

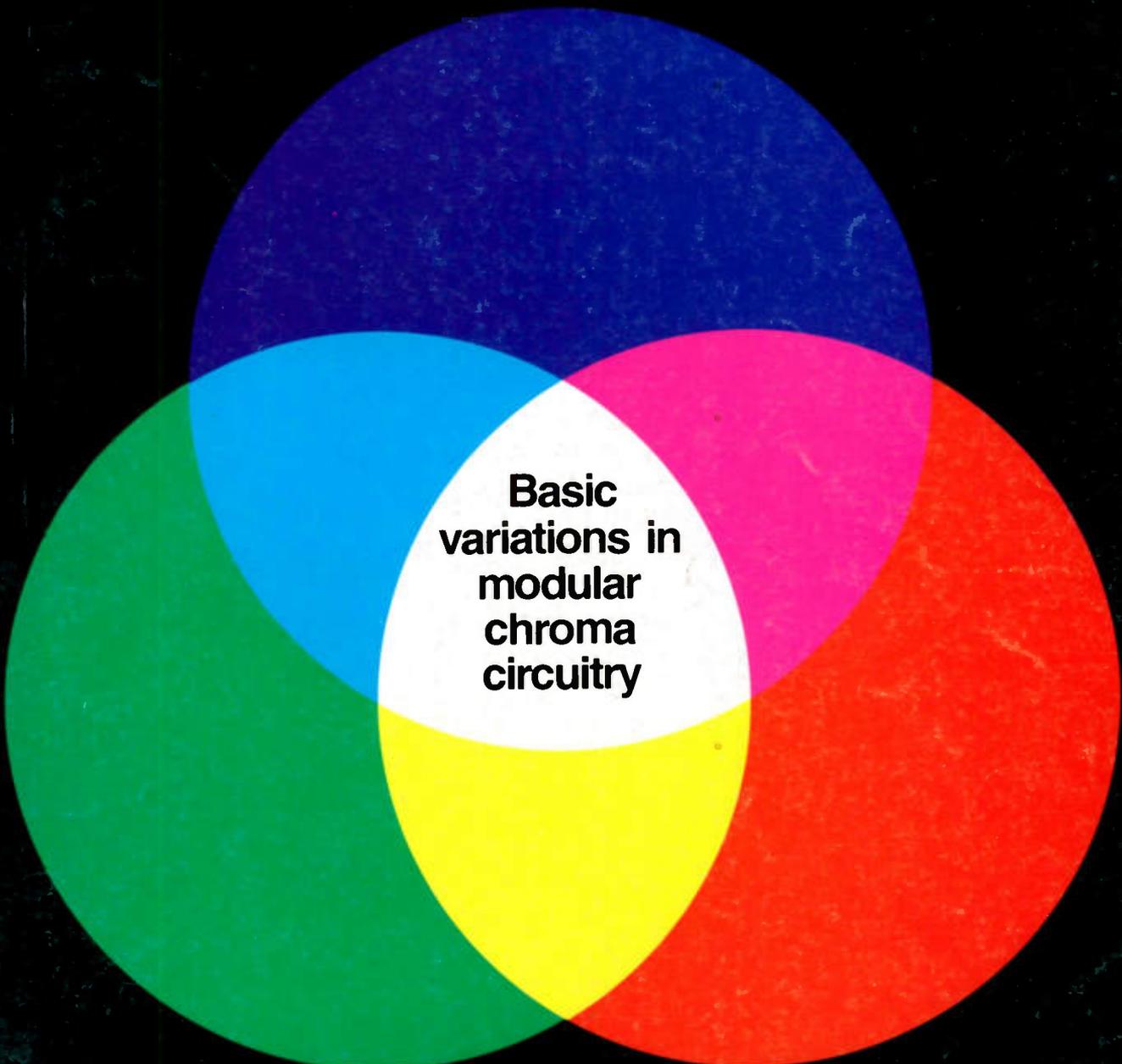
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NEWS OF THE INDUSTRY

Planners Expect 30,000 Attendance For Winter CES Show in Vegas

Winter Consumer Electronics Show planners are hoping for an attendance of some 30,000 for this January's gathering in Las Vegas.

A spokesman for the show says it is anticipated more than 500 exhibitors will be on hand for the event, to be held in the Las Vegas Convention Center and the Hilton. The Personal Communications Show, which has been merged with the Winter CES will be allotted 75,000 square feet of the total 350,000 square feet of floor space.

Meanwhile, plans for the larger Summer CES, scheduled for Chicago next June, are also moving ahead. CES officials have announced that more than a quarter of the 400,000 square feet of exhibit space will be allocated to audio systems manufacturers.

In a major drive to attract audio manufacturers, CES says it will construct 50 audio sound rooms on the Lobby Level of McCormick Place. But, the "entire facilities of the adjacent McCormick Inn, including 75 audio sound exhibit rooms and all hospital-ity suites and sleeping rooms, will be devoted exclusively for the use of audio systems exhibitors." And that's not all. Just five minutes away at the Conrad Hilton, "an additional 75 sound rooms for the exclusive use of esoteric audio systems exhibitors are being planned.

"These facilities...represent the expenditure of a quarter of a million dollars, to provide ideal show facilities for audio systems, which constitute the major portion of the Summer CES," show planners said.

RCA Predicts Record Color TV Sales

RCA Corp. reports that sales of its color television models are running at a record pace this year and predicts industrywide sales of color will be the largest since the record year of 1973 when 10 million units were sold.

A company spokesman said that the sale of RCA models is running 11 per cent ahead of last year's pace and 5 per cent above its record year of 1973. In addition, the sale of color television units industrywide this year should reach 8.8 million, up some 7 per cent over the 8.2 million units sold last year.

In the area of video games, an RCA spokesman said it is possible that as much as 70 per cent of the year's sales

will be achieved during the Christmas holiday season. RCA is looking for total industry sales of video games of some \$450 million. That would compare with 1976 dollar volume of \$225 million, when 3.6 million game units were sold.

Bleak CB Report Issued

"More than" 25 per cent of today's CB radio manufacturers will be out of the market or out of business by the end of next year, according to a report released recently by a Connecticut based market research firm.

However, the down trending CB market will be followed by "skyrocketing growth" in the use of personal two-way radio, according to International Resource Development, Inc., of New Canaan, Ct.

In a summary of a 210 page report which it recently completed, IRD said the citizens band "boom" of 1974-76 was merely an indicator of the desire for personal two-way communications. Other indicators are "the lengthy waiting lists for two-way mobile radiotelephone services in and around major metropolitan areas, and the growing popularity of radio paging services."

In effect, IRD said, the CB and telephone markets will eventually merge. "Eventually, probably by 1985, consumers will be able to purchase a cordless home telephone system for less than \$100" and some of these cordless telephones will be equipped with CB capability. This they will serve as a CB base station as well as for making telephone calls.

Overall, however, the research firm said, the long term prospects for all sectors of the mobile radio market are excellent.

California Urges Warranty Study

The California State Electronics Association, charging the current warranty system is being used by manufacturers to obtain "below cost" warranty service, has called for an end to the practice of limiting the number of shops authorized to provide such service.

The current system, the association charged, "is being used by manufacturers as economic leverage to obtain warranty work below the cost of even the most efficient service agencies."

A resolution passed by the association has asked manufacturers to make a study of repair costs and to publish prices and establish technical criteria based on the study. Then, the association says, manufacturers should authorize all service shops meeting these criteria for warranty work.

According to the association, the current warranty system gives service



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THE COVER: Color by addition. The three primary colors are combined on our cover as they are on the television screen to provide the color spectrum. See Modular Chroma Servicing feature on page 32.

21 Digital primer: Part one

As the microprocessor and other forms of digital circuitry filter into more and more consumer electronics products, digital electronics becomes a subject no qualified technician can afford to ignore. In this first article of ET/D's three part digital series, you'll learn about binary arithmetic, the key to digital logic. By Joseph J. Carr, CET

27 RCA color television 1978

Energy conservation is the key behind two new color TV chassis from RCA for 1978. We take a detailed look at their modular construction.

32 Modular chroma servicing—Part one

The first important step in servicing modular chroma is a basic understanding of what is really going on inside those IC demodulators. Here's a look at the functions they perform. By Bernard B. Daien

36 Magnetic tape recorders—A prelude to video

As a prelude to a more sophisticated look at the highly complex circuitry in today's video tape recorder/players, ET/D first reviews some principles. By Bernard B. Daien

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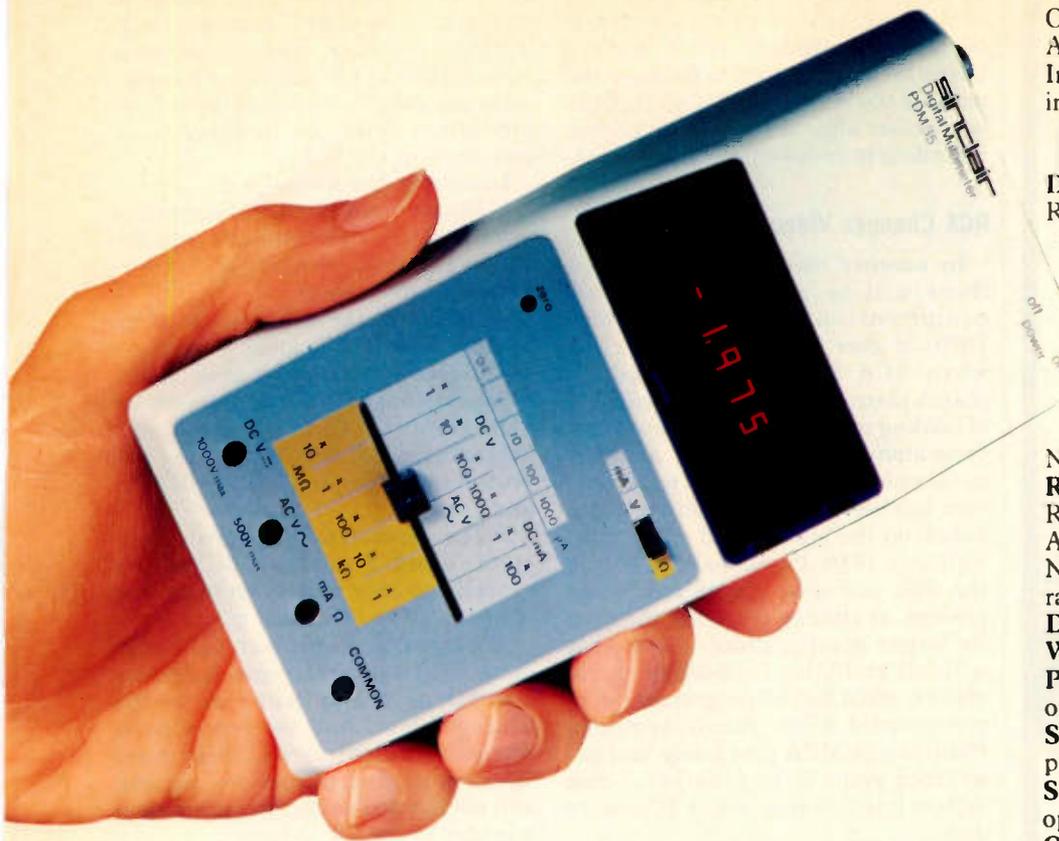
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agencies the option of accepting warranty work below cost or "effectively becoming excluded." This in turn forces service agencies to increase the price of the service that is charged to consumers after the warranty period, according to an association statement.

RCA Changes Video Disk Plans

In another move RCA announced there will be no RCA video disk equipment on the market before 1979—if ever. That was made clear when RCA announced revised research plans to develop a disk capable of holding up to two hours of television programming. In addition, an RCA spokesman said no decision, pro or con, ever has been made on whether to put a disk on the market and won't until well into 1978. Problems confronting the disk and disk player market at present, as cited by RCA, are the need for longer playing disks, a unit that will sell profitably for \$400 or thereabouts, and a lack of programming, or pre-recorded disks. North American Phillips and MCA previously had announced plans to test market a disk system late this year with a 30 minute disk.

Zenith Announces Massive Layoffs; Move to Foreign Production Sites

Massive cost-cutting programs will result in the layoff of over one-fourth of Zenith Radio Corporation's United States workforce during the next 12 months and transfer of its module and chassis assembly operations outside United States borders.

Zenith, among the last of the major U.S. TV manufacturers to hold out against the transfer of its color TV production facilities to foreign borders, will also stop making stereo units in the U.S. and instead will buy foreign made products to market under the Zenith label.

The moves are the culmination of Zenith's long-running battle for import curbs against cheaper made Japanese products. Board Chairman and President John J. Nevin said he expects the moves to put Zenith's slipping earnings picture back on the recovery track.

Zenith, which last year reported earnings of \$38.6 million, or \$2.05 per share, announced recently first half results for this year were down 11 per cent due largely to "competitive pressure from low priced imports."

The pioneer Chicago-based radio-television firm which in its national television commercials has extolled the virtues of the American worker, is running neck and neck with RCA for first place in the U.S. television market. In announcing the cutbacks, Nevin said "Zenith has tried longer

and has tried harder than others to protect the jobs of its U.S. employees. It is clear, however, that competitive manufacturers are obtaining increasingly significant cost advantages from production activities in lower-labor cost areas of the world."

In essence the moves will:

—Result in the immediate layoffs of some 600 salaried employees—including technicians—working at its Glenview research center.

—Result in the elimination of an overall 5,600 U.S. jobs. Television module production and chassis assembly operations will be transferred from U.S. plants in Chicago, Paris, Ill., Springfield, Mo., Sioux City, Ia., and Watsontown, Pa., to plants in Mexico and Taiwan.

—The decision to buy stereo equipment, about 9 per cent of Zenith's overall business, will result in the loss of about 1,500 U.S. jobs.

A company statement said that some final color television assembly operations would continue in the Chicago plant. And the reduction in research staff, primarily middle management engineers and technicians, will not jeopardize Zenith's position as a leader in the TV industry.

However, it does mean the previously announced video-disk program and flat panel television screen will be eliminated as research projects. "We haven't taken actions that would impair Zenith's ongoing business opportunities," Nevin said.

The severe cutbacks by Zenith come on the heels of the company's announcement that it was cancelling its cooperative effort with the Corning Glass Company to develop a picture tube envelope that was to have resulted in substantial production cost savings in conjunction with the manufacture of Zenith's CRT gun. The savings never materialized.

Home Computers: Your Next Service Opportunity?

The "home computer," that mysterious black box that will assist the homeowner-businessman with his budgeting, financing, and inventory control, and the housewife with shopping lists, scheduling and graphic designs (for sewing), is an evolving service opportunity area for existing consumer electronics repair shops.

Who says so? Vantage Research, Inc., a California based market research firm which told attendees at the recent Wescon '77 show in San Francisco that by 1982 the "personal computer" market will total \$1.15 billion.

There are 50,000 "hobby" and "personal" computers in use in the United States now. (In fact Macy's in San Francisco is selling them over-the-

counter). This Christmas season will see another 30,000 enter American homes, according to Vantage Research Company spokesman Robert F. Wickham.

"During 1977 a number of products will be introduced which are aimed specifically at the home computer market. The first of these is the Commodore PET priced at \$495," he said. "Additional products from National Semiconductor and Radio Shack will also have a heavy consumer orientation."

"These products are expected to have retail sales valued at \$25 million in 1977 (and) distribution is through computer stores, consumer electronics shops and department stores," he added.

