sensitive, yet fully protected to 2000 VDC overloads. Hi-Lo Power Ohms circuit simplifies in-circuit resistance measurements.

DVM37 *New* \$268

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PORTABLE DVM

Prime standard .1% accuracy on the bench or in the field for less than \$250. The DVM37 is the most accurate portable DVM you can buy, with 15 Megohm input impedance for 50% more accuracy. Includes automatic features—Auto Zero, Polarity, Decimal, Overrange. Fully protected inside to over 2000V on all functions, including Ohms, and protected outside with super-rugged case. Full ranges for every test. Fingertip "Push-On" switch in probe saves batteries as power is applied only when needed.



New DVM37



DVM32

DVM32 \$225

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PORTABLE DIGITAL MULTIMETER

Bench and field master for digital accuracy measurements anywhere. 0.5% DCV accuracy, backed with 15 Megohm input impedance. Exclusive battery-saving Auto-Display turns the display on automatically when you make a measurement. 2000V input protection on all functions and ranges—including Ohms.

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DVM35 \$134

3 DIGIT 1% DCV ACCURACY
POCKET PORTABLE DVM

Fast, direct reading digital accuracy for the man on the go. Same features as DVM36, except 3-digit, 1% DCV accuracy, backed by 15 Megohm input impedance that is ten times more accurate than analog meters.



DVM38



DVM36

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Circle No. 130 on Reader Inquiry Card



provide some idea of microcomputer operation, introducing the world of the central processing unit, registers and memory. The KX-33B, basically a controller, is built around the Panasonic 4-bit MN1400 microprocessor. In addition to the arithmetic/logic unit, the chip includes 1024 words by 8 bits of read-only memory for the system program and 64 words by 4 bits of random-access memory which stores keyboard data. Also included are two static RAM chips with 256 words of 4 bits each, which hold the musical tunes keyed in by the user, an 8-bit latch, audio amplifier, and a speaker. Priced, assembled, at \$229.

Test Lead Holder

Circle No. 166 on Reader Inquiry Card

A new test lead holder that mounts quickly on any vertical surface is new from *ITT Pomona*. Called the Model 4408, the new holder holds cable to 8.13 cm. Test leads are easy to store and easy to remove. The holder is made of cold rolled steel with a baked enamel finish. Priced at \$3.85.



Singlesideband Marine radio

Circle No. 167 on Reader Inquiry Card

A new 24-channel high frequency singlesideband marine radio is available from *Motorola Marine*. Featuring solid state circuitry and 16 half duplex channels, the unit is built with plug-in modular design, and is factory-equipped with the International Distress Frequency, 2182 KHz. Other features include: electronic

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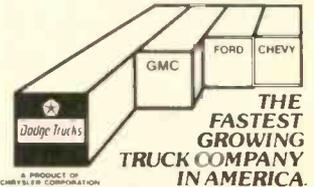
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RF Signal Generator

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A new RF signal generator designed for radio, television, and telecommunication laboratories has been introduced by Philips Instruments. Designated Model PM5326, the new generator features a high level of IF amplifiers in FM and TV receivers. The output frequency extends from 100 KHz to 125 MHz in 9 pushbutton selected ranges covering the AM/FM spectrum. A five-digit display allows setting of frequencies to one part in 10,000.

bandswitching, Sinad squelch, variable dimmer control for panel lights, and a clarifier control that allows all receive frequencies to be varied by + 175 Hz.

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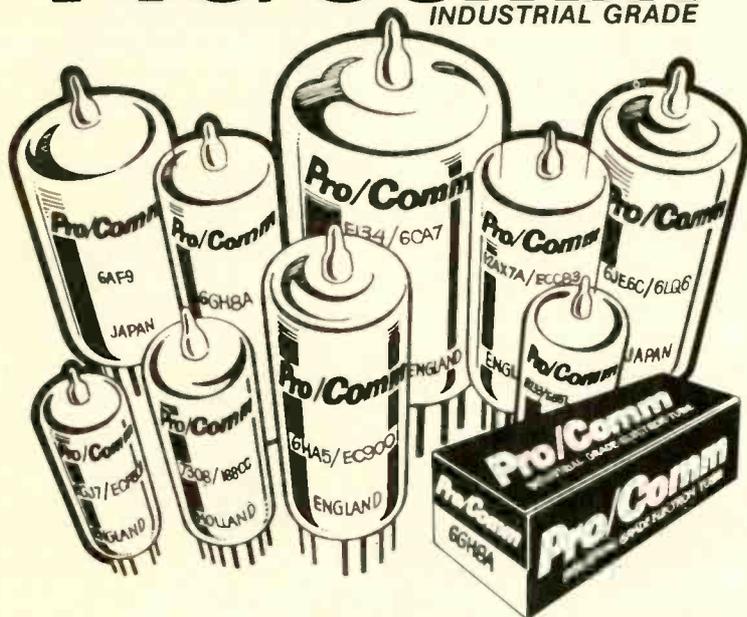
CB Slide Mount System

Circle No. 169 on Reader Inquiry Card

A new slide mount system designed to provide portability for mobile CB transceivers has been introduced by GTE Sylvania. The new system, designated SYL-SM, consists of a CB slide mount and vehicle bracket containing all CB-to-vehicle connections including RF, power, and extension speaker. The snap-loc system has an all-in-one disconnect feature that facilitates complete removal of the CB unit. Made of heavy duty steel, the slide mount comes with a low-loss automatic connect-disconnect shielded RF plug termination for negative-fade transmission; positive signal reception, and low VSWR over the entire 40-channel band. It can be used with 6 or 12 volt DC positive or negative ground systems.

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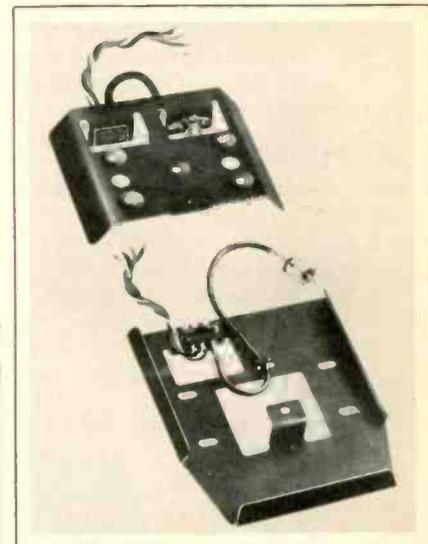
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AM/FM/CB Antennas

Circle No. 170 on Reader Inquiry Card

A new line of pillar-mount AM/FM/CB tri-way antennas, designed specifically for Honda, Datsun and Toyota automobiles, is being introduced by Harada Industry of America. The line consists of five models: two for Datsuns, one for Toyotas, and two for Hondas, each utilizing the same mounting base as the current AM/FM pillar mount models already available. A top loaded mast and specially designed cable and coupler is reported to provide best reception for each of the three broadcast modes.

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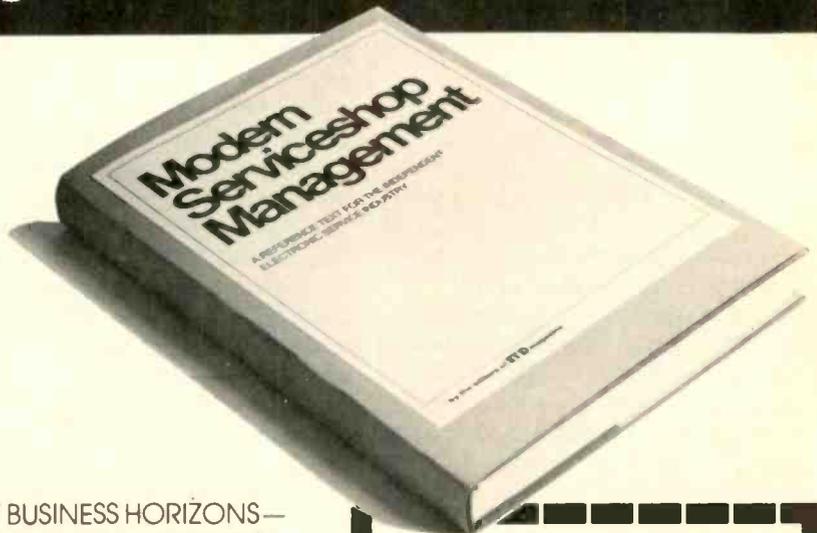
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In-line Banana Plug

Circle No. 171 on Reader Inquiry Card

A do-it-yourself in-line banana plug has been introduced by *ITT Pomona*. The new plug is said to be ideal for job repairs of patch cords since the plug can be soldered or crimped. It will accept wires up to 18 AWG. The plug body is brass and electro-tin plated, while the spring is beryllium copper with a Lexan jacket. It is made in red or black.



SONY

continued from page 22

Sony design provides a separate horizontal output transformer for maximum efficiency. Yoke matching is adjustable as a function of the horizontal size taps on the primary side. The secondary of the H.O.T. is, in essence, a scan power transformer providing pulses for 18, 30 and 200 volt B+ rectifiers. Higher voltages, for screen and focus, are tapped down from the 1100 retrace pulse on the primary side.

An easy way to understand this circuit, is to simply say this is the D.C. circuit concerned with yoke operation (See Fig. 3). When the G.C.S. cuts off, the inductance provided by the yoke and the output transformer creates a large

retrace voltage spike of some 1100 volts.

The duty cycle of this pulse is only 13.5 μ s which does produce fast retrace (See Fig. 4), but does not allow enough time to operate the flyback high voltage block supply. A good stiff source of high voltage is mandatory to producing a small spot size, so essential in high resolution design receivers.

Pulse stretching is achieved through the use of a series resonant coil and the tuning of the flyback primary with resonant capacitors. The resulting flyback driving pulse now has a long duration with a maximum p/p of 450 volts. Flyback secondary voltage is in the order of 7 to 10kv depending on the high voltage block. An important observation at this point: all Sony color requires two high voltage levels. One is fixed and provides a second anode voltage of some 25 kv. The other level is adjustable at approximately 800v less than the second anode. Purpose of the second voltage? You guessed it—horizontal static convergence on any Sony color comes from this potential applied to pairs of internal deflection plates mounted in front of the yoke field. Varying the voltage difference between the outer and the inner plates causes the red and blue beams to converge with the green beam to provide horizontal convergence across the Trinitron. Vertical convergence is a function of yoke design with some help from dynamic circuit correcting edge mis-convergence.

Basically, servicing Sony sweep is simple and easy if you remember a few simple precautions when working with the G.C.S. DC shorts are easily found with an ohmmeter. Replacement devices are easily installed. But, you must remember never to turn on a repaired Sony with full line voltage. A good rule is to start up at, say, 90 volts

(AC) and monitor the G.C.S. gate waveform. If a Variac is not available, a simple SCR type household light dimmer will work (the poor man's Variac). **ETD**

NON LINEAR

continued from page 26

RF waveshapes, and are sometimes used as RF attenuators by applying a varying DC current through them along with the RF signal, as in Fig. 5.

Resistor R in Fig. 5 forms a voltage divider with the resistance of the diode. Resistor R2 is a "choke," which passes the small DC bias current, but blocks the signal because of its high resistance. The circuit works well with small input signals in the millivolt range or less ... but a signal of millivolts amplitude at RF is a pretty healthy signal.

Most things in nature are not linear, but usually, logarithmic. The growth rate of trees, as shown by the rings in a cross section of tree trunk is logarithmic. If you wish to form an efficient horn for a speaker, the best shape is the log, or "exponential horn." The human eye's pupil has a diaphragm which opens and closes as light level changes ... a form of AGC action which results in logarithmic response. The ear has a similar response curve, which is why sound levels are given in Decibels ... also logarithmic.

Similarly, we recognize this applies to electronics as well, so most signals are given in db for the same reason. It is a fact that the world of electronics is not as linear as we have been conditioned to think it is. Try using your non-linear eyes, and non-linear ears to perceive all the non-linearities from now on.

TEST INSTRUMENT

continued from page 34

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WARRANTY!**
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Semiconductors

ECG#	ECG#	ECG#	ECG#
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101	.98	164	5.75
102	1.04	165	8.95
102A	.98	171	1.37
103	1.05	172A	.72
103A	1.11	175	1.62
104	1.20	176	2.06
105	2.60	177	.49
106	.80	179	5.69
107	.79	180	6.39
108	.89	181	5.40
121	2.38	182	3.35
123	.79	183	3.63
123A	.79	184	1.37
124	1.53	185	1.70
126	1.16	186A	1.46
127	4.60	187A	1.46
128	1.37	188	1.59
129	1.56	189	1.59
130	1.95	190	1.85
131	1.95	191	2.07
132	1.01	192	.98
133	1.14	193	1.04
132	1.43	194	.82
133	1.85	195A	2.98
154	2.34	196	2.06
155	2.02	197	1.89
157	1.63	198	1.95
158	1.08	199	.59
159	.86	210	1.37
160	1.43	211	1.56
161	.89	218	3.08
162	5.75	219	4.36
		220	1.90
		221	1.90
		222	1.99
		223	2.79
		224	5.06
		225	4.34
		226	1.67
		228	1.21
		229	1.06
		230	3.40
		231	4.40
		232	.70
		233	.74
		234	.72
		235	3.83
		236	7.57
		237	5.07
		238	8.95
		239	3.02
		241	1.71
		242	1.90
		243	8.72
		244	3.16
		245	3.17
		246	5.06
		247	6.35
		248	4.24
		249	3.21
		250	3.22
		251	7.99
		252	5.75
		253	3.25
		254	5.75
		255	3.25
		256	.69
		257	.74
		258	.74
		259	.88
		290	.98
		291	1.99
		292	2.26
		293	1.08
		294	1.14
		295	2.02
		297	1.13
		298	1.13
		299	2.02
		300	2.02
		302	2.80
		306	2.80
		307	2.57
		308	7.65
		309K	3.63
		310	7.65
		311	2.13
		312	1.13
		313	1.00
		314	7.85
		315	2.01
		316	2.74
		317	24.20
		318	20.60
		319	1.11
		320	26.00
		321	7.65
		322	1.80
		323	3.53
		324	3.53
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MONITORS—ELECTRONIC PARTS

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YOU ALWAYS
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ABLE TO
OBTAIN...**

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Serviceshop
Management"**

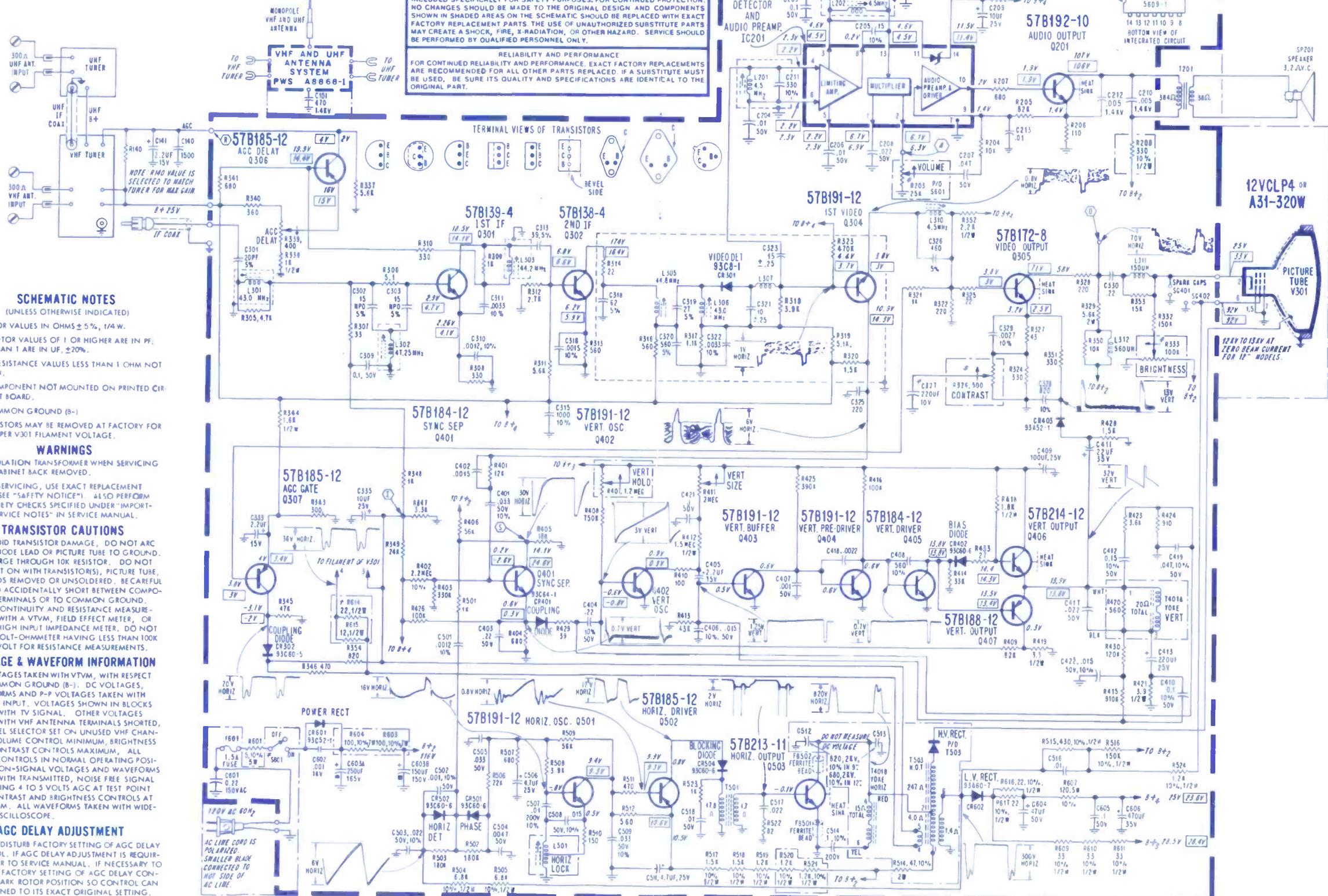
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SCHEMATIC NUMBER1737 GTE-SYLVANIA1739
 B/W Portable Models GAI-11219C & D,
 GAI-11244C & D Color TV Chassis E21-22

GENERAL ELECTRIC1738 ZENITH1740
 Electronic Tuning System, 1978 Color TV Chassis 25JC49

SAFETY CRITICAL COMPONENTS
 THE DESIGN OF THIS RECEIVER CONTAINS MANY CIRCUITS AND COMPONENTS INCLUDED SPECIFICALLY FOR SAFETY PURPOSES. FOR CONTINUED PROTECTION, NO CHANGES SHOULD BE MADE TO THE ORIGINAL DESIGN AND COMPONENTS SHOWN IN SHADED AREAS ON THE SCHEMATIC SHOULD BE REPLACED WITH EXACT FACTORY REPLACEMENT PARTS. THE USE OF UNAUTHORIZED SUBSTITUTE PARTS MAY CREATE A SHOCK, FIRE, X-RADIATION, OR OTHER HAZARD. SERVICE SHOULD BE PERFORMED BY QUALIFIED PERSONNEL ONLY.

RELIABILITY AND PERFORMANCE FOR CONTINUED RELIABILITY AND PERFORMANCE, EXACT FACTORY REPLACEMENTS ARE RECOMMENDED FOR ALL OTHER PARTS REPLACED. IF A SUBSTITUTE MUST BE USED, BE SURE ITS QUALITY AND SPECIFICATIONS ARE IDENTICAL TO THE ORIGINAL PART.