Who's going to repair these units, which now range in price from \$500 to \$1,500? Wickham says this:

"Repair and maintenance of home computer systems is expected to be handled primarily by the existing consumer electronics repair shops located throughout the country. Just as CB radio has been absorbed by a combination of independent service shops and factory repair stations, this same type of service will be extended to programmable video games and home computers. Initially, the service will have to be handled by factory repair stations since the small number of systems in the field will not justify the educational upgrading of the service technicians."

"The expected introduction of general purpose programmable game systems into TV consoles by 1978 will bring the TV oriented service shops into the computer age and allow them to expand the base of service to include home computers."

"In addition, the computer retail stores and the large retail chains will continue the 'service what we sell' philosophy and offer repair services. It should be noted that diagnostics can be incorporated in the home computer system which will indicate the need for service and help the technician locate the trouble in the equipment. In the event of complete failure, normal troubleshooting methods would be used with the assistance of MPU based test equipment."

Wickham said home computers will be popular with families with children where academic achievement is important. Repetitive math, reading and interactive instruction will be used.

Another area just emerging is the computer monitoring of personal health and diet, he said. "The home computer would be connected to a set of peripheral sensors which would provide inputs regarding body condition" and the effects of diet, exercise and other activities could be interpreted by the computer for the user. ■



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2SA 561 .59	2SB 400 .59	2SC 627 1.60	2SC 1096 1.00	2SC 1908 .59	3SK 40 2.25		
2SA 562 .59	2SB 405 .70	2SC 632A .70	2SC 1111 3.40	2SC 1909 4.40	3SK 41 2.50		
2SA 564A .59	2SB 407 1.40	2SC 644 .59	2SC 1116 4.40	2SC 1951 1.10	3SK 45 2.50		
2SA 565 1.10	2SB 415 .70	2SC 645 .70	2SC 1166A 4.90	2SC 1957 1.20	MK 10 2.00		
2SA 566 3.40	2SB 434 1.20	2SC 650 1.30	2SC 1124 1.30	2SC 1969 4.90			
2SA 606 1.90	2SB 463 1.50	2SC 668 .59	2SC 1162 1.10	2SC 1973 1.10			
2SA 624 1.10	2SB 471 1.60	2SC 680 2.80	2SC 1166 59	2SC 1975 4.40	AN 2140 IC 3.40		
2SA 627 3.60	2SB 472 2.80	2SC 684 1.40	2SC 1175 90	2SC 2028 .90	AN 315 3.70		
2SA 628 .59	2SB 474 1.20	2SC 693B .59	2SC 1177 14.00	2SC 2029 3.90	BA 511 3.40		
2SA 634 .90	2SB 492 1.00	2SC 696 1.95	2SC 1189 1.40	2SC 2091 3.60	BA 521 3.70		
2SA 640 .59	2SB 507 1.60	2SC 708A 1.90	2SC 1210 70	2SC 2092 3.90	HA 1151 3.70		
2SA 643 .70	2SB 509 1.90	2SC 710 .59	2SC 1213 .70	2SC 2098 3.90	LA 4400 3.70		
2SA 659 .59	2SB 514 1.90	2SC 711 .59	2SC 1222 4.50	2SD 28 2.80	TA 7045M 3.00		
2SA 663 4.90	2SB 516 1.30	2SC 712 .59	2SC 1226 1.00	2SD 75 1.10	SN 7400 .19		
2SA 666 .70	2SB 527 1.90	2SC 717 .59	2SC 1237 4.25	2SD 90 1.60	SN 7490 .60		
2SA 672 .70	2SB 528D 1.60	2SC 730 4.40	2SC 1239 3.50	2SD 91 1.60	TA 7055P 3.00		
2SA 673 .70	2SB 531 3.40	2SC 732 .59	2SC 1279 7.70	2SD 92 1.50	TA 7060P 1.60		
2SA 678 .70	2SB 536 1.60	2SC 733 .59	2SC 1306 4.40	2SD 118 3.00	TA 7061AP 1.90		
2SA 683 .70	2SB 537 1.60	2SC 734 .59	2SC 1307 4.90	2SD 130 1.20	TA 7062 1.90		
2SA 684 .70	2SB 539 4.90	2SC 735 .59	2SC 1312 .59	2SD 142 2.00	TA 7205P 3.90		
2SA 695 .70	2SB 541 4.40	2SC 738 .59	2SC 1313G .59	2SD 143 2.80	TA 7310P 3.95		
2SA 697 .70	2SB 554 10.00	2SC 756 2.80	2SC 1317 .59	2SD 178 1.40	uPC 592H2 1.60		
2SA 706 1.60	2SB 557 3.40	2SC 763 .59	2SC 1317 .59	2SD 180 2.50	PLL 02A 8.80		
2SA 715 1.40	2SB 561B .70	2SC 773 .70	2SC 1318 .59	2SD 187 .59			
2SA 719 .70	2SB 564 .90	2SC 774 1.60	2SC 1327 .59	2SD 188 3.00			
2SA 720 .70	2SB 595 1.90	2SC 775 1.95	2SC 1330 1.50	2SD 205 1.40			
2SA 721 .70	2SB 600A 7.00	2SC 776 2.65	2SC 1342 .59	2SD 217 4.40			
2SA 725 .59	2SC 183 .59	2SC 777 3.50	2SC 1344 .59	2SD 218 3.70			
2SA 726 .59	2SC 184 .59	2SC 778 3.60	2SC 1345D .59	2SD 223 1.90			
2SA 733 .59	2SC 281 .59	2SC 781 2.65	2SC 1359 1.40	2SD 224 1.90			
2SA 740 2.65	2SC 284 1.40	2SC 783R 3.60	2SC 1360 1.00	2SD 226 1.60			
2SA 744 3.70	2SC 367 .90	2SC 784 .59	2SC 1362 .59	2SD 227 .59			
2SA 747 4.40	2SC 369 .70	2SC 785 .70	2SC 1364 1.40	2SD 234 1.00			
2SA 745R 4.40	2SC 371 .59	2SC 789 1.00	2SC 1377 4.90	2SD 235 1.00			
2SA 750 .59	2SC 372 .59	2SC 793 2.80	2SC 1383 .59	2SD 287 3.70			
2SA 756 3.40	2SC 373 .59	2SC 799 3.60	2SC 1400 .59	2SD 313 1.10			
2SA 758 5.80	2SC 374 .59	2SC 815 .59	2SC 1402 3.70	2SD 315 1.20			
2SA 774 .59	2SC 380 .59	2SC 829 .59	2SC 1403 3.70	2SD 325 1.10			
2SA 777 1.10	2SC 381 .59	2SC 838 .59	2SC 1419 1.10	2SD 356D 1.10			
2SA 798 .70	2SC 382 .59	2SC 839 .59	2SC 1444 2.80	2SD 357D 1.00			
2SA 814 1.90	2SC 387 .59	2SC 870 .59	2SC 1448 1.10	2SD 358 1.30			
2SA 816 .70	2SC 394 .59	2SC 871 .59	2SC 1449 1.00	2SD 360 1.20			
2SA 818 1.40	2SC 430 1.10	2SC 897 2.65	2SC 1451 1.60	2SD 371S 2.80			
			2SC 1475 1.40	2SD 382 1.40			

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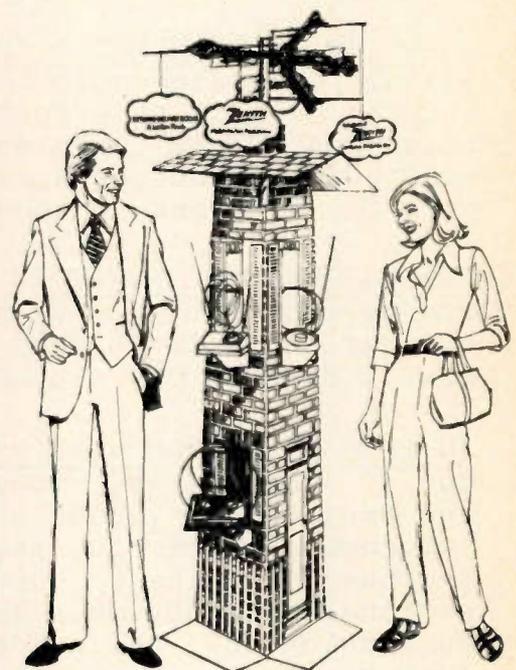
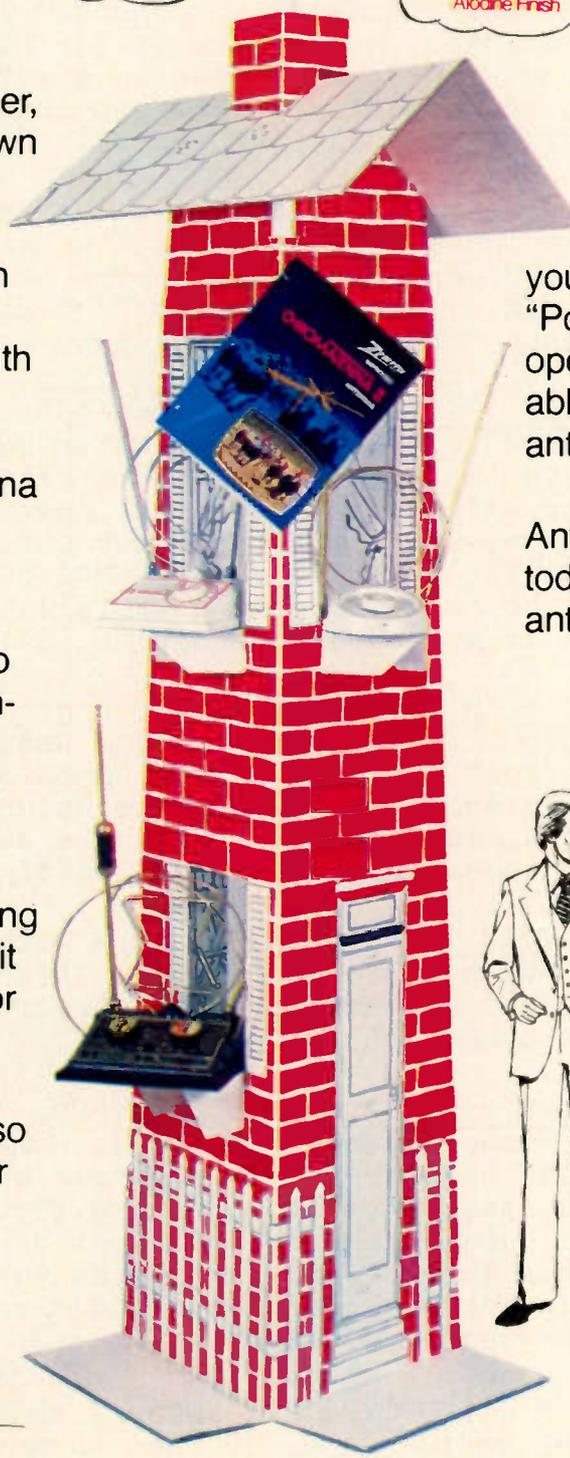
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NOVEMBER 1977, ELECTRONIC TECHNICIAN/DEALER / 7

NEWSLINE

DANA LABORATORIES IS SOLD. Dana Laboratories, a wholly-owned subsidiary of Dana Electronics, Inc., of Irvine, California, has been sold to Racal Electronics, Ltd., a British firm listed on the London Stock Exchange, with annual sales reported at 200-million pounds sterling, which in American money, amounts to around \$350-million. Racal already operates a division called Racal Instruments, Ltd., which will be combined with the Dana acquisition to become Racal-Dana Limited in England, Racal-Dana, Inc., in the U.S., and Racal-Dana SA in France. A Dana Electronics spokesman said that his firm felt that Dana Laboratories, a producer of digital multimeters, frequency counters and timers, had grown to a point where further development required the additional strength that could only be provided by a company of Racal's caliber.

GE RECEIVES AN EMMY. General Electric has been given an Emmy award from the TV broadcast industry for outstanding achievement in engineering development through the first application of the Vertical Interval Reference (VIR) signal system to TV receivers. The VIR feature was added to the GE color TV line last year.

NEW OPTICAL VIDEO DISK IS DEVELOPED. A new optical video disk that can store recorded television programs on both sides has been developed by the North American Philips Corporation and MCA, Inc. It isn't the first two-side disk announced, however. RCA has already demonstrated a two-side prototype disk but hasn't decided whether or when to market it. The Philips-MCA disk and player, it is reported, will be test-marketed next fall. Philips is a manufacturer and MCA is a producer of movies, TV shows and records.

COAST GUARD TO MONITOR CB RADIO. The U.S. Coast Guard says it will install CB radio equipment at its Search and Rescue stations throughout the U.S. in an effort to improve its communication link with the thousands of small boaters. Decision as to which channel will be monitored has not been made yet, but the Guard says it intends to have the monitors in operation by the 1978 boating season.

RCA HAS RECORD PROFIT IN THIRD QUARTER. RCA earnings in 77's 3rd quarter rose 88% on sales increase of 10%. This is the 3rd best quarter in their 58-year history -- and the third record quarter in a row. Comes to 82¢ a common share.

BUYER'S GUIDE FOR HOME VIDEO PRODUCTS LAUNCHED. A sign that the day of video games, videocassette recorders, home video cameras, and projection systems has arrived is provided by the newly launched consumer publication, "Video." The first edition of this new buyer's guide to home video products went on sale at newstands nationally on November 1st. According to the publisher, Reese Publishing Co., the guide will provide product comparisons, manufacturers' list prices and specifications.

RECORD SALES WEEK FOR COLOR TV. EIA reports that dealers bought more color TV in week ending Sept. 30 than in any other week in history. Total of 321,700 sets were sold, with a year-to-date total of 5,887,236.

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New Compact Portable Model 461

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- Bright 0.43" LEDs, automatic zero
- High-impact case with tilt-view adjustable handle
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For \$299:

Deluxe 460-3A

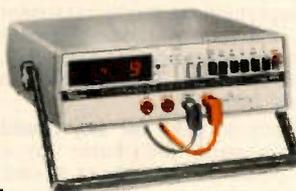
- 0.1% DC V accuracy, custom MOS/LSI circuitry
- 32 ranges including low power resistance ranges and 10A AC/DC current
- Bright 0.43" LEDs, automatic ZERO
- Calibrated auxiliary analog meter
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For \$275:

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- 29 ranges including low power resistance
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NOVEMBER 1977, ELECTRONIC TECHNICIAN/DEALER / 9

TECHNICAL LITERATURE

Two-way Radio Test Equipment is fully described in a new catalogue issued by Motorola. The new literature covers 31 of the newest equipment additions to the firm's line. It includes, in full-color, information about the R-1200A service monitor, the R-1010A signal generator, the S-1338A FM station monitor and numerous other test instruments for the required maintenance and repair of all FM two-way radio communications equipment. For a free copy, contact Barbara Bennett, *Motorola Literature Distribution Center*, 1301 E. Algonquin Road, Schaumburg, IL 60196.

Prepackaged Electronic Components available for self-service selection are covered in a comprehensive catalog from Sprague Products. Catalog C-651 contains 28 pages of information on carded components ranging from all types of capacitors, including trimmers, to carbon-film and vitreous-enamel resistors, silicon and germanium transistors, rectifiers, diodes, integrated circuits, quartz crystals, optoelectronic devices, switches, wiring components, pulse transfer

mers, and CB noise filters. Available free from Sprague distributors, or from Technical Information Service, *Sprague Products Company*, 65 Marshall Street, North Adams, Mass. 01247.