SCHEMATIC NOTES
 (UNLESS OTHERWISE INDICATED)

RESISTOR VALUES IN OHMS ± 5%, 1/4 W.
 CAPACITOR VALUES OF 1 OR HIGHER ARE IN PF; LESS THAN 1 ARE IN UF, ± 20%.

COIL RESISTANCE VALUES LESS THAN 1 OHM NOT SHOWN.

⊕ COMPONENT NOT MOUNTED ON PRINTED CIRCUIT BOARD.

⊕ COMMON GROUND (B-).

† RESISTORS MAY BE REMOVED AT FACTORY FOR PROPER V301 FILAMENT VOLTAGE.

WARNINGS

USE ISOLATION TRANSFORMER WHEN SERVICING WITH CABINET BACK REMOVED.

WHEN SERVICING, USE EXACT REPLACEMENT PARTS (SEE "SAFETY NOTICE"). ALSO PERFORM ALL SAFETY CHECKS SPECIFIED UNDER "IMPORTANT SERVICE NOTES" IN SERVICE MANUAL.

TRANSISTOR CAUTIONS

TO AVOID TRANSISTOR DAMAGE, DO NOT ARC 2ND ANODE LEAD OR PICTURE TUBE TO GROUND. DISCHARGE THROUGH 10K RESISTOR. DO NOT TURN SET ON WITH TRANSISTOR(S), PICTURE TUBE, OR LEADS REMOVED OR UNSOLDERED. BE CAREFUL NOT TO ACCIDENTALLY SHORT BETWEEN COMPONENT TERMINALS OR TO COMMON GROUND. MAKE CONTINUITY AND RESISTANCE MEASUREMENTS WITH A VTVM, FIELD EFFECT METER, OR OTHER HIGH INPUT IMPEDANCE METER. DO NOT USE A VOLT-OHMMEETER HAVING LESS THAN 100K OHMS/VOLT FOR RESISTANCE MEASUREMENTS.

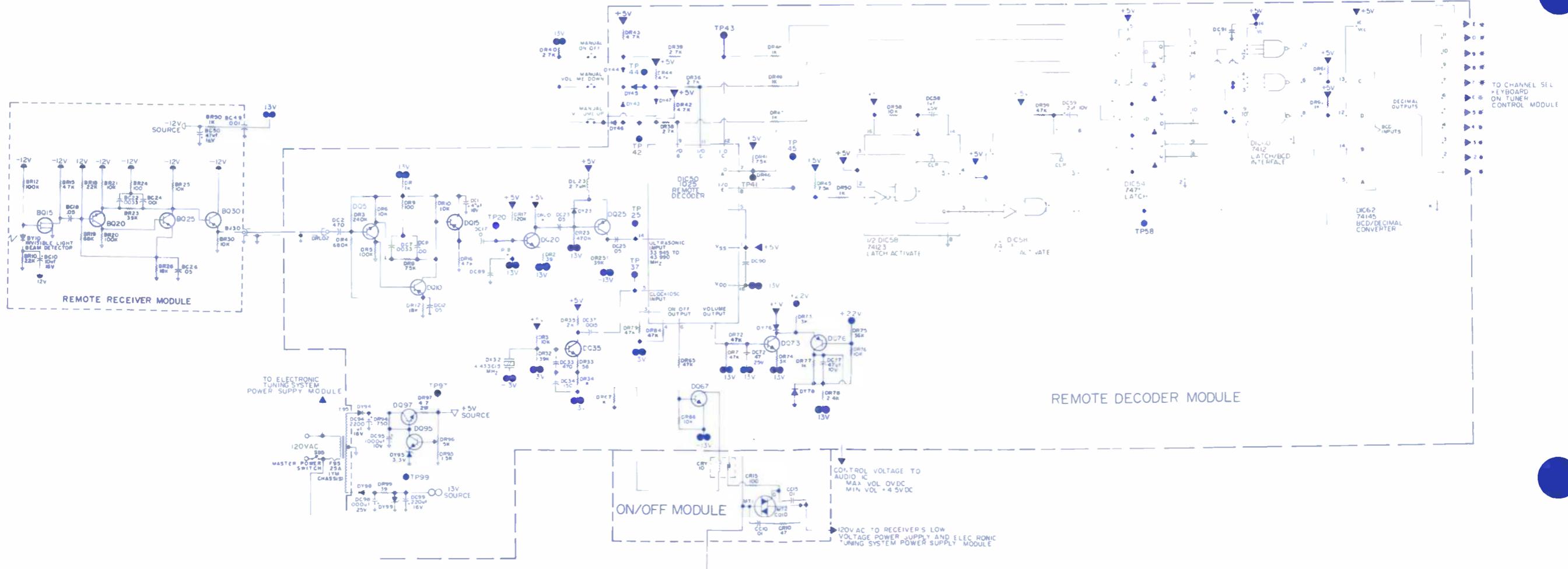
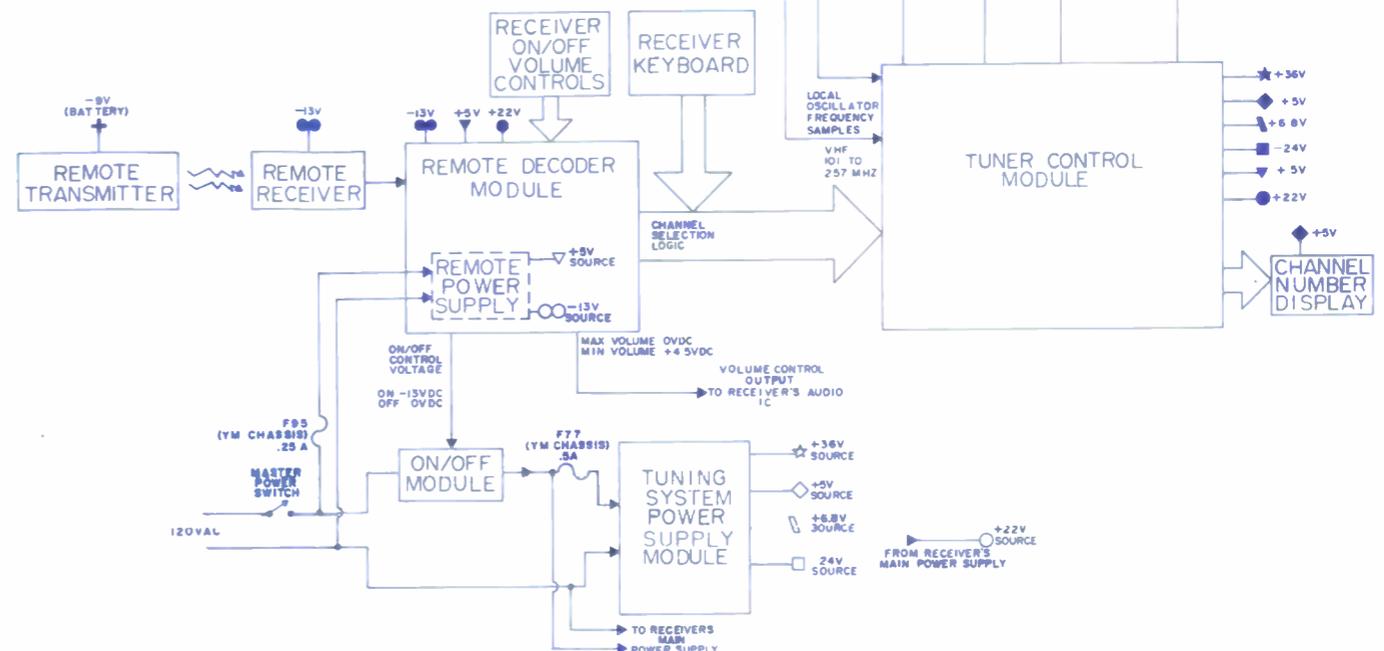
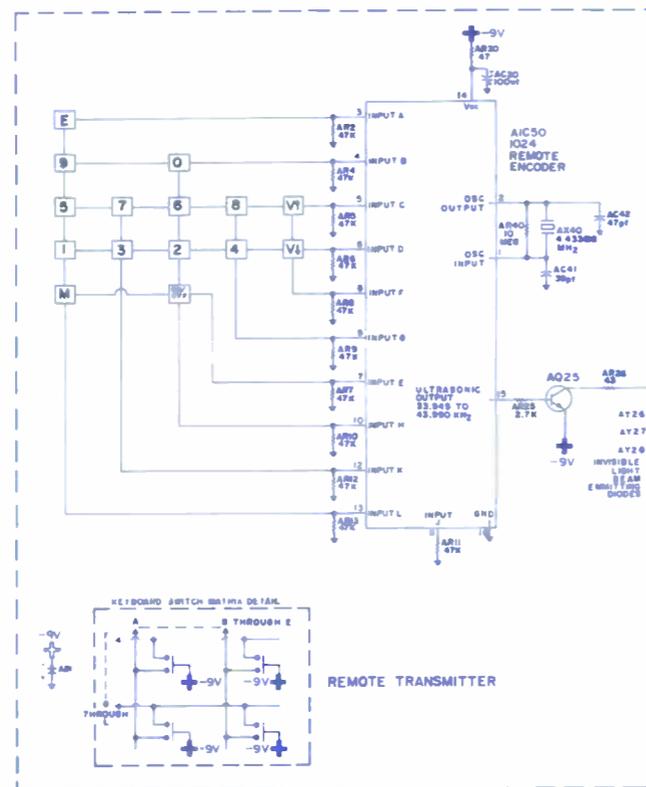
VOLTAGE & WAVEFORM INFORMATION

DC VOLTAGES TAKEN WITH VTVM, WITH RESPECT TO COMMON GROUND (B-). DC VOLTAGES, WAVEFORMS AND P-P VOLTAGES TAKEN WITH 120V AC INPUT. VOLTAGES SHOWN IN BLOCKS TAKEN WITH TV SIGNAL. OTHER VOLTAGES TAKEN WITH VHF ANTENNA TERMINALS SHORTED, CHANNEL SELECTOR SET ON UNUSED VHF CHANNEL, VOLUME CONTROL MINIMUM, BRIGHTNESS AND CONTRAST CONTROLS MAXIMUM. ALL OTHER CONTROLS IN NORMAL OPERATING POSITION. ON-SIGNAL VOLTAGES AND WAVEFORMS TAKEN WITH TRANSMITTER, NOISE FREE SIGNAL PRODUCING 4 TO 5 VOLTS AGC AT TEST POINT (Ⓢ). CONTRAST AND BRIGHTNESS CONTROLS AT MAXIMUM. ALL WAVEFORMS TAKEN WITH WIDE-BAND OSCILLOSCOPE.

AGC DELAY ADJUSTMENT

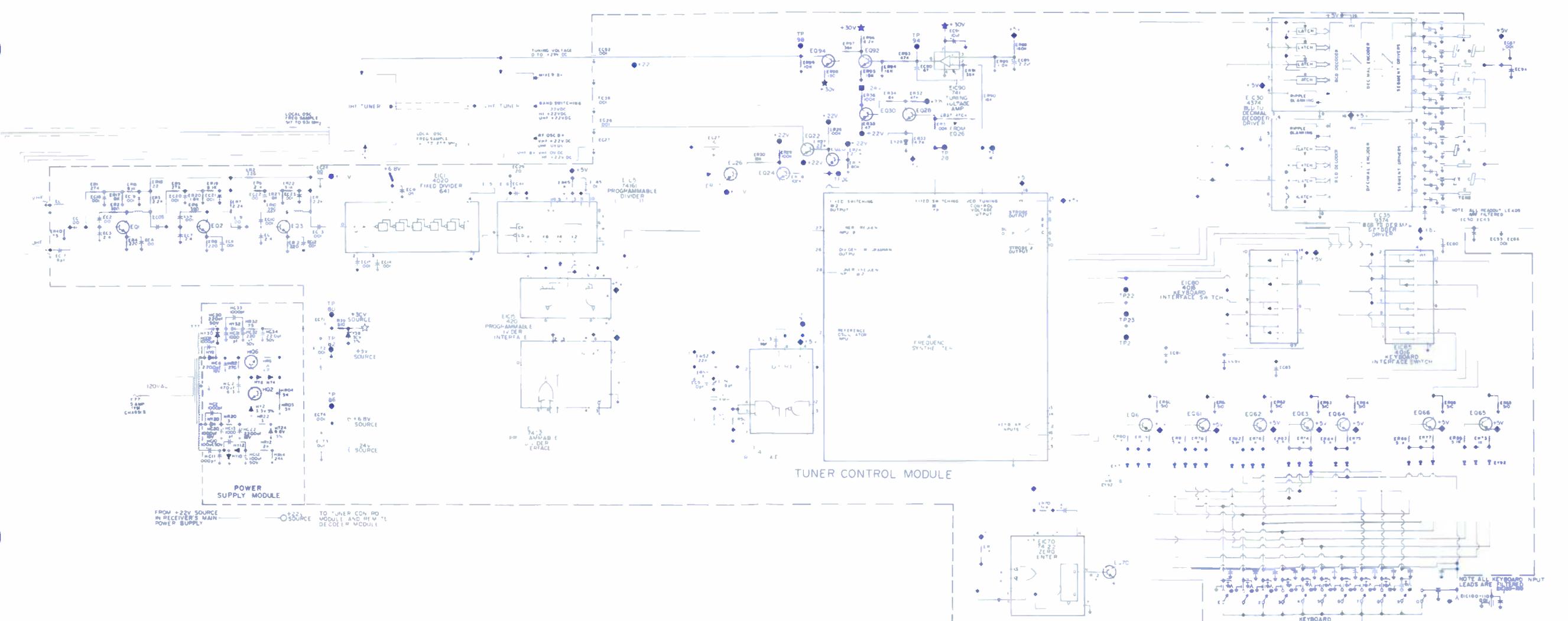
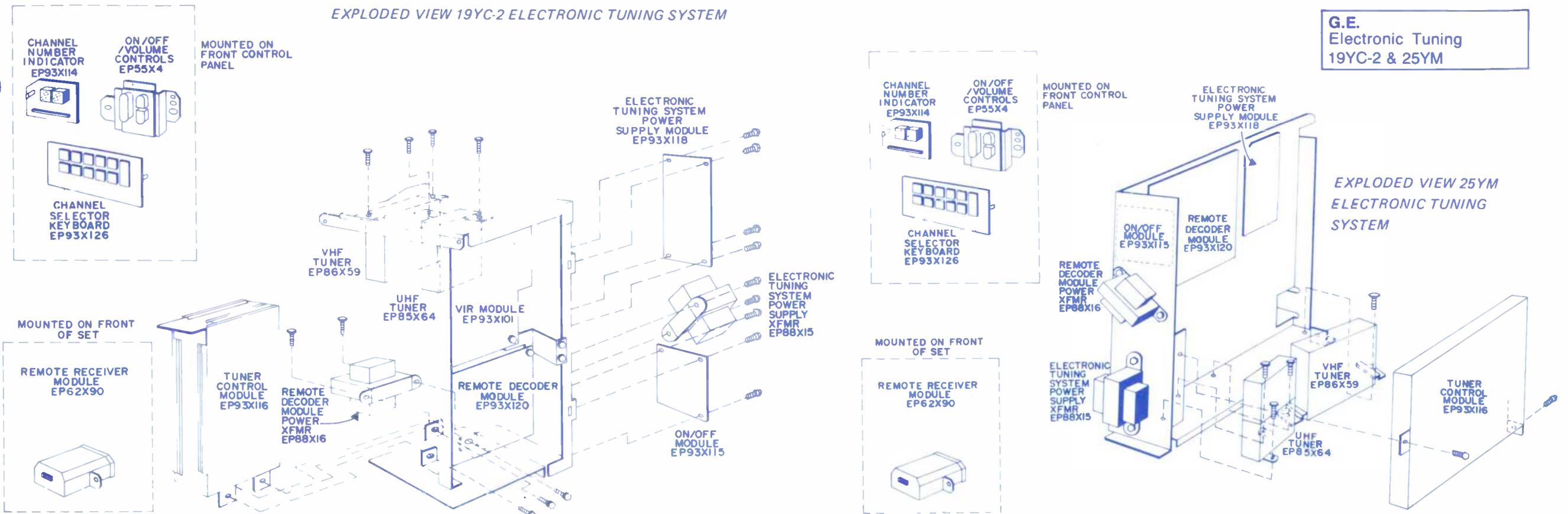
DO NOT DISTURB FACTORY SETTING OF AGC DELAY CONTROL. IF AGC DELAY ADJUSTMENT IS REQUIRED, REFER TO SERVICE MANUAL. IF NECESSARY TO DISTURB FACTORY SETTING OF AGC DELAY CONTROL, MARK ROTOR POSITION SO CONTROL CAN BE RETURNED TO ITS EXACT ORIGINAL SETTING.