Remote Control Switches in sizes 30 to 4000 amps are contained in a new catalog from Automatic Switch. Used in existing or new buildings, these switches turn lights on or off using any number of push button control stations, photo-electric devices and timers. The new catalog describes where and why remote control switches are used, how they are operated, how to select them, and numbers, ratings and dimensions. Available free from *Automatic Switch Co.*, Florham Park, N.J. 07932.

A New, Miniaturized Catalog of silicon rectifier bridges, diodes, high voltage rectifiers, assemblies and TV high voltage diodes is available now from Electronics Devices. The rectifier bridges covered are standard, fast recovery, high surge, and three phase bridges with ratings up to 30 amp. and to 1,000 volts PRV. The diodes offer fast and standard recovery with ratings to 15,000 PRV and currents to 6 amp. High voltage packs, TV diodes, industrial multiplies, and X-ray assemblies are also covered. The catalog

is free from Sales Manager, *Electronic Devices, Inc.* 21 Gray Oaks Ave., Yonkers, N.Y. 10710.

Personal Computing Systems are fully described and priced in a new full-color booklet from Heath Company. Covered in detail are the firm's new 8-bit and 16-bit digital computers, H8 and H11. The catalog describes in detail the many functions performed by both computers, along with a listing and description of accessories, software and accompanying literature. The booklet is free from *the Heath Company*, Benton Harbor, Michigan 49022.

A New Consumer Products Line Catalogue from Channel Master is available now. The 32-page, full color catalogue illustrates and describes 7 home stereo compact systems, an 8-track deck, 3 bass reflex ported speaker systems, 4 portable cassette player/recorders, 2 FM/AM digital clock radios, a variety of FM, AM, and multi-band radios, 3 CB transceivers, base stations and hand-held microphones, 10 channel scanners, 8 automobile radios and tape players, and 5 car stereo speaker systems. Dealers may obtain the catalogue by writing on their letterhead to Consumer Products Dept., *Channel Master*, Ellen-ville, N.Y. 12428.

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Platt also has rugged hardware. Like an aluminum rim for extra strength. Steel core handles. And tough brass locks. Inside there are compartments for larger tools, parts boxes and testing equipment. And multiple lid pockets for paper and order books.

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Semiconductor Products, in a broad range, are listed and described in the newest cross-reference product guide from Mallory. The new catalog (9-710D) describes the firm's lines of transistors, complementary pair transistors, zener diodes, diodes, high-voltage components, color crystals, integrated circuits and field effect transistors. The guide is free at distributors and *Mallory Products Co.* field sales offices.

The Complete Audio And Recorder product line from Robins Industries is covered in the latest catalog available now. Robins features, in the catalog, 79 price reductions, 41 new products, 132 new bulk packed items, and in total, the catalog lists more than 308 products. The combined catalog/price sheet simplifies the buyer's job in locating product descriptions and total cost structure. Pricing information includes suggested list, professional net, dealer, standard packaging and other pertinent data. New items shown for the first time include: entertainment/PA microphones, stereo headphones, hi-fi switches, L-pads/crossover networks, intercom systems, telephone accessories, and a cassette storage carousel. Available free from Charles Condikey. *Robins Industries Corp.*, 75 Austin Blvd., Commack, N.Y. 11725.

Portable Electronic Thermometers are described in new literature from Pak-Tronics, Inc. The two-sided data sheet describes the ability of the thermometers to check indoor, outdoor, air or fluid temperature, food storage areas, temperature baths, freezer zones, hot houses and greenhouses and other industrial installations. The literature is free from *Pak-Tronics, Inc.*, Dept. 1750 PR, 4044 N. Rockwell Ave., Chicago, Ill. 60618.

Cable Connectors for CB Radios are described in new literature from Switchcraft. The brochure covers the company's line of CB connectors, or cord plugs and receptacles that also can be used with other radio and communications gear. The literature is free from *Switchcraft, Inc.*, 5555 N. Elston Ave., Chicago, Illinois 60630.

A CB Coil Replacement Guide and cross reference to 67 CB trade names is now available from Bell Industries. Some 3,300 manufacturer part numbers are cross referenced to the J.M. Miller line of replacement coils for color and black & white TV, radios and audio equipment. Coils are available at local distributors. The 12-page guide is available from Jerry Hall, Operations Manager, *Bell Industries*, J.W. Miller Division, 19070 Reyes Avenue, Compton, California 90224. ■

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FROM THE EDITOR'S DESK

The future of the home TV receiver



The home entertainment electronics industry has entered another great evolutionary period and its thrust will be to keep the color television receiver at the very center of the American family's attention.

But, unlike the changes we've seen in the past—the change from electron tubes to transistor to integrated circuits and modular construction—the new thrust involves not only changes in technology but also in the functional use to which the TV receiver is put.

The implications of this for the service industry are very important. It means American families will be using their television receivers just as much—if not more—than in the past. But the way in which they use them will change to a large extent. The receiver will no longer be an end in itself in all cases, but will become just a component of another totally different functional system. Witness the popularity explosion of video games and the expansion of the home video recorder/player market which is occurring right now.

The point is, all of these events translate into an important development for the home servicer of electronic products. It means continued service opportunities in regard to traditional service products, i.e., television, stereo, CB, two-way. But it also means added service opportunity in relations to the new products that will interact directly with a family's home television receiver.

I am not suggesting there is much to be gained in servicing a home video game which retails for \$39.95. I am suggesting there are now developing opportunities for larger, more expensive television "add on" devices. Specifically the home video recorder/player and, perhaps at some future date, video discs if companies currently attempting to bring these units onto the market are successful.

Beyond this, we are told of a burgeoning potential for additional home service opportunities in the "home" minicomputer area. I've heard one estimate that by 1982 as many as 2 in 10 American households will own their own minicomputer system—a system that will sell for about \$600.

All in all, for the price of learning and keeping updated on the advances in electronic technology as they relate to these new products, the independent service shop will be in a position to add significantly to the profit potential of the business. Already we see digital technology impacting the nation's service shops in television electronic tuning assemblies, DVMS and counters. This trend, I feel sure, will grow virtually across the board in all areas of consumer electronics.

This is one reason I would like to call your attention to the first article this month in a series on digital concepts which ET/D will be running. It is an important subject. If it's new to you, you'll need it. If you are already familiar with digital, the series should provide you with a quick and concise review.

Sincerely

Richard M. Lay

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before, and all this.

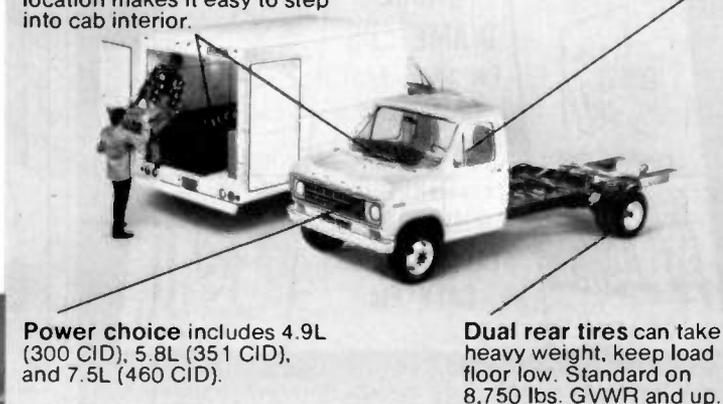
One look tells you why Ford's your first choice in Parcel Delivery vans. Its 14-ft. body is largest of any Parcel Delivery van. And 40% more cube than Ford's previous design body means you can take on bigger jobs! 8 ft. wide, 6'2" headroom. GVWR's now go to 10,000 lbs.! 12-ft. body also available. Cruise-O-Matic Drive available. Ford's way out front in vans!

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Roomy design. Plenty of up-front move-around room—and wide doors. Forward axle location makes it easy to step into cab interior.

New tilt steering wheel option for extra driving comfort, in-and-out ease.



Power choice includes 4.9L (300 CID), 5.8L (351 CID), and 7.5L (460 CID).

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93 out of 100 of all Ford Trucks registered over the last 12 years are still on the job. (Based on data as of July 1, 1976.)

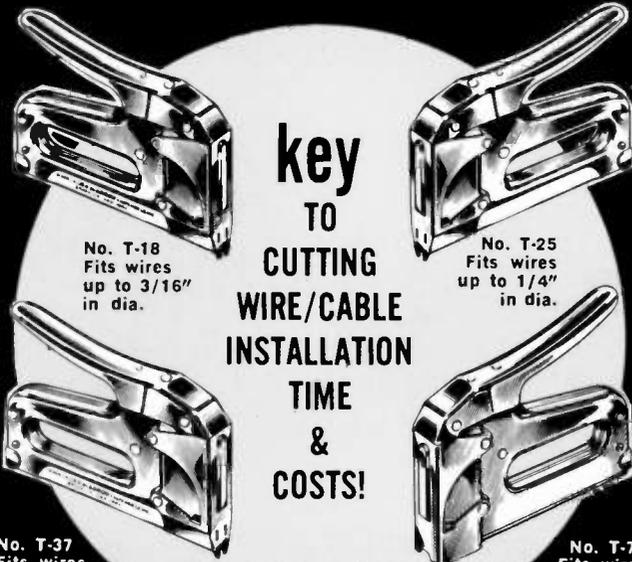
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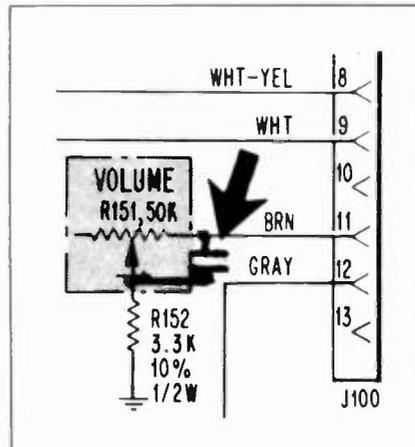
SERVICE SEMINAR

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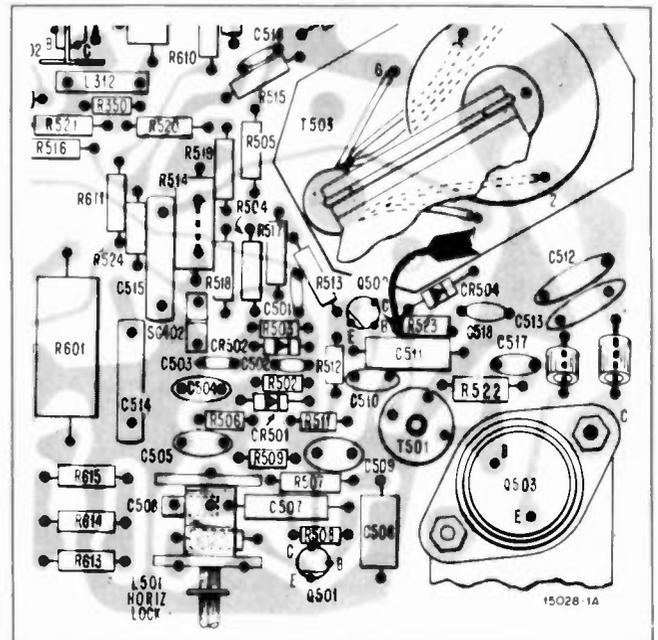
ADMIRAL

Color TV Chassis 9M50—Raspy audio when volume control is adjusted

A possible cure for this trouble is the addition of 4.7uf, 50 volt lytic (67A200-479-7) from the center tap on the volume control to the high side of the volume control. See drawing below.



B/W TV Chassis TL6—Horizontal foldover in center of the picture
The possible cause of this trouble is a leaky capacitor, C511 (5mf, 25V), as shown in drawing. Replace capacitor. See drawing below.



Color TV Chassis M45—Picture tube and/or deflection yoke replacement

When replacing picture tube and deflection yoke, be sure to remove R100 and R101 from the terminal strip on the old yoke and solder them in place on the new yoke. These resistors DO NOT come as part of the new yoke assembly. See drawing on page 17.

Here's a miniature 3½ digit portable multimeter that delivers extraordinary performance and value for only \$189.



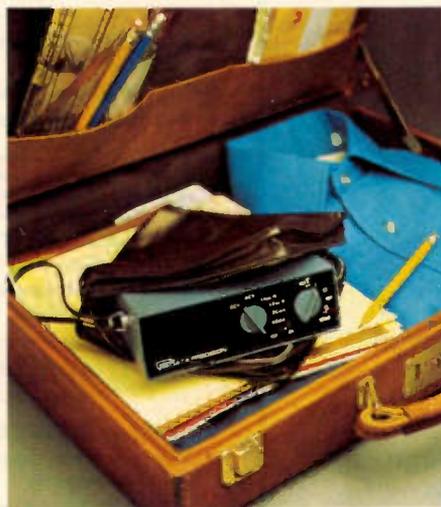
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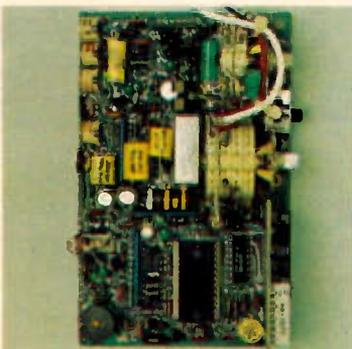
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Color TV Chassis MB-2—Circuit breaker trips

The normal troubleshooting techniques do not correct this problem. To repair, disconnect the degaussing coil and apply power with all modules installed. If breaker does not trip, measure the resistance from degaussing coil to chassis. It should read almost infinity. A reading of up to 5K ohms indicates that the coil may be shorting to the CRT shield or other grounded part. Remove and inspect the degaussing coil. Remember that the breaker does not trip when the HV Regulator is removed.

MAGNAVOX

B/W TV Chassis T998—Defective horizontal hold control

If the wiper arm of the Horizontal Hold control opens or becomes intermittent in the T998 chassis, the Horizontal Output transistor and associated resistors could be damaged. You can correct the problem by soldering a jumper lead between the arm terminal and the unused end terminal on the replacement control. This jumper will ensure that the entire resistance of the control is always in the circuit and that repeat failures will be minimized. As a preventative maintenance measure, check all the T998 chassis that come into the shop and add the jumper if it is missing.

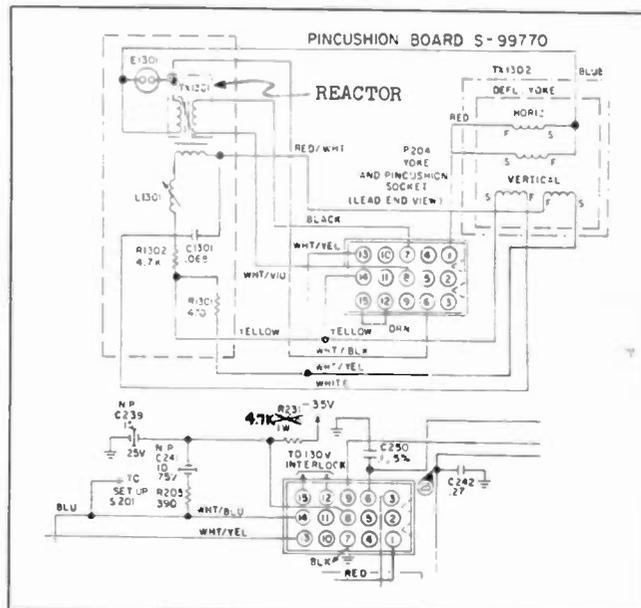
Color TV Chassis T981/T982/T987—Loss of fleshtones

A defective capacitor, C154, can be the cause of loss of fleshtones in these chassis. C154 is a 180 pf polystyrene capacitor mounted on the "signal" board between the Chroma Demodulator module and the Chroma Processor module. Since the capacitor is polystyrene, it is subject to degradation from excessive heat, flux, cleaning solution, etc.