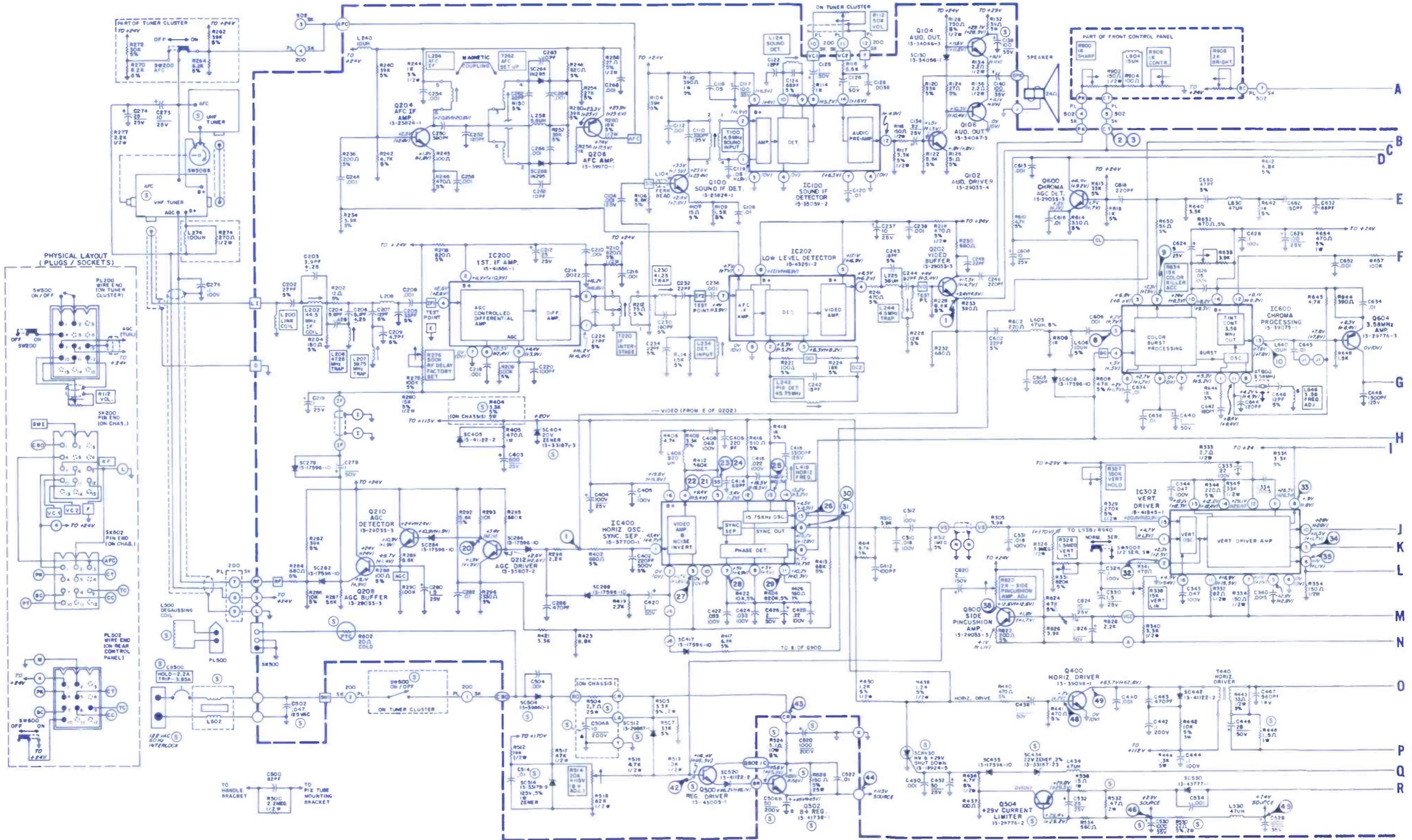
BLOCK DIAGRAM ELECTRONIC TUNING SYSTEM



EXPLODED VIEW 19YC-2 ELECTRONIC TUNING SYSTEM

G.E.
Electronic Tuning
19YC-2 & 25YM

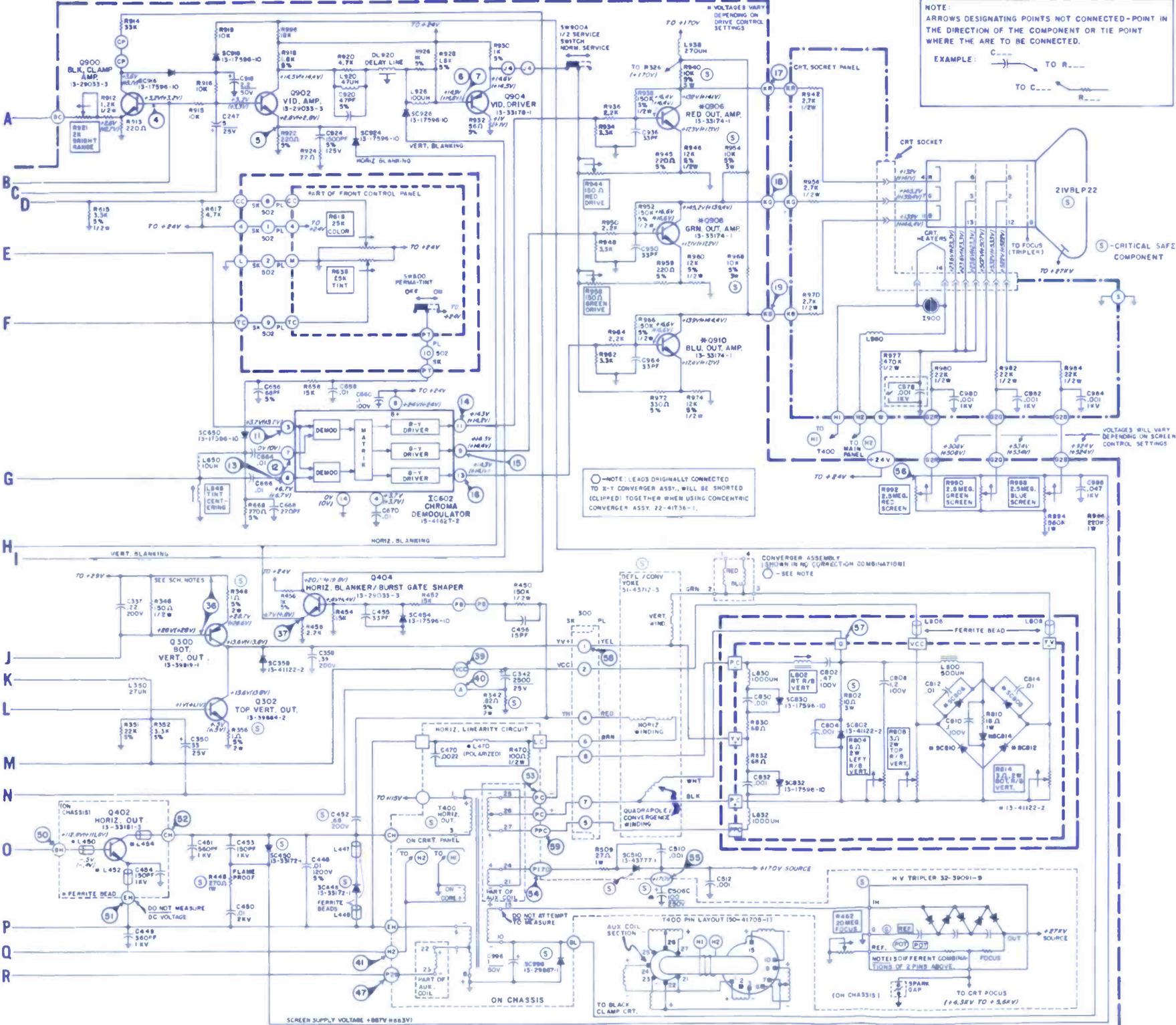
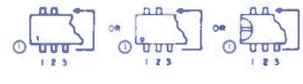




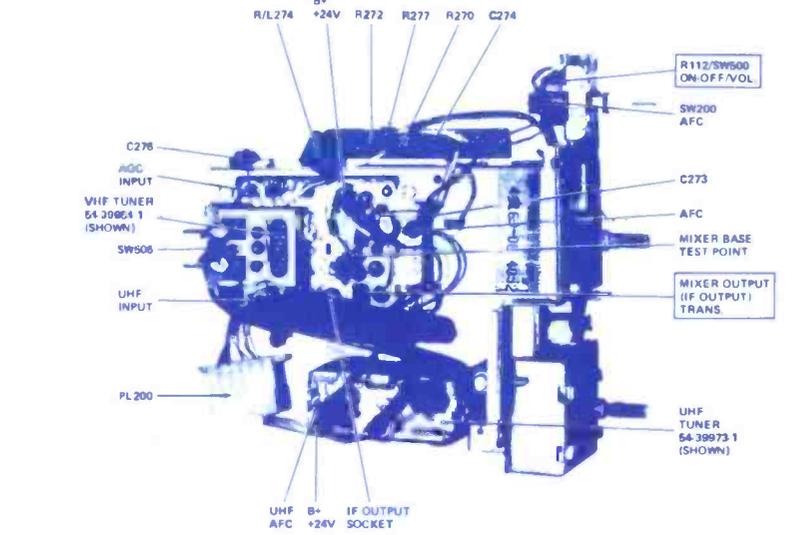
TRANSISTOR BASINGS
(# INDICATES ALTERNATE BASINGS)

- 13-25824-1
- 13-29033-3,-4
- 13-29776-2,-3
- 13-33176-2
- 13-35807-2
- 13-39970-1
- 13-29033-3,-4
- 13-29776-2,-3
- 13-33176-2
- 13-35807-2
- 13-39970-1
- 13-33174-1
- 13-39098-1
- 13-39148-1
- 13-25824-1
- 13-18924-5
- 13-33174-1
- 13-34046-3
- 13-4047-3
- 13-48008-1
- 13-33176-1
- 13-33178-1
- METAL SURFACE
- 13-39819-2
- 13-39844-2
- 13-33174-1
- 13-34046-3
- 13-4047-3
- 13-48008-1

IC KEY (TOP VIEW)

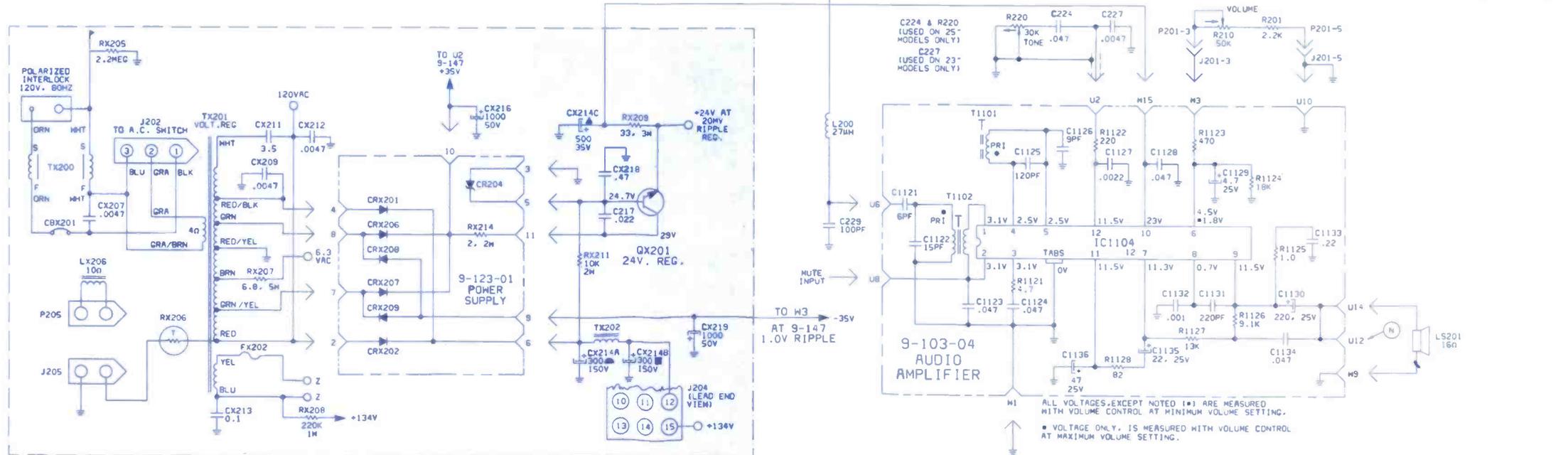
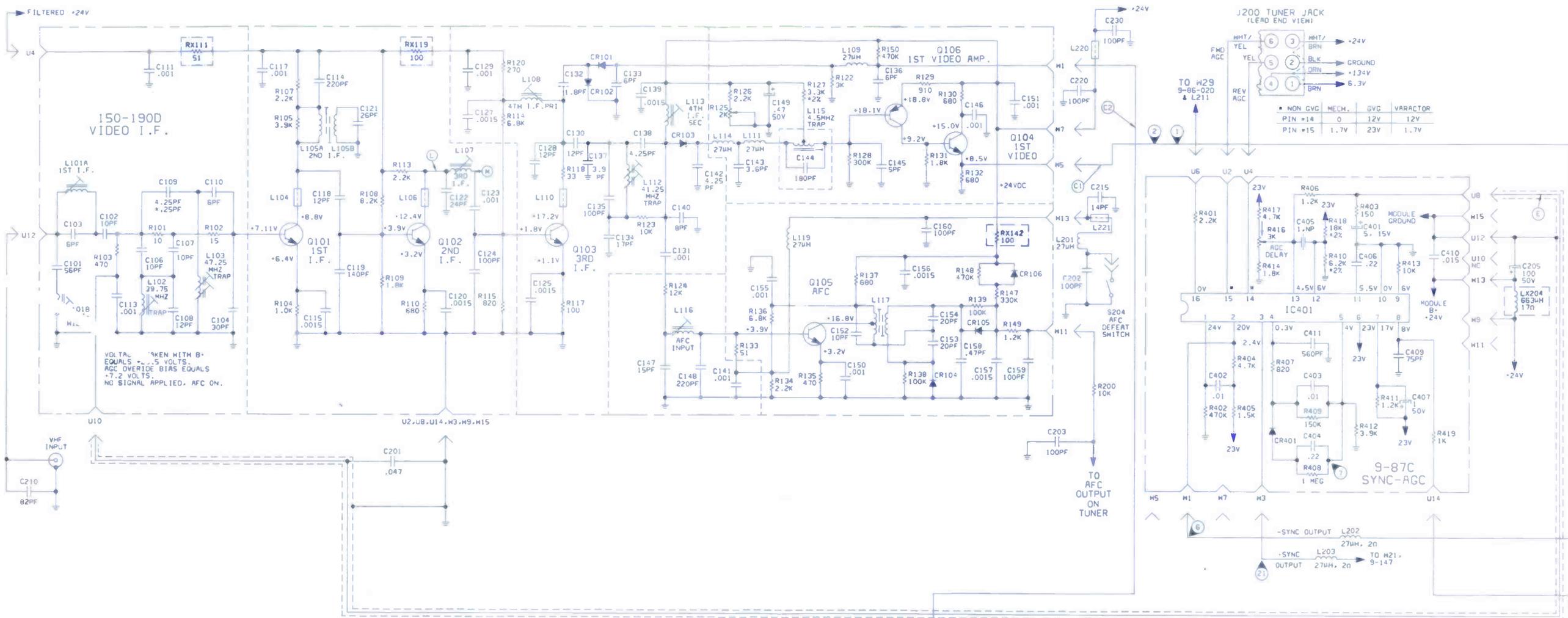


TUNER CLUSTER (E21-22 CH.)

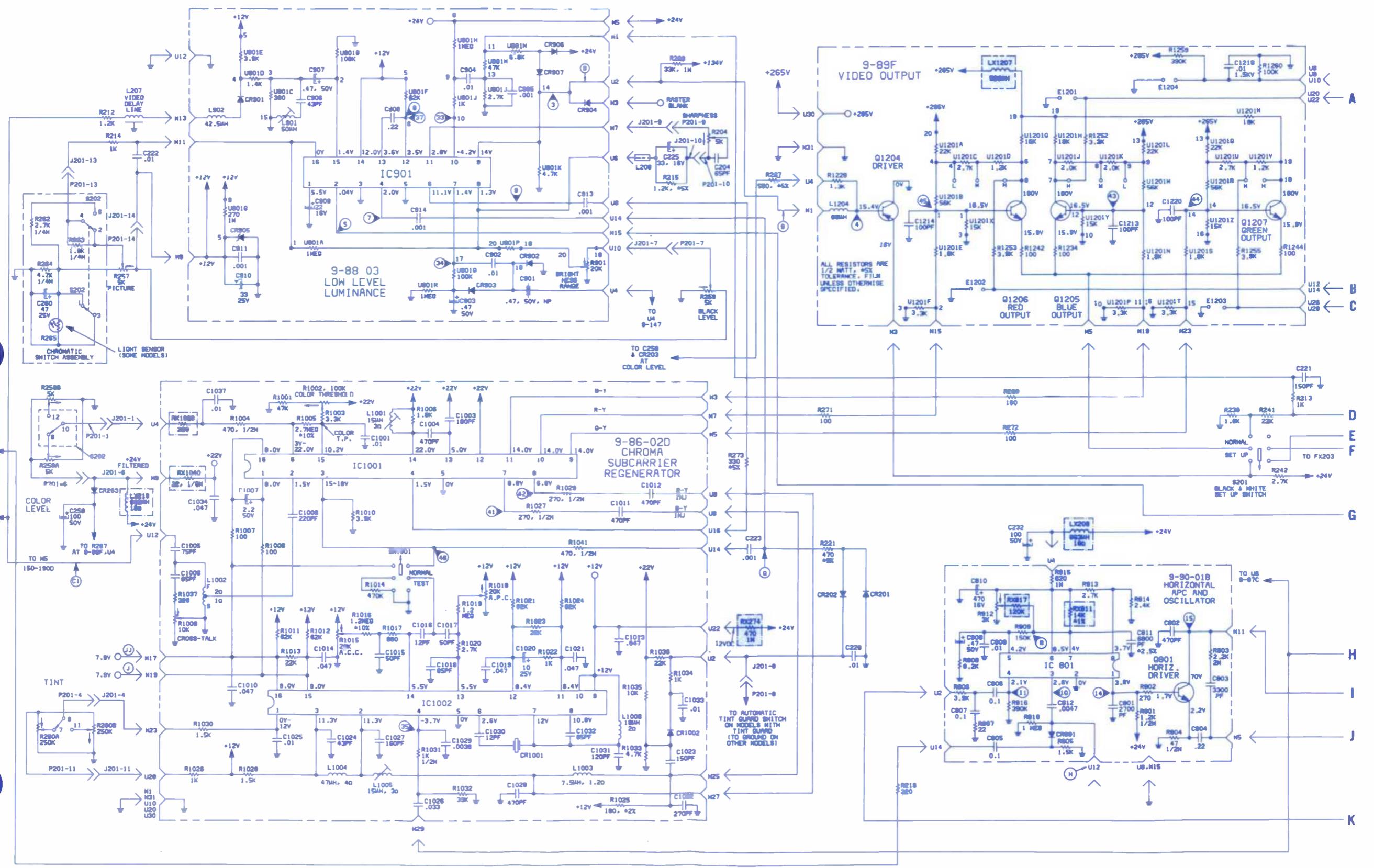


NOTE:
ARROWS DESIGNATING POINTS NOT CONNECTED-TIE POINT IN THE DIRECTION OF THE COMPONENT OR TIE POINT WHERE THE ARE TO BE CONNECTED.
EXAMPLE: TO C... TO R...