ZENITH

Color TV Chassis 25HC50, 23HC50, 23HC50Z—Existence of drive line

A drive line in these early production H-line receivers may develop, caused by a pincushion reactor with excessive inductance. The drive line will be noticeable only in the zoom mode. It can be eliminated by replacing R231, a 5.6K, 1-watt resistor, with a 4.7K, 1-watt resistor. This lower resistance causes a slight increase in reactor current, which effectively lowers the inductance of reactor, 95-3182. In later H-line models this was factory modified.



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Digital electronics: Part 1 The binary mode

By Joseph J. Carr, CET

It's a subject you no longer can *afford* to ignore. In this first of a three-part series, the logical foundation for digital-counting circuits—binary arithmetic—is explained in easy-to-read style.

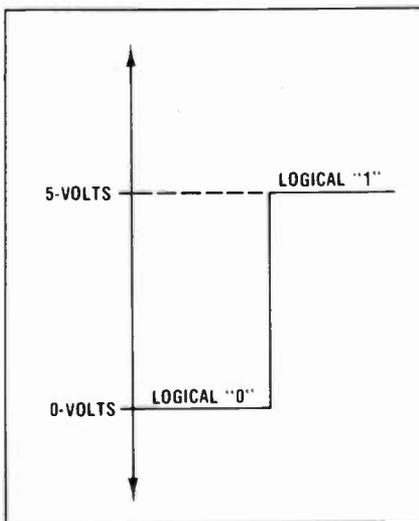


Fig. 1—A digital signal may consist of only two discrete voltage levels. In this case, 0-volts represents the logical-0 condition and +5 volts represents the logical-1 condition.

Decimal	Binary	Decimal	Binary
0	000000	21	010101
1	000001	22	010110
2	000010	23	010111
3	000011	24	011000
4	000100	25	011001
5	000101	26	011010
6	000110	27	011011
7	000111	28	011100
8	001000	29	011101
9	001001	30	011110
10	001010	31	011111
11	001011	32	100000
12	001100	33	100001
13	001101	34	100010
14	001110	35	100011
15	001111	36	100100
16	010000	37	100101
17	010001	38	100110
18	010010	39	100111
19	010011	40	101000
20	010100		

Fig. 2—Straight binary represents decimal numbers from 0 to 40.

■ Digital electronics have been around for sometime, but until recently they were limited to industrial, military, or "commercial" electronic equipment and products. In today's market, however, digital devices have become so low cost that they are being featured in consumer products in ever increasing numbers.

Digital electronic circuits process "signals" consisting of certain discrete voltage levels which represent an "on" or "off" condition. These signals are voltage levels that are allowed to assume either of two values. Normally these levels are 0-volts and +5 volts, or, in another system they could be

0-volts and -5 volts. No other voltage levels except the specified two are recognized or allowed in a digital electronic system.

Since the 0-volt, +5 volt levels have become industry standard, or almost so, we will concentrate our discussion on these two values. They are generally the norm because these voltages are recognized by the ubiquitous TTL (transistor-transistor-logic) family of I.C. logic devices.

TRUE OR FALSE

Obviously if there are only two voltage levels permitted in a digital system, then there can be only two meanings assigned to these

states. In classical logic it is "true" or "false" and in electronic applications it is "1" or "0". The system which assigns logical level "0" to the 0-volts condition and logical level "1" to the +5 volts condition is called *positive logic*. In a *negative logic* system, exactly the opposite convention is used: logical level "0" is +5 volts and logical "1" is zero volts.

Unless otherwise specified in some particular discussion or application, always assume that positive logic is being used. The names assigned to most TTL and CMOS digital integrated circuits assume positive logic, so they have become almost universally standard. In all of our discussions, then:

Logic level	Voltage
0	0-volts
1	+5 volts

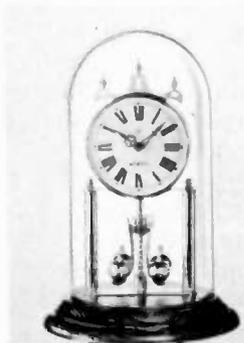
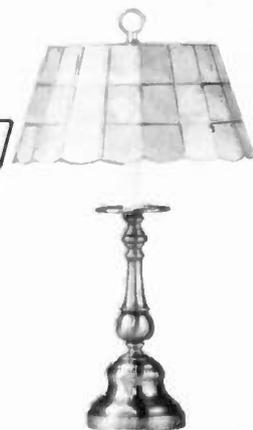
Before going any further into digital *electronics*, though, we should discuss the system of arithmetic which recognizes only



Fig. 3—Digital home room thermometer. (Courtesy The Heath Company)



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two "states", or digits. It is the binary system. Essentially it is the math of base-2 instead of the more familiar base-10 which we all have grown up with.

At least one authority, a man whom I personally respect, claims that this is irrelevant, but I have yet to see someone really learn the field of digital electronics without having at least some familiarity with binary numbers if for no other reason than it helps explain what the circuitry inside a computer, a microprocessor or a frequency counter is doing. So grit your teeth...Keep in mind that base-2 is just like the base-10 insofar as the basic rules are concerned. The main feature of the binary system is that it recognizes only two digits, 0 and 1.

WEIGHTED NOTATIONS

In the common base-10 decimal system you already know we have 10 digits: 0 through 9. If we want to express a quantity greater than

9 we still use the same basic numbers *but* we now have to create a *weighted notation* in which the position of a digit determines value. For example, take the number 436. In reality this is a weighted expression with the following position values:

hundreds	tens	units
4	3	6

In the position immediately to the left of the decimal point, the value of the digit is the same as its "natural" value, it is unchanged. In this case it is equal to (6 x 1) which is merely 6. In the next position, each digit represents ten times its basic or natural value. In this case its weight is 10, so it denotes (3 x 10) or 30. In the last position (also called the most *significant digit*, a term that will have more meaning as we study digital electronics) the digit represents a quantity one hundred times its natural value. In this case the weight is 100, so the quantity denoted is (4 x 100) or

400. The representation "436", then, is merely our ordinary daily "shorthand" method for writing
 $(4 \times 100) + (3 \times 10) + (6 \times 1) = 436$

Remembering that any number to the "zero power" is one, i.e., $6^0 = 1$; $82^0 = 1$; $10^0 = 1$; we can also write this number as:

$$(4 \times 10^2) + (3 \times 10^1) + (6 \times 10^0) = 436$$

IDENTICAL CONCEPTS

In binary arithmetic we also use the identical concept, that is a digit's position adding weight. In this case, though, each position may be occupied by only one of two digits, 0 or 1. But, instead of each position being ten times more significant than the position immediately to its right, it is now only two-times more significant. The general expression for the binary number system is:

$$2_n + 2_{(n+1)} + \dots + 2^3 + 2^2 + 2^1 + 2^0$$

Since we are speaking of two number systems it may be appropriate to demonstrate that both can be used to represent the same



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quantity. Take a decimal number "114", for example. In binary notation this is 1110010 (see Figure 1 for other examples). This binary number is an expression of:

$$\begin{aligned} \text{(Binary)} &= 1110010 \\ \text{(Weighting)} &= (1 \times 2^6) + (1 \times 2^5) + (1 \times 2^4) \\ &+ (1 \times 2^3) + (1 \times 2^2) + (1 \times 2^1) + (1 \times 2^0) \\ \text{(Decimal Equivalents)} &= 64 + 32 + 16 + 0 \\ &+ 0 + 2 + 0 \\ &= 114_{10} \end{aligned}$$

(the "10" subscript on the final answer lets us know that it is expressed in decimal form).

FOUR BASIC RULES

The rules of binary arithmetic are very simple. Some find it actually simpler than adding and subtracting in base-10. There are really only four rules you need to remember to add with the binary system. They are:

$$\begin{aligned} 0 + 0 &= 0 \\ 0 \times 1 &= 1 \\ 1 \times 0 &= 1 \\ 1 \times 1 &= 0 \end{aligned}$$

plus a carry "1" to the next place to the left.

Example:

Add the two binary numbers 101 (decimal 5) and 001 (decimal 1).

$$\begin{array}{r} 1 \\ 101 \\ \times 001 \\ \hline 110 \end{array}$$

"carry 1"

Binary 110, of course, is equal to decimal 6.

SUBTRACTING BINARY NUMBERS

Subtraction in a digital circuit must be done by *fooling* the circuit into thinking that it is adding! Even the best computer is a dummy that can only add, so if you want to subtract it is necessary to use a "trick" method—in this case *two's complement* arithmetic.

(EDITOR'S NOTE: In computers, a negative number may be designated either by a "0" or "1" representing the + or - sign, or, it can be designated in complementary form. By *adding* a complemented number to another number, the result is the *same* as subtracting. Because additional circuitry is required using the "sign" method (a six bit register is required to represent a five bit binary number and its sign) computers are more economically designed if they use the complemented number to represent a negative quantity. Thus the computer is able to use the same basic circuits to perform all functions;



Fig. 4—Delco's digital AM/FM-stereo car radio uses digital circuitry in several areas. It features a digital frequency dial (showing 1249-KHz here), digital clock, digital time, etc. on the same display. This radio is a good example of how digital electronic circuitry has invaded the consumer field in areas that were once the exclusive preserve of analog.

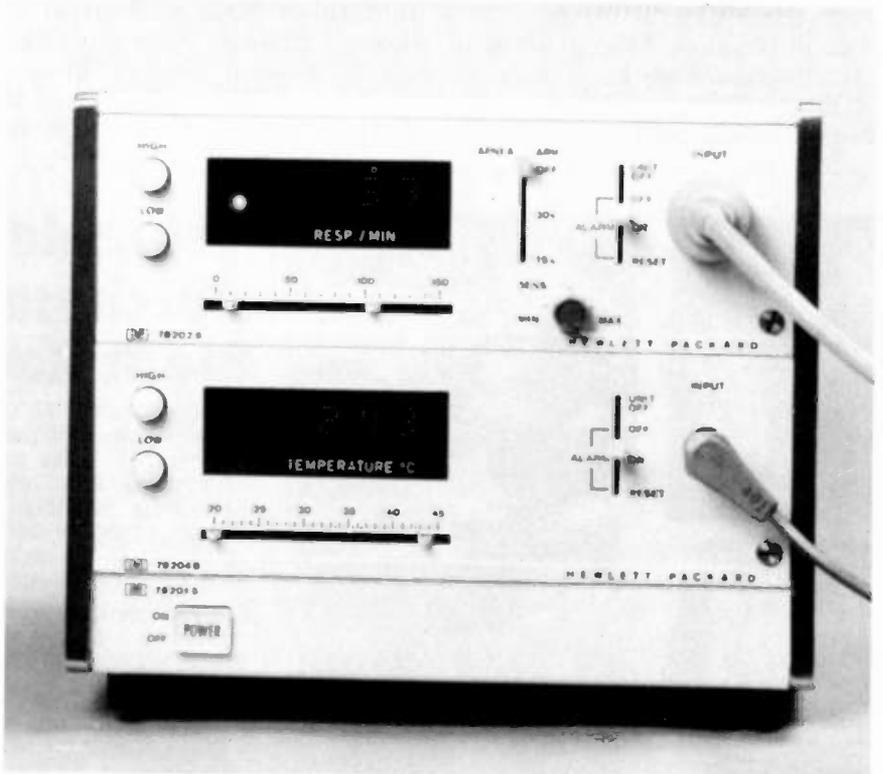


Fig. 5—Medical electronic instruments feature digital readout for unambiguous display of values. (Courtesy of Hewlett-Packard)

addition, subtraction, multiplication, and division. Subtraction becomes "complemented" addition, multiplication becomes repeated additions, and division becomes repeated "complemented" additions.)

COMPLEMENTING A NUMBER

The complement of any binary is

its inverse. That is to say, the complement of 0 is 1 and the complement of 1 is 0. When we complement a binary number, of however long the length, we merely change all of the zeroes to ones and all of the ones to zeroes.

Digit	Complement
1	0
0	1

continued on page 53

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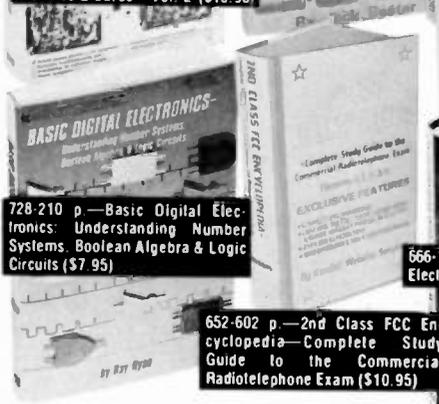


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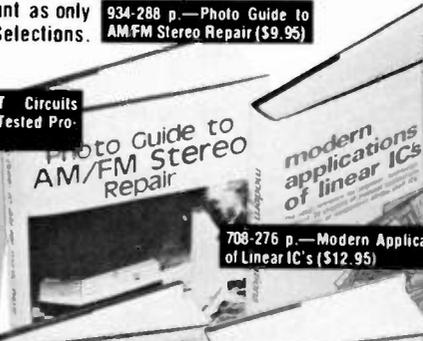
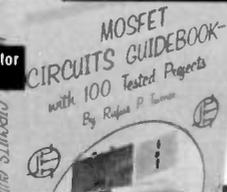
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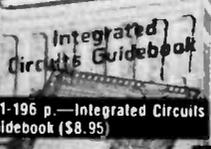
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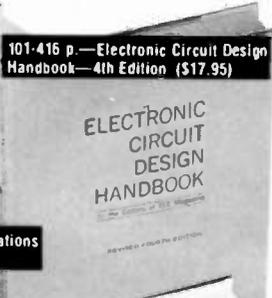
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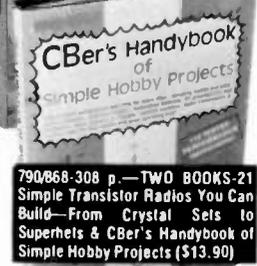
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RCA color television for 1978

A lower level of energy consumption is the design feature of RCA's two new color TV chassis—CTC 85 and CTC 90. We take a detailed look at the modular construction of the new chassis.

By Don W. Mason

■ Color television engineers at RCA have produced two new chassis that are said to use 35 per cent less power than last year's models. The new CTC-85, in the 19-inch receivers, and CTC-90, in the 25-inch receivers, consume approximately the same amount of energy as an average 100-watt lightbulb. And, because the new chassis uses less energy, they operate at least 16 per cent cooler than previous RCA TV receivers. This cooler operating temperature is expected to mean longer life for the new chassis.

Outside of a slight difference in power consumption, different picture tubes, and a different Luminance/Sync Module, circuitry in both CTC-85 and CTC-90 chassis

is similar. Power consumption in the CTC-85 is an average of 91 watts, and the CTC-90, with the larger picture tube, uses an average of 102 watts.

THE POWER CIRCUITS

As might be expected with the goal of lower power consumption, certain changes have been made in the power supply circuitry of the new "Xtended Life" chassis. To begin with, the chassis does not use a power transformer between AC input and the +150-volt supply for the horizontal output stage. Instead, a fullwave bridge rectifier and a new SCR regulator develop approximately 110-volts DC to operate the horizontal-output stage. All other chassis power is derived

from secondary windings on the horizontal-output transformer and separate rectifier circuits, as shown in Fig. 1. This means that the 150-volt power supply is "hot" even though the remainder of the main chassis is isolated from the power line. And, of course, this also means that an isolation transformer should always be used for servicing the chassis.