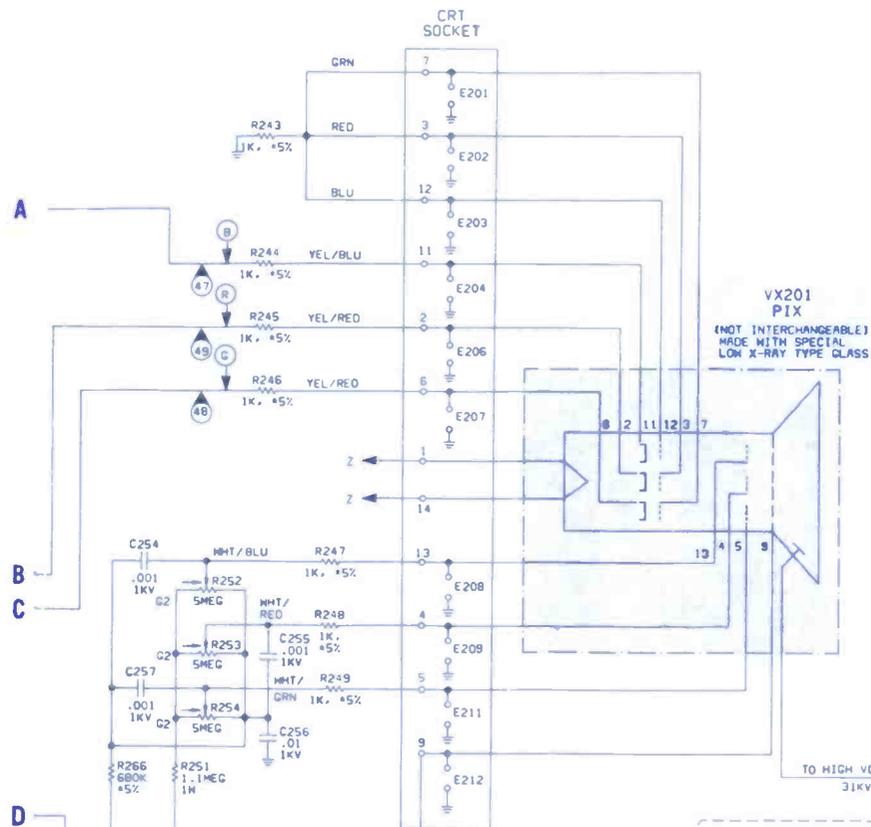
1	2.2 VPP Horiz.	2	*1.5 VPP Vert.	3	*.8 VPP Vert.	4	1 VPP Horiz.	5	1.8 VPP Horiz.	6	*6 VPP Horiz.
7	*6VPP Ver.	8	.16 VPP Horiz.	9	.5 VPP Horiz.	10	1 VPP 3.58MHz	11	.38 VPP Horiz.	12	1.5 VPP 3.58MHz
13	1.5 VPP 3.58MHz	14	6 VPP Horiz.	15	2 VPP Horiz.	16	6 VPP Horiz.	17	80 VPP Horiz.	18	40 VPP Horiz.
19	68 VPP Horiz.	20	20 VPP Horiz.	21	8 VPP Horiz.	22	8VPP Vert.	23	5.3 VPP Horiz.	24	5.3 VPP Vert.
25	5 VPP Horiz.	26	7 VPP Horiz.	27	8 VPP Horiz.	28	2 VPP Horiz.	29	4 VPP Vert.	30	15 VPP Horiz.
31	15 VPP Vert.	32	5 VPP Vert.	33	23 VPP Vert.	34	3 VPP Vert.	35	2.5 VPP Vert.	36	*2 VPP Vert.
37	4.2 VPP Horiz.	38	12 VPP Vert.	39	5 VPP Vert.	40	3 VPP Vert.	41	21 VPP Horiz.	42	9 VPP Vert.
43	6 VPP Vert.	44	9 VPP Vert.	45	25 VPP Vert.	46	2.5 VPP Vert.	47	240 VPP Horiz.	48	3 VPP Horiz.
49	150 VPP Horiz.	50	440 VPP Horiz.	51	440 VPP Horiz.	52	440 VPP Horiz.	53	100 VPP Horiz.	54	100 VPP Horiz.
55	5 VPP Vert.	56	12 VPP Vert.	57	18 VPP Vert.	58	25 VPP Vert.	59	80 VPP Horiz.		



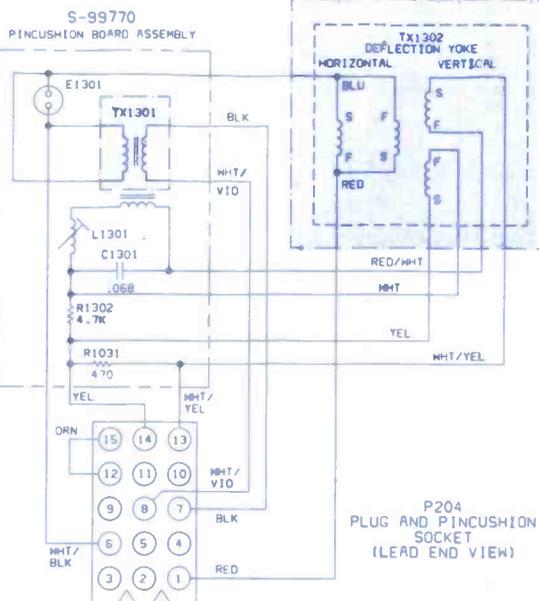
ADDITIONAL INFORMATION NEXT PAGE



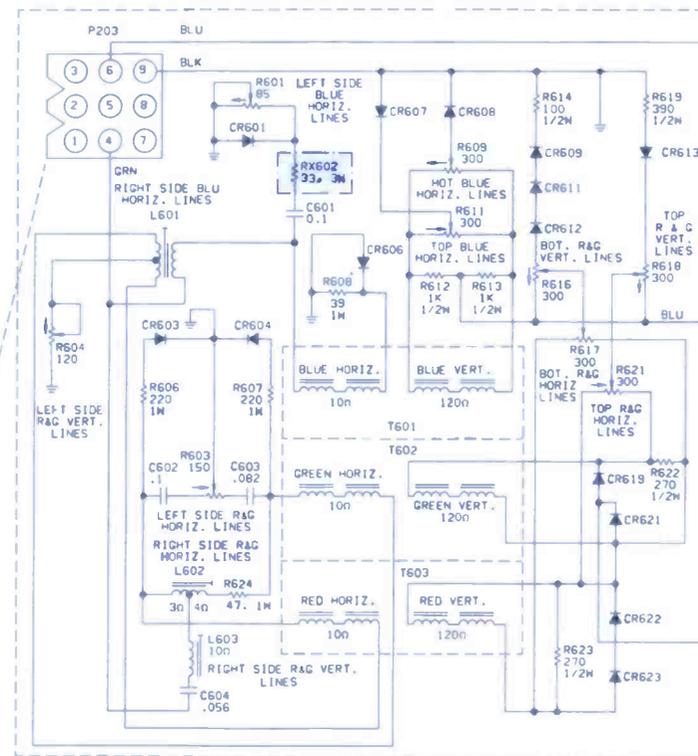
ZENITH
Color TV Chassis
25JC49



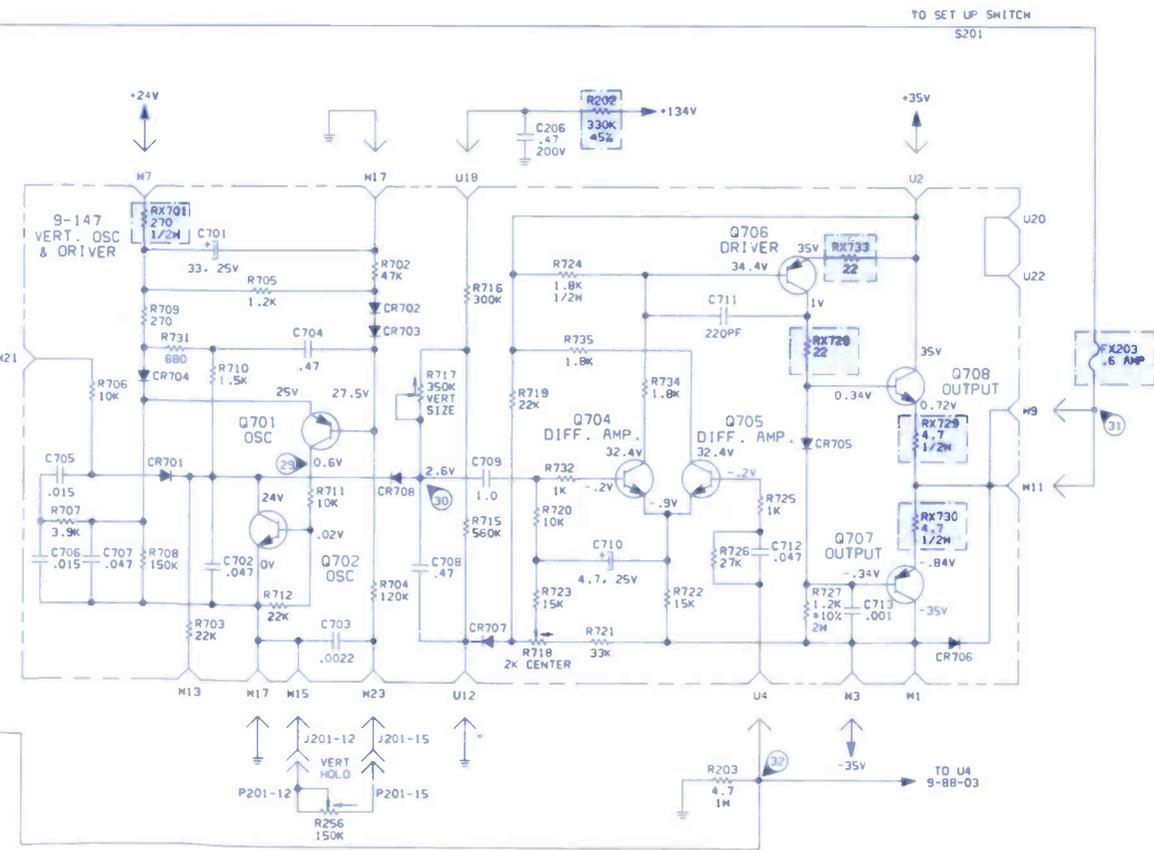
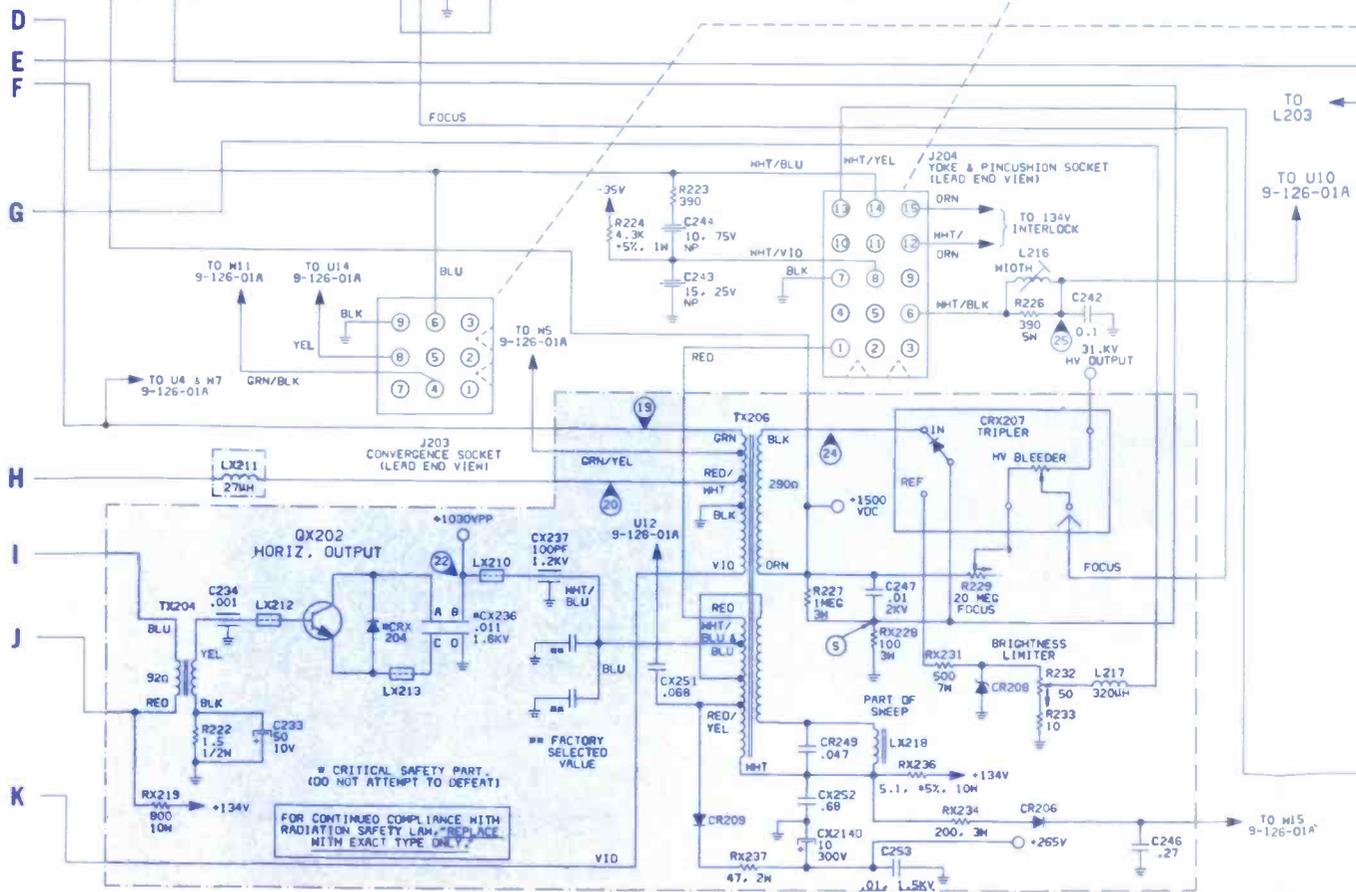
A-6598
DEFLECTION YOKE PINCUSHION BOARD & HOUSING ASSEMBLY