THE MODULE LINEUP

Both chassis use eight modules, seven of which are new to the RCA line. The new modules include: MDG 001 for Vertical Deflection; MDL 001 in the CTC-85 and MDL 002A in the CTC-90 for Luminance/Sync; MDC 001 for Chroma Processing; MDD 001, the R/G/B Kine Driver; MDS 001 for Sound; MDH 001, the Horizontal Oscillator module; and MDR 001, the Regulator module. The only module carried over from previous RCA chassis is the MCK 002 IF/AFT module. The eight modules used in the two chassis contain almost all of the chassis circuitry except the horizontal output stage and power supply components. CTC-85 and CTC-90 circuitry, in general, consists of three principal sections: power supply, signal and deflection.

The IF/AFT Module

Two integrated circuits and one bipolar transistor are contained in Module MCK 002, which is the one module carried over from previous RCA chassis. One of the IC's performs the signal processing functions of the first, second, and third

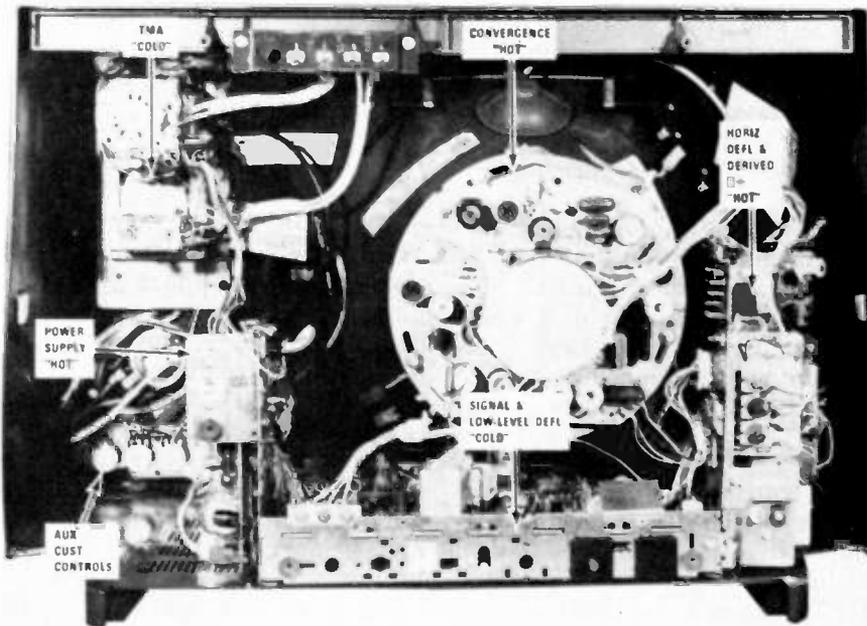


Fig. 1—Major sections of the new CTC 85 chassis.

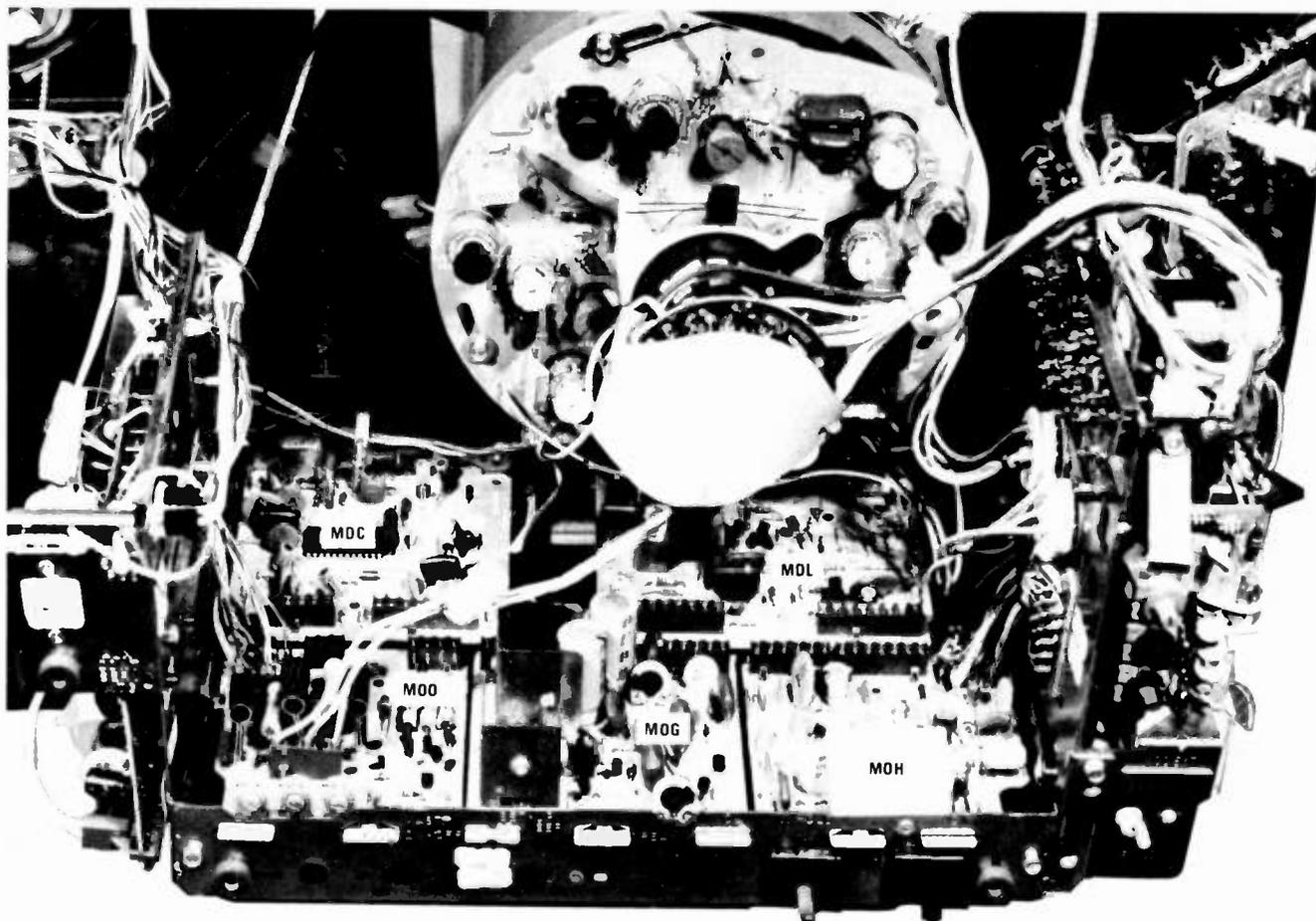


Fig. 2—The location of signal modules—MCK and MDS modules are on left end of chassis.

IF amplifiers, along with the video detector. This first IC also develops its own AGC for the IF stages and provides a source of tuner RF-stage AGC. The second IC produces AFT correction voltage for the VHF and UHF tuners and serves as a 4.5 MHz detector and amplifier to provide 4.5 MHz intercarrier sound to the sound module. The bipolar transistor is an emitter-follower (video buffer) stage which supplies 6 volts p-p negative-going video to the drive Luminance/Sync module. In addition, MCK 002 supplies chroma information to Chroma Processor module MDC 001.

Inputs to MCK 002 are the 45-MHz IF signal from the VHF tuner, and an AGC keying pulse from the horizontal-output transformer.

The outputs are luminance video to the MDL module, chroma to module MDC, tuner AGC and AFT voltage, and a 4.5 MHz IF signal to the MDS module.

The Chroma Module

Module MDC 001, the first of the

seven new modules in the new 1978 chassis, uses a new medium-scale-integrated circuit (MSI) serving as a combined chroma processor, and two bipolar transistors. Functions of the module are color bandpass amplifications, 3.58 MHz carrier regeneration, AFPC and ACC systems, along with chroma demodulation. The IC also contains circuitry for the RCA 'customer features'—Automatic Fleshtone Correction and Automatic Chroma Overload Control.

Inputs are: approximately 600 mV chroma signal from the MCK module, and sync from the sync separator stage on the MDL Video module, used for burst keying. Interfacing with the module are the "color" and "tint" controls.

The Kine Driver Module

Six transistors are used in Kine Driver MDD 001. They are employed in a way similar to that in earlier RCA chassis—CTC 74 and 81. Three individual color output stages with two transistors for each stage are used. One transis-

tor serves the video output stage function and the other is a bias control transistor.

Inputs to MDD 001 are: red, green, and blue color difference signals from the Chroma module, luminance video, and a DC-restoration reset pulse from the Luminance/Sync module.

Outputs from MDD are: red, green, and blue video signals to drive the CRT.

The Luminance/Sync Module for CTC-85

MDL 001, the Luminance/Sync module, provides video amplification and sync separation. The module also contains the brightness limiter stage, bias reset (DC restoration) circuitry, and an integrated circuit 22-volt regulator. Included on the module are seven transistors with four used for video amplifier functions. The other three transistors are the sync separator, the brightness limiter, and bias reset devices.

Inputs to the module are: 6-volt negative sync video from the IF module MCK, vertical and hori-

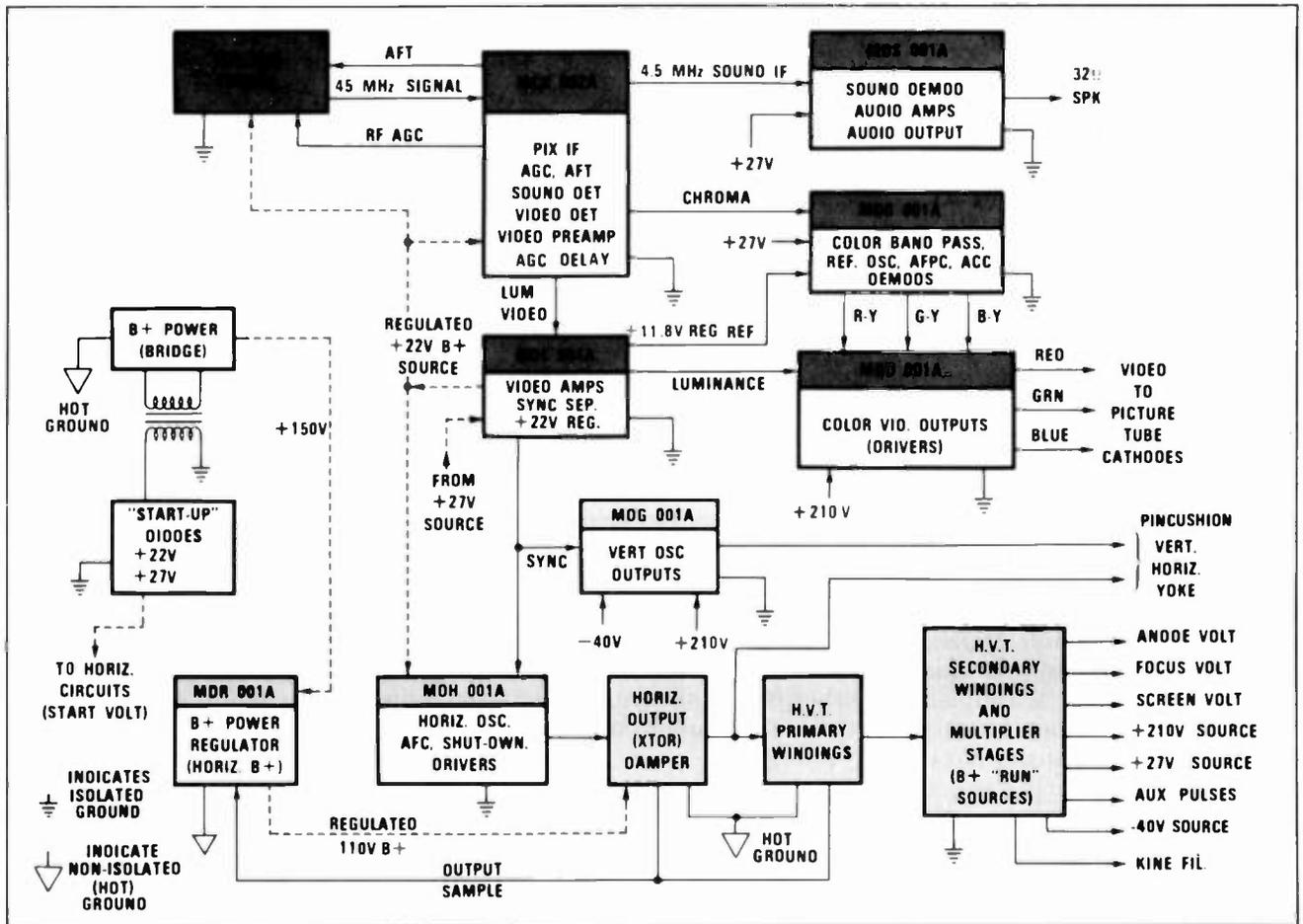


Fig. 3—Functional Block Diagram of CTC 85 color chassis.

zontal pulses for blanking, and DC restoration. Also considered as an input for this module is the +27V for the IC 22-volt regulator.

Modular outputs are: 1 to 2-volt positive sync video, 20-volt p-p composite sync, and a 5-volt negative reset pulse used for DC restoration on the MDD module.

The Luminance/Sync Module for CTC-90

A different combination of components is used on Module MDL 002A for the CTC-90 chassis. Six transistors and one IC are used. The transistors perform the functions of Contrast buffer, Video buffer, sync separator, Beam limiter, DC restoration and 22 VDC regulator. The IC functions as a luminance processor.

Inputs to MDL 002A are: 6V p-p negative sync video from the MCK module, -180 V p-p shaping pulse and the 210 V p-p blanking pulse from the horizontal output transformer. A sample of beam current and a vertical blanking pulse is also fed to the MDL module.

Outputs are: amplified video

and restoration pulse furnished to the kine driver module. Sync is furnished to the MDC, MDH and MDG modules. The 22 V DC regulated voltage is supplied to MCK module, the tuners and the MDH module.

The Sound Module

A single IC that is almost identical to that used in previous XL-100 and ColorTrak chassis is employed on the MDS 001 Sound Module. Aside from looks and a lower B+ input, the only difference between the MDS module and previous versions is the fact that this module drives a 32-ohm speaker rather than the 16-ohm speaker systems used previously.

Input to the module is the 4.5 MHz intercarrier sound that comes from the MCK IF/AFT module. The "volume" control also interfaces with MDS.

Output is audio at approximately 1.5 watts to drive the speaker.

The Vertical Deflection Module

Almost all of the vertical cir-

cuitry used in the CTC 85 chassis is contained on MDG 001, the vertical deflection module. The system is basically a relaxation-oscillator 'switch' that controls the charge and discharge of a 'ramp' capacitor. Sawtooth voltage is developed by this action and fed to a high-gain vertical amplifier circuit whose output drives the vertical windings of the deflection yoke. Ten transistors are contained on the module.

Inputs to MDG 001 are: sync derived from the sync separator circuit on the MDL module, negative feedback from the yoke circuit, and a "pin-cancel" signal. Interfaced with the vertical circuit is the *vertical-hold* control, the *vertical-height* control, and the *pin-cushion* amplitude control.

Outputs include: drive current to the vertical coils of the yoke and convergence circuits and a vertical blanking pulse for the MDL module.

The Horizontal Oscillator Module

The MDH 001 module uses seven transistors and one SCR to

perform the horizontal oscillator functions. The module, basically, is a multivibrator which drives inverter, buffer, and driver stages. Additional transistors are used for an AFC amplifier, and an X-ray protection circuit. The SCR, operating in conjunction with a zener diode, is used in a B+ protection circuit that senses excessive B+ and shuts down the horizontal-output stage, thus removing B+ from all chassis circuitry.

The inputs to MDH 001 are: sync from the MDL module, positive and negative horizontal sawtooth references, a sample pulse to the X-ray protection circuit and a 27-volt B+ sample. The *horizontal-hold* control mounted on MDH interfaces with module MDH.

The module output is a square-wave signal which is coupled to the horizontal-output transistor through a driver transformer that maintains AC powerline isolation between the main chassis and the horizontal output stage that is

"hot" with respect to one side of the line.

The Regulator Module

Regulator function is performed by MDR 001. It uses five transistors in a comparator and oscillator driver circuit to provide duty-cycle control of a power SCR that switches DC to the input of the horizontal-output stage. The regulator uses a duty-cycle modulation switching system wherein the regulated DC appearing at the output of the SCR becomes a function of the "on" time of the device. The module circuitry provides the control functions to generate a source of regulated +110 volts to operate the horizontal deflection stage. Line-voltage independent operation is assured because all other B+ supplies are taken from the horizontal-output transformer windings.

CHASSIS SERVICEABILITY

With most of the circuitry in

modular form, (Fig. 3) it's obvious that servicing the new RCA CTC-85 and 90 chassis will consist to a large extent of troubleshooting and exchanging modules. RCA engineers seem to have done a good job of making the modules easily accessible for servicing.

To make module removal easier, all chassis connections are brought out to contacts located on *one* side of the module. This arrangement allows the technician to remove the module by simply hooking a special extraction tool under each plug of the module and prying the module in the direction of arrows on the extraction tool. The tool, incidentally, is included with each chassis.

In addition to plug-in modules, the new chassis features sockets for the horizontal-output transistor and the B+ regulator SCR. A number of protective fuses are also used in the new chassis to protect critical areas against accidents and catastrophic failures. ■

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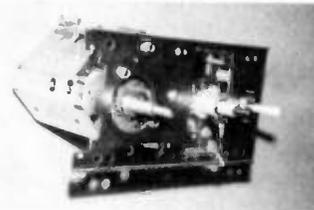
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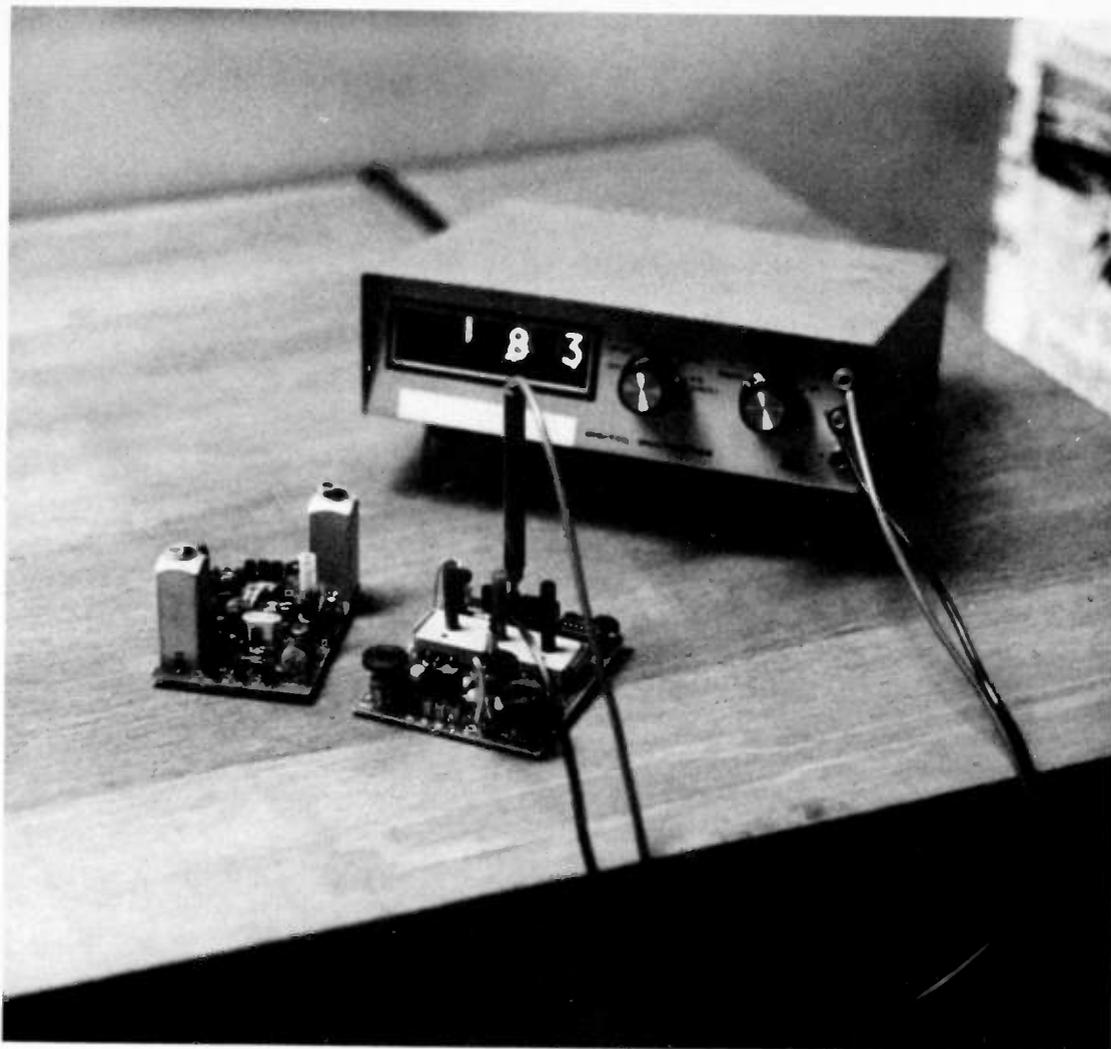
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Modular chroma servicing

Modern modular chroma circuits often need servicing when module replacement proves impractical. Knowing the functions performed by the chroma modules is your first step toward efficient troubleshooting. Part 1

By Bernard B. Daien

■ Modern modular color television receivers often need troubleshooting and repair. In smaller towns there may be no source of trade-in modules within distance. Or, the set under repair may not be a popular brand and there may be no easily obtainable components.

Whatever the reason, when a module has been replaced and promptly fails again, further module replacement is not indicated until the cause of the failure is determined. We all know, attempts to charge the customer for a module twice can lead to some real customer relations problems.

Some manufacturers in the past, have viewed the modular concept as an answer to "the technician problem". As TV sets grew more complex due to automatic controls, and frills, the level of technicians' skills demanded has increased rapidly. It was thought that modules, interchanged by semi-skilled personnel would reduce the need for trained technicians. But, actual practice has shown that this is not the case, (as

intermittent burst.

This circuit does not use a continuous, free running oscillator to provide the continuous signal. Instead, the burst amp delivers 3.58 MHz bursts to the 3.58 MHz crystal via C1. Since the crystal has a very high "Q", it "rings", providing a slowly damped wave train, which does not decay to zero before the next burst rings the crystal again. Thus the output of the crystal is varying in amplitude, but never stops completely. Coil L2 and C2 are impedance matching for the high input impedance of an emitter follower which drives a clipper amplifier. Here the signal is amplified, then limited, to provide a signal which no longer varies in amplitude. The next, or output amplifier has a slug tuned 3.58 MHz tuned circuit which eliminates the harmonics associated with a clipped wave, and restores a sine wave. (Note, the clipper amplifier and following tuned amplifier is almost the same in function to the limiter used in F.M. receiver I.F. circuitry). Thus the intermittent burst signal is converted into a continuous signal, as in the previous locked oscillator circuit.

BASIC DIFFERENCES

There is a significant difference between the two circuits however, which must be pointed out, since it is important in trouble shooting. The locked oscillator runs at all times...but on the correct frequency only when the burst is present. When the burst is absent the oscillator frequency is incorrect.

The ringing crystal circuit has no output when the burst is absent. Thus the absence of burst produces different symptoms in these two main variations of color burst regeneration, as you can now appreciate. This has a marked effect on the color killer and other circuits, dependent upon signals from the regenerator circuitry.

Generally the chroma signal, "C", is amplified by two bandpass amplifiers, with passband of 1 MHz width, centered on 3.58, (3.58 ± 0.5 MHz). These amplifiers are quite conventional, and resemble broadly tuned I.F. stages. They have a form of AGC, called "ACC"

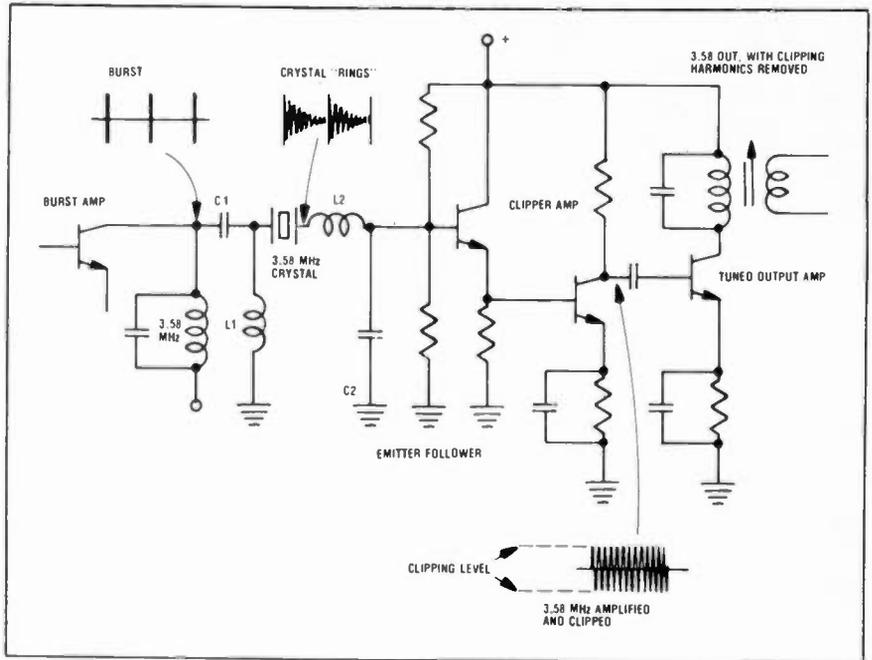


Fig. 2—Schematic drawing of 3.58 MHz "crystal ringing" oscillator circuit.

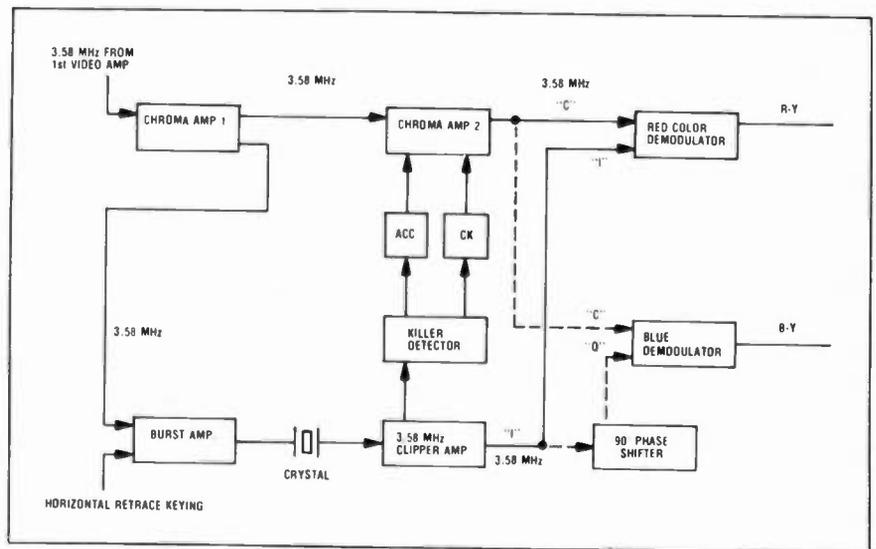


Fig. 3—Block diagram of typical chroma section.

(Automatic Color Control).

There is one important function that is not in a conventional IF...the color killer. The color killer acts as a switch, cutting the chroma amp off when the color burst is absent, (that is, when color is not being transmitted). This prevents colors appearing in black and white telecasts, or in the noise on unused channels.

COLOR KILLER DEFECTS

Both the ACC, and the color killer, usually operate from the same level detector, called the "killer detector"...but the ACC is a gain control, while the color killer, "CK" is an on/off switch. Thus a

defect in the killer detector affects both ACC and CK in most cases. On modular sets there is often an adjustment for the ACC. On sets with crystal controlled 3.58 MHz free running oscillators, the burst may vary in amplitude with the signal over a considerable range of amplitude, therefore a color killer threshold control is often included. On sets with ringing crystal burst regenerators, the absence of burst results in no drive to the clipper limiter, and thus no base (grid) leak bias. The absence of grid leak bias is a positive indication of no burst, hence the color killer threshold control is often omitted.

The output of the chroma ampli-

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fiers is called the "C" signal, and is one input to the color demodulators, (also called phase detectors, or synchronous detectors). Refer now to Figure 3.

The "C", or chroma output of the chroma amp is fed to the phase detector (red demodulator), and the output of the burst regenerator is also fed to the same demodulator. The regenerator output is labeled "I", and is a rock steady reference. The "C" is phase modulated in accordance with the color being transmitted, hence there is a varying phase difference between the C and the I, and the phase detector converts this phase difference into an output. When red is transmitted, the red demodulator output is at maximum, (and C and I are in phase.)

THE "BLUE" REFERENCE SIGNAL

These same two signals, I and C are also used to develop the blue signal in a similar manner, with one exception, as shown by the dotted lines in Figure 3. For blue, a 90 degree phase shifter is placed in series with the I signal. The phase shifted "I" signal is labeled "Q". Maximum output from the blue demodulator is obtained when C and Q are in phase. Thus the blue demodulator has its maximum output when the C signal is shifted 90 degrees from red, which is blue.

The important thing to note here is that the demodulator outputs are marked "R-Y" and "B-Y". "Y" is the symbol for the luminance channel, hence R-Y means red without luminance...or pure color only. R + Y would indicate red plus luminance. It is important to note this, as it is the key to the several variations of color demodulators used in modular receivers. The above circuit is the basic one, used in most early color receivers, and therefore considered a "standard".

For the present we'll leave our discussion of modern modular color circuitry with this basic model. Next month we'll want to talk about some variations of this standard circuit, and we'll end with a look at some specific manufacturer's models now on the market along with procedures for diagnosing color problems. ■

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Magnetic tape recorders -A prelude to video

By Bernard Daien

(EDITOR'S NOTE: With the progression of the video tape recorder player from the educational and industrial environments into the area of home entertainment products, the need now exists among servicers of home electronic products for a basic understanding of these units. None is possible without a basic grasp of magnetic tape recording theory.

Of course, many who read this magazine already possess such an understanding, having serviced home audio tape recorders in their shops for many years. For others, however, it is a new area of potential service business and as such, ET/D feels the need exists for a review of magnetic tape recording theory.

With this article, ET/D will begin a series that will lead ultimately toward a detailed look at the specific, and very complex, circuitry to be found inside of the three basic home video tape machines now being promoted so aggressively by the nation's major television manufacturers.

It is an entirely new market, thus a new opportunity for more

service business, for the shop that is ready and prepared to handle the challenge.