A-3124
CONVERGENCE ASSEMBLY



TEST POINT	FUNCTION
C1	PICTURE DETECTOR OUTPUT
C2	SOUND DETECTOR OUTPUT
D	RY-PASS WITH 25UM, .25V ELECTRO. DURING COLOR ALIGNMENT.
E	I.F. A.C.C.
H	ZERO BEAT OF HORIZONTAL HOLD
J	FOR COLOR ALIGNMENT
JJ	FOR COLOR ALIGNMENT
N	AUDIO OUTPUT TO SPEAKER
Q	A.C.C. VOLTAGE
R	RED COLOR AMP. COLLECTOR
G	GREEN COLOR AMP. COLLECTOR
B	BLU COLOR AMP. COLLECTOR
S	BEAM CURRENT ADJUSTMENT



Zenith's full line of antennas, featuring

CHROMATENNA II

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



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



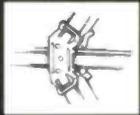
Aluminum Construction of all key metal parts works to eliminate rusting—provides long life. **Golden-Color Aloxine Finish** is conductive—helps improve electrical performance!



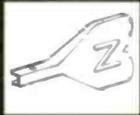
High-Impact Plastic Insulators double-lock each element to the boom for extra bracing and durability.



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



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



Zenith Dipole on UHF. (Combination models only.)



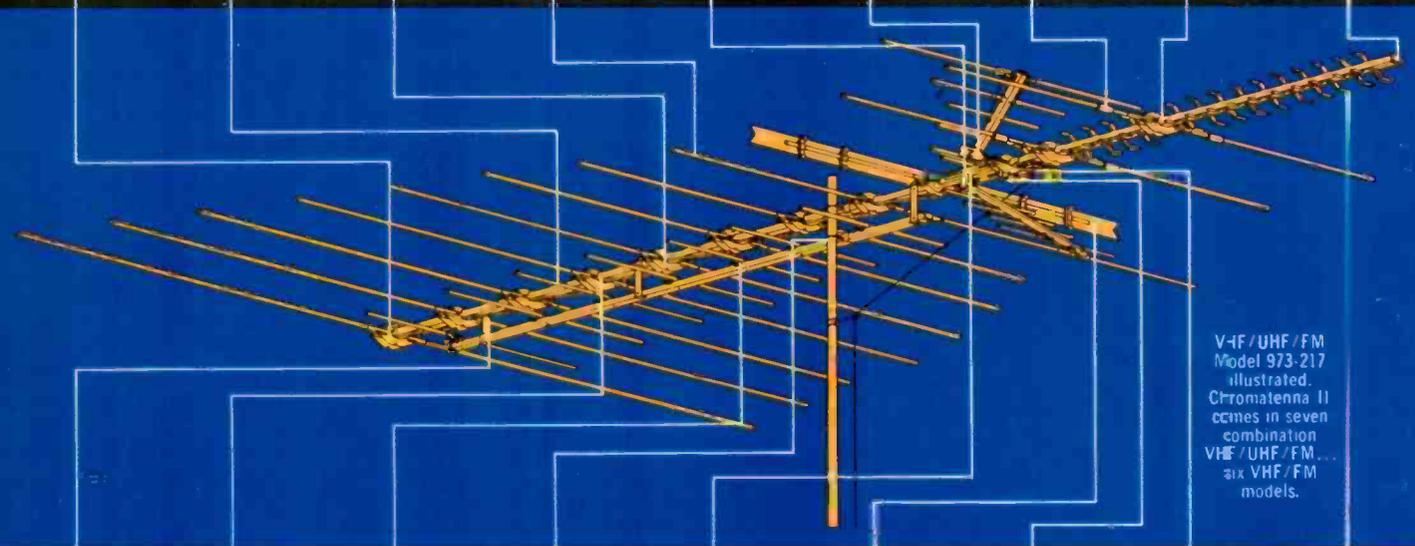
VHF Collinear Directors provide extra signal boost on both low and high band VHF.



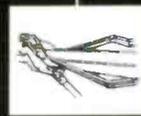
Loading Straps—metal plates close to first VHF element insulators provide compensation for Lo and High band by tuning the first driven element with extra capacity.



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



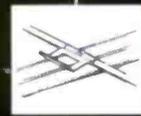
VHF/UHF/FM Model 973-217 illustrated. Chromatenna II comes in seven combination VHF/UHF/FM... six VHF/FM models.



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



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



Hi-Bracket with angled ends for added strength.



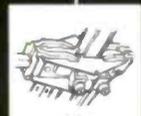
U-Bolt Mounting provides a larger clamping area; larger locking nut with teeth an integral part assures a more rugged U-BOLT arrangement.



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



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



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



Strain Relief Insulator accommodates either 300-OHM twin-lead, foam lead or Coax downlead..



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

Zenith has quality do-it-yourself antenna kits—UHF only, VHF YAGI and Stereo FM antennas as well as a complete line of reception aid equipment. See your Zenith distributor for news of his exciting, money-making Spring programs and Catalog No. 902-1760!



How to tell a Super-VOM from just the everyday garden-variety Brand X.

ONLY THE SUPER-VOM (Triplett's New 60) HAS ALL THESE FEATURES:



X'TRA RUGGED CONSTRUCTION
(For an accidental drop up to a five-foot height)

BUILT-IN "CONFIDENCE-TEST"
for periodic meter reassurance checks after overload/drops.

OVERLOAD PROTECTED
(All ranges; 3-fuse arrangement including diodes and 2 Amp/1000 V protection fuse)

SINGLE-RANGE SELECTOR SWITCH
(Most VOM's have 2 or more. Single switch minimizes range selection errors)

SAFETY DESIGNED FOR YOU
(Completely insulated; new Safety Leads; prevents explosive arcs from high energy circuits up to 20 KW)

48" SAFETY ENGINEERED TEST LEADS
(Especially designed recessed safety connectors and heavily insulated alligator clips)

ONLY 2 RECESSED INPUT JACKS
(Makes lead changes unnecessary—Some VOM's have as many as seven)

DETTENTED HANDLE POSITION

\$102

Nobody else offers these features in a VOM at any price. So for only \$102, the Model 60 is the safest, most versatile, most honestly priced quality VOM you can buy. And, for just \$8 more, you can have the Model 60-A that has 1½% DC accuracy, plus a mirrored scale.

That's the kind of Triplett one-upmanship appreciated the world over by value conscious users in industrial production and maintenance. TV - Radio - Hi-Fi shops, vocational training and hobbyists, airconditioning, appliance and automotive service, R & D, and application engineering . . . anyone who wants to be more productive with the latest in VOM technology. Model 60 Type 2 Approved by MESA. Approval 2G-2880.

Drop in on your nearest Triplett distributor or Mod Center and drop the new Model 60. Ask for a no-obligation demonstration of every feature. Compare it with any other VOM. You'll know why Triplett Models 60 and 60-A eliminate over 90% of the costly repairs from VOM misuses. Cultivate a profitable habit for selecting Triplett design-firsts.



TRIPLETT

BLUFFTON, OHIO 45817

Triplett. The easy readers

Circle No. 104 for Information—Circle No. 105 for Demonstration

NEWCOM '78
Booth K 18-22