We would also like to point out that the manufacturers themselves are currently running instructional schools on video tape recorder/player servicing. If you are seriously considering making this area a part of your regular service business, we would highly recommend you consider attending one of these schools).

The simplest theoretical audio frequency tape recorder consists of four basic parts; a recording head, magnetizable tape, a motor to pull the tape past the head, and a source of the electrical current waveforms which are to be recorded.

In practical machines, however, we need to add many more working parts, electrical, mechanical, and electromechanical. Electrical parts include those necessary for biasing, erasing the tape before recording, and equalization networks to match the frequency characteristics of the tape recording/playback process.

Electromechanical parts in-



RCA's new "SelectaVision" video cassette recorder is an example of the different types of video recorders now on the market. The model shown will record and playback up to four hours of TV programming. Optional accessories are a microphone and black-and-white TV camera.

clude motors, and controls for the proper operation of the machine. Finally, many machines include some type of audio gain control to prevent overload of the tape (saturation). Sometimes volume compression is employed in record, and expansion in playback, in order to achieve a wider range of amplitude than the tape itself can accommodate.

THE RECORDING HEAD

Recording heads are made of metals like mu-metal, or ferrite, with a small air gap. The signal is applied by means of a current through a winding on the core. The tape is held in close contact with the core, and pulled across the gap, as in Figure 1.

The width of the air gap is important, and depends upon the highest frequency to be recorded, and the speed at which the tape is pulled. This is due to the fact that if the gap is equal to a half wave (as printed on the tape), then a corresponding magnetic half wave will be impressed on the tape by the magnetic field which extends outward from the gap and penetrates the tape. But if the gap is large enough to accommodate a full wave, then both the positive and the negative half waves will exist simultaneously, cancelling each other, and imprinting nothing on the tape. This is shown in Figures 2A and 2B.

We can easily calculate the maximum width of the gap. For example, let's assume we wish to record 15 kHz at a speed of 7.5 inches per second. Then, at 15 kHz, one cycle takes $\frac{1}{15,000}$ of a second. During this time the tape will move 7.5 inches, divided by 15,000, which equals one half of a thousandth of an inch.

HIGH FREQUENCY PROBLEMS

A half wave would occupy only a quarter of a thousandth of an inch! Thus the gap becomes quite small—too small for the lower frequencies, reducing the range of frequencies which can be handled with the head. What can we do to make the gap larger? If we increase the tape speed to 15 inches per second, then a full wave becomes one thousandth of an inch, and the half wave a half thou-

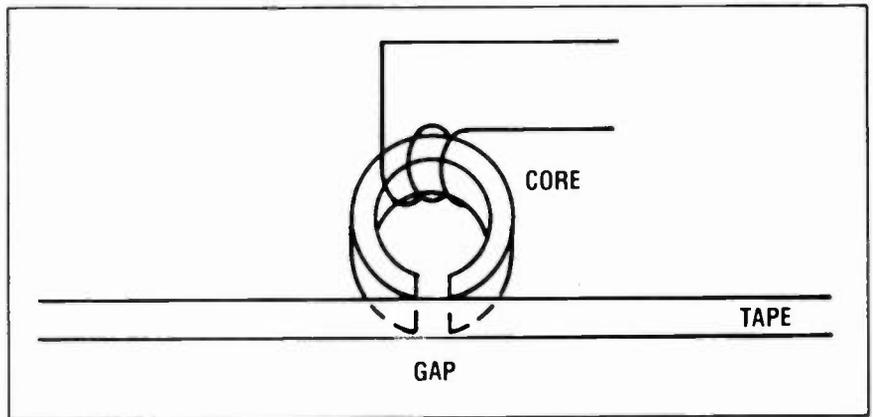


Fig. 1—Pulsating magnetic fields from the record head, in step with the modulating signal, penetrate the tape as it passes the gap, creating small bar magnets on the tape. On playback, the magnetic fields associated with the bar magnets penetrate the field created by current in a playback coil. A voltage is created which is then amplified and reproduced as sound.

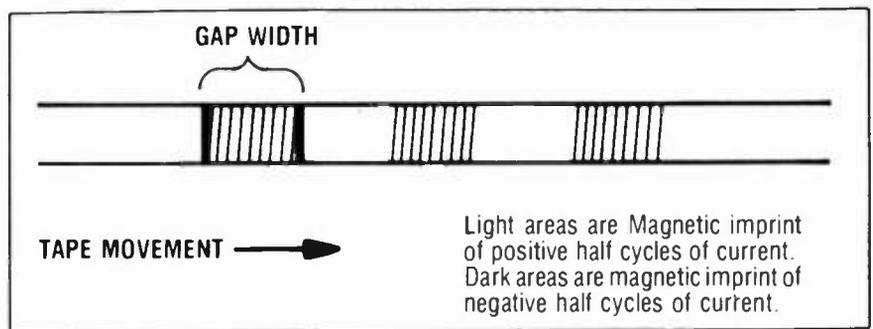


Fig. 2A—Light areas represent magnetic imprints of positive half cycles of current. The dark areas are the imprint of the negative half cycles of current.

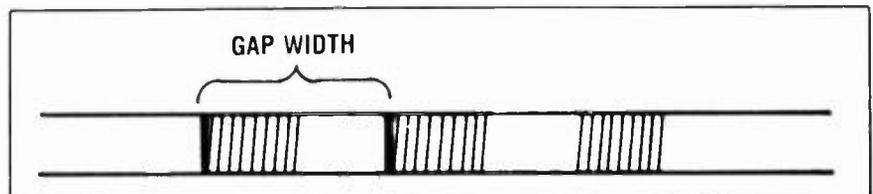


Fig. 2B—Tape recorded on the machine with a gap width corresponding to a full wave.

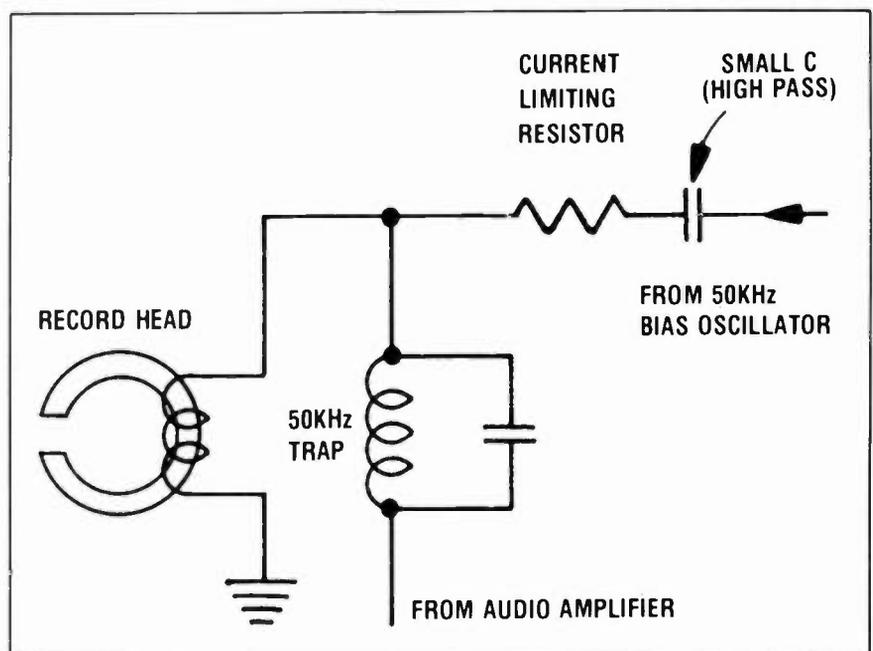


Fig. 3—Parallel resonant trap used for decoupling the bias and audio circuitry.

sandth of an inch at 15 kHz. Thus high tape speeds are required to record high frequencies, if reasonable head gaps are to be used. This is why professional machines use 15 inches per second for high fidelity, while the little pocket recorders intended for telephone quality dictating use run at less than 2 inches per second.

By now you probably realize that if we have problems with tape speed and head gap at audio frequencies, we need to find more sophisticated techniques to achieve video frequencies of four megaHertz. Further, even at 15 inches per second, a one hour recording requires 4,500 feet of tape. If we increase tape speed, we use even more tape per hour! And there is a limit to how small a gap can be made, and still be practical. As a matter of fact, the problem of head gap size limits the frequency range of tape recorders to less than ten octaves. Thus, if the highest frequency to be recorded is 20 kHz, then the lowest frequency with useful output will be about 40 Hz.

Again, this poses a problem if we are to record video, which requires a bandwidth of zero to four megaHertz. We solve the problem with a combination of heterodyne frequency conversion and frequency modulation. But this is the subject of a later article.

BIAS AND ERASE OSCILLATOR

Recording audio on tape results in weak, noisy, and distorted signals. This is due to the non-linearity inherent in the hysteresis loop of magnetic materials. Such loops are basic to magnetic components such as transformers, reactors, etc., and consequently are part of every fundamental electronics course, and so will not be rehashed here.

Suffice to say that it has been discovered that the use of another, larger, sine wave, applied to the tape simultaneously with the audio, reduces the distortion and noise, and increases the tape output level. This "bias" frequency is well above the audible range, and thus is not heard, even if it records on the tape...usually being in the range of 40 kHz to 80 kHz. The bias current in the recording head

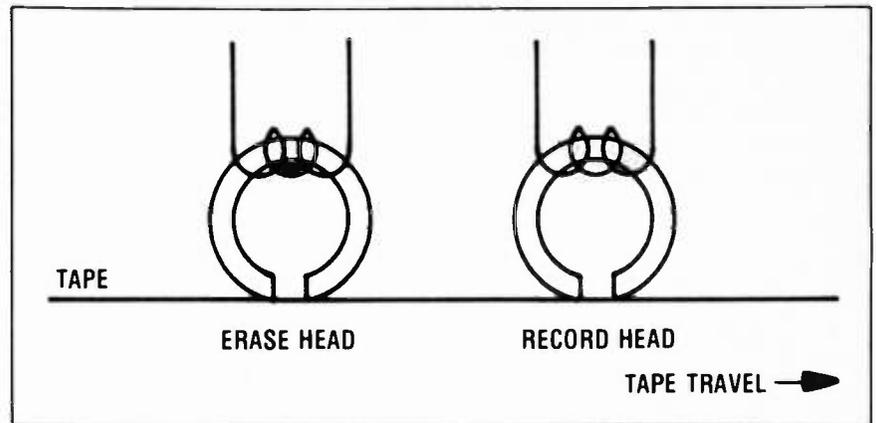


Fig. 4—Placement of the erase and record heads in a typical recorder.

is several times greater than the signal current to be recorded. If you consider that the amplitude and frequency of the bias current is larger than the signal current, it becomes apparent the bias is a "carrier" on which the signal rides as "modulation". The circuit arrangement is shown in Figure 3. Note the use of the parallel resonant trap which aids in decoupling the bias and audio circuitry.

SEPARATE ERASE HEAD

The bias oscillator is also used for erasing the tape prior to recording. Erasing is accomplished by means of a separate head in most machines. The erase head uses a larger gap than the recording head, since its only function is to demagnetize and not to record. The erase head current is at least ten times greater than the bias current, running to hundreds of milliamperes, and requiring several watts of power. The arrangement of heads is shown in Figure 4.

It should be noted for service purposes that the bias/erase waveform must be symmetrical. If the wave is distorted so that one half is greater than the other (clipping, bottoming, or saturation), the resulting magnetic field will likewise be greater in one direction than the other, leaving the tape magnetized, rather than demagnetized. What is essential is a good clean sine wave.

THE PLAYBACK HEAD

A head similar to the recording head is used for playback. (Some of the less expensive machines use the same head for record and

playback, with the bias current turned off in playback). As the tape moves past the head, the magnetic field induces a voltage in the head coil. The voltage induced depends upon the rate of cutting the magnetic lines of force, thus a high frequency, which changes faster, induces more voltage in the playback head than does a low frequency. This results in a rising characteristic in voltage versus frequency. This rate of rise is approximately six decibels per octave. The average playback head output is about one millivolt at 1 kHz.

In order to compensate for the loss of low frequencies, an equalization network is incorporated in the playback circuitry, providing low frequency boost. Since the lows are amplified more than the highs, any 60 Hz hum becomes very noticeable, and with 60 Hz motors nearby, careful lead dress and shielding is required. Any repairs must take this into account. The use of unshielded substitute parts such as open frame transformers definitely will result in problems. Some machines use low frequency boost in recording, in order to provide more low frequency signal level on the tape, to help overcome this situation.

THE MOTORS

Small battery operated recorders use DC motors and AC operated machines use AC motors, but with a great variation as to the type and number of motors. Small home recorders use only one motor, while professional machines use as many as three to perform the functions of wind, re-

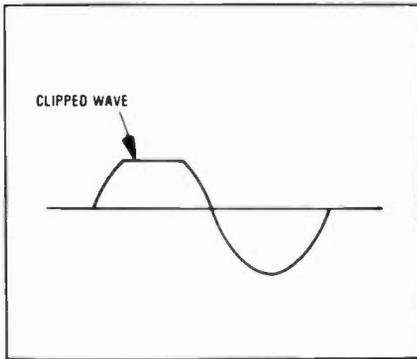


Fig. 5—Distorted bias waveform results in a magnetized tape as it is dragged pass the "erase" head instead of a demagnetized tape necessary for noise-free recording.

wind, and fast forward. Different motor arrangements result in wide variations in the electro mechanical controls, such as relays, solenoids, switches, etc., in order to insure that uniform tension is applied to the tape as it runs over the head. If slack develops, the tape will fall away from the head. Excessive tension will stretch or snap the tape. Either condition is worsened by sudden stopping and

starting.

Another important factor is reel synchronization. The reels must be synchronized in *lineal* tape speed, and not in revolutions, since as the tape passes from reel to reel, the effective diameter of one decreases as the other increases. The speed must be constant, since any variation results in a change in the frequency recorded, or replayed.

VIDEO TOLERANCE SMALL

In audio, such variations results in 'wow'. In video the effect is seen as incorrect color. Not even the smallest change can be tolerated by the phase modulated color signal since the phase represents the color being reproduced. Thus any variation in tape speed shows up as phase error in relation to the color signal.

Remember that color lock must be good to less than one cycle out of 3,579,545 cycles per second. Thus, it is obvious a need for elaborate

systems to control and maintain the speed of video machines exists. Synchronous motors are frequently used, although they run very hot if any attempt is made to control speed electrically. They need a flywheel for uniform speed and consequently come up to speed slowly, are large, heavy and expensive. Induction motors accelerate fast, run cool, radiate very little hum field, and are easily speed controlled electronically.

Experience has shown us that dirt is the commonest maintenance problem on recorders. Gummed bearings cause friction and drag, overheating motors, and changing tape tension with consequent tape and head wear. Dirt scratches the head, which ruins the tapes. And, vice versa, a dirty tape will sometimes scratch a head.

(In our next article, we will discuss the complexities associated with recording a color video signal). ■

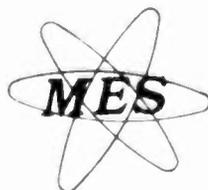
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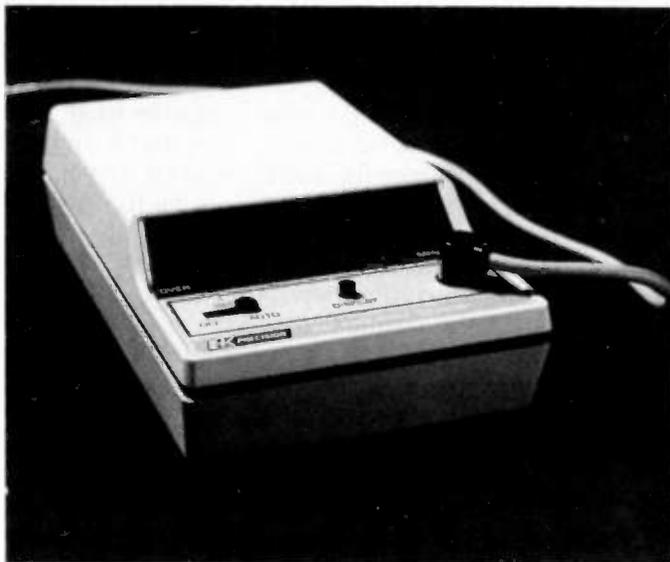
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TEST INSTRUMENT REPORT



For more information about this test instrument circle 147 on the Reader Service Card in this issue.

B&K-Precision's autoranging counter model 1827

■ The new Model 1827 Autoranging Frequency Counter from B&K-Precision is an exceedingly compact, portable, lightweight instrument of almost shirt-pocket size. It has been designed for measurement of frequencies from 100 Hz to 30 MHz.

A front panel function switch

selects 1 SEC preset gate interval or AUTO range. In the AUTO position, the correct gate interval for maximum resolution without overranging the instrument is automatically determined and proper frequency unit indicators for kHz or MHz are turned on. In the 1 SEC position, the display will indicate frequency to the close Hz even if the leading most significant digit (MSD) is beyond the display range.

The display consists of six 7-segment LED numerical display units and three LED's for units and overrange indication. An internal time base of 4 MHz is generated by a crystal-controlled oscillator.

A battery saver feature is incorporated into the Model 1827. The frequency being measured is displayed only when the DISPLAY button is pushed. The display will stay as long as the button is depressed and for an additional 10 seconds after the button is released. External power defeats the battery saver, and the display stays on continuously.

The counter is said to be low on power consumption and operates on 6 AA batteries, with an optional charger/adaptor, or external DC.

The model 1827 frequency counter weighs less than one pound with batteries. It is priced at \$120.00 ■

Hickok model 422 mobile CB tester

■ The Hickok Instrument Company has just introduced a test instrument for mobile CB radio that seems to live up to its description—completely portable. The new Model 422 Mobile CB Tester is housed in a lightweight (3 lbs.) carrying case, operates from the vehicle's cigarette lighter outlet, and will test the complete mobile CB system from microphone to antenna, from battery to speaker.

By way of an 8-step self-guided test sequence, the Model 422 will check all transceiver functions including output frequency, power, and SWR plus accurate receiver and modulation tests. All output readings are displayed on a digital readout.

Frequency tests cover the full Class D citizens band, with 100 ppm time base accuracy (± 1 count). RF power can be checked from 01.0 watts to 10.0 watts, with 3-digit readout with $\pm 2\%$ accuracy at 4 watts. SWR is checked from 01.00 to 20.00, with a 4-digit readout, ± 0.2 accuracy from 1.00 to 3.00. Audio modulation test detects audio envelope of RF output of the transceiver and provides an accurate audible signal by means of its built-in speaker. The receiver test provides a modulated RF signal at 27.205 MHz (channel 20) of 20 μV ($\pm 5 \mu\text{V}$) with 30% modulation at 1 kHz.

The new instrument also checks battery voltage from 11.5 to 17.0 VDC, with a 3-digit display ± 0.3 volt accuracy. An internal dummy load allows off-the-air testing of all transceiver functions except antenna SWR. The unit will also self-test itself by connecting the receiver test signal to frequency measurements circuits.

The Model 422 comes complete with two 2½ foot cables with a male PL-259 connector to the radio and a female PL-259 connector to the antenna. Power requirements are 11.5 to 17 volts, 1 amp; via a standard plug for connection into the vehicle cigarette lighter outlet. Dimensions are 9-¾ inches wide by 9-¾ inches long by 4 inches high. It is list priced at \$325. ■



For more information about this instrument, circle 148 on the Reader Service Card in this issue.

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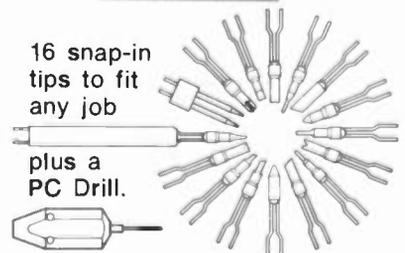
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DEALER SHOWCASE

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CB TROUBLE TAPE

149

A new tape cassette that will allow a CB owner to identify and eliminate CB interference sources is now available in a counter-top merchandising program available from *GC Electronics*. The tape fits all cassette players, and is accompanied by a pamphlet that de-



scribes various types of interferences, and which suppressor to use. The merchandising program, No.17-250, consists of a P.O.P. easel supporting six trouble tapes. Suggested retail price per tape is \$4.95.

TAPE HEAD CLEANER

150

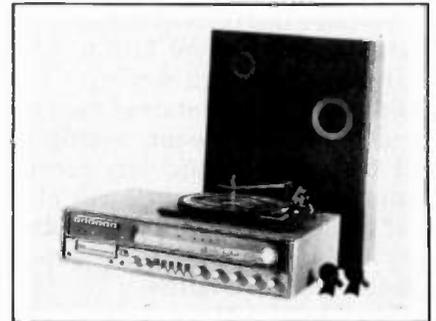
A new Foam-cleaner kit for audio, video, instrumentation and digital recording equipment has been introduced by *Nortronics*. The new kit includes a liquid cleaner that breaks up



oxide and dirt accumulations on tape heads, capstans and guides—and a supply of cellular foam swabs that are lint-free and reusable. The liquid cleaner is said to be safe for use on rubber parts and tape heads, and will not leave a residue. Designated QM-85 Foam & Cleaner, the kits are supplied dealers in a stand-out package for rack or shelf mounting. Illustrated instructions appear on the rear panel of each package.

HOME ENTERTAINMENT SYSTEM 151

A new tri-mode home entertainment system that provides 7 watts of continuous power per channel minimum RMS at 8 ohms from 100 Hz to 20 kHz, is new from *Channel Master*. The new unit consists of a deluxe AM/FM multiplex receiver with stereo 8-track



recorder player and built-in record changer, and dual speakers in bass reflex ported cabinets. The receiver features 2 large illuminated dual-function meters. One is used in the receiving mode, for AM tuning, and the other for FM tuning. In recording, the meters automatically become left and right channel recording level indicators. All input functions are identified on the front panel by LED lights. It retails for \$339.95.

FREQUENCY COUNTER

152

A new frequency counter designed primarily for mobile CB applications has been announced by *EICO*. Designated the model 700, the new counter operates automatically on transmit and indicates frequencies in a range



from 5 Hz to 27 MHz. In standby only the decimal point of the readout is lighted and a current of less than 70 mils is drawn. Accuracy is ± 10 ppm in measurements from audio frequencies

up to radio frequency range. Can be driven directly with 5 volt TTL signals. \$69.95 in kit form and \$99.95 assembled.

CB ANTENNA HARDWARE DISPLAY 153

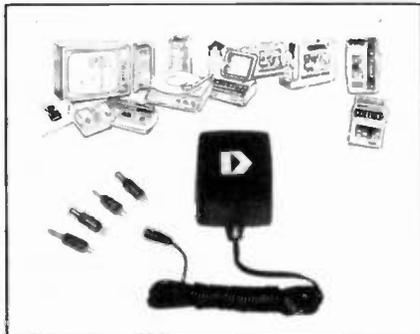
A complete collection of antenna installation hardware, as well as essential accessories for antenna maintenance, are now available in a store display from *GC Electronics*. The products are all 40-channel approved



and are displayed on an attractive 4 foot by 4 foot self-service display. Ten different types of hatchback, trunk, mirror and bumper mounts are featured. Four varieties of co-phase harnesses with GC's Mixer Balun Circuitry are included in the display.

UNIVERSAL AC ADAPTER 154

A universal power adapter for the operation of toys, games and appliances that usually operate on 2 to 5 dry cells, or the 9-volt transistor batteries is now available from *Dynamic Instrument*. Called the *Quadrplug*, the device features four interchangeable



able plug tips and a variable voltage range. Two models are available—the deluxe model, U390-5, and the less expensive model, S690-5. The U390-5 has a 3 to 9 volt selector switch, and the S690-5, without the switch, has a 6 to 9 volt range. Available either in

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blister card pack, or in a chipboard box.

RV/TV ANTENNAS

155

TV antennas and related accessories for recreational vehicles are featured in a new do-it-yourself merchandising rack now available from *Winegard Company*. Designated as the WR-1000 rack, the display features a simulated RV roof which allows mounting and actual demonstra-



tion of any Winegard RVH/TV model antenna. Customers can see how the

antenna is installed and can actually raise, lower and rotate it. The rack is sold as a complete package and includes such RV/TV products as couplers for operating two sets, band separators, AM FM takeoff/12 volt battery adapter, FM radio amplifier, TV outlets, matching transformers and wire, and both coaxial cable and twinlead.

CLOSED CIRCUIT TV FOR SECURITY

156

A new closed circuit television system for home or business security is being introduced by *Sharp Elec-*



tronics. The new system, Model IT-25Z, includes a compact camera, a 9-inch monitor, and a two-way intercom. The two-pound camera comes

with a standard 16 mm F 1.6 "C" mount lens which adjusts to changing light systems. It is said to be unaffected by weather, voltage or humidity extremes. Intercom has a talk button that activates the system for about 30 seconds. The TV monitor works off 120 volts with a power consumption of only 32 watts. Priced at \$425.

PUSHBUTTON REMOTE CB

157

A new 40-channel remote CB transceiver featuring IC chip technology has been introduced by *Hy-Gain Electronics*. The new radio, called Thumbs Up, features a computer style



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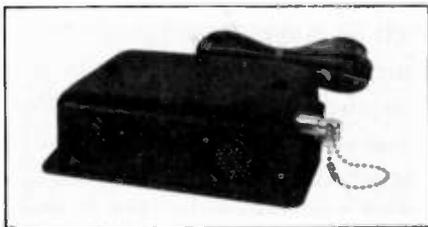
RCA QT Parts

...for more details circle 131 on Reader Service Card

keyboard with pushbutton control of fourteen functions and controls, including memory. The new control unit mounts on the dash and can be removed easily for secure storage. The transceiver itself can be installed in the trunk or under the seat. The Thumbs Up CB control module has two memory units that allow the operator to return to previous channels instantly without having to readjust settings. It also has an LED digital clock. Retail at \$249.95.

ULTRASONIC ALARM SYSTEM 158

An ultrasonic motion-detecting alarm system to work with vehicular 12-volt negative ground systems is now available from *Delta Products*. Trade-named "Sonic Sentry," the device is switch-activated and blankets interior space with harmless, ultrasonic beams. When the beams are



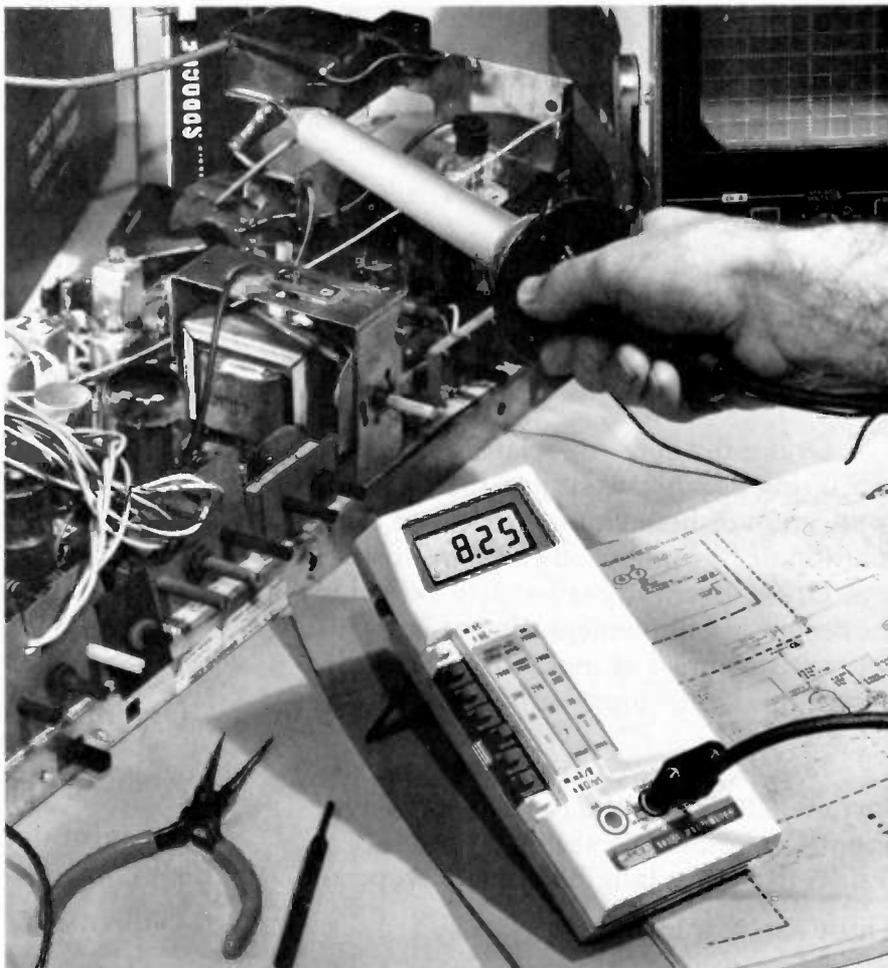
broken by an unwanted intruder, the alarm system is activated. An automatic reset mechanism keeps the alarm working on a repeat basis in the event of a prowler's return. A 5-second entry delay and 15-second exit delay give owners time to activate and deactivate the system. Installed by the connection of three wires.

SCOPE FREQUENCY CONVERTER 159

A new CB frequency converter that will allow any oscilloscope with at least 1 MHz bandwidth to present the CB modulation envelope on the screen is now available from *Sencore, Inc.* Designated Model CB44, the new converter drops the 27 MHz CB signal down to less than 1 MHz so that the servicer can view the modulation envelope for distortion and alignment. Priced at \$75.00. ■



How do you really use a multimeter?



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The 8020A has six resistance ranges, including a 20 megohm range for those special high-resistance TV components. Plus, you can measure focus dividers, pcb and capacitor leakage clear up to 10,000 megohms with the new conductance function. And conductance allows you to measure transistor beta—unique

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Your 8020A comes with a full-year warranty, with worldwide service backup. Regardless of what happens to it, we'll fix it inexpensively and quickly, making the 8020A a truly cost-effective investment.

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Command Performance: Demand the Fluke 8020A.

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NEW PRODUCTS

Descriptions and specifications of the products included in this department are provided by the manufacturers. For additional information, circle the corresponding numbers on the Reader Service Card in this issue.

DESOLDERING SYSTEM 160

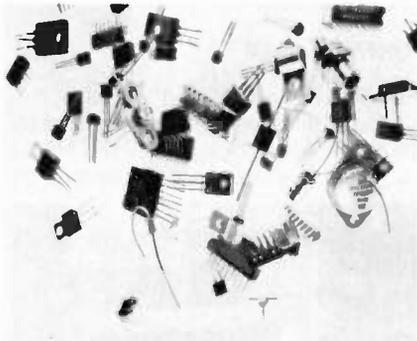
A new desoldering/soldering system for use in electronic repair or in electronic production work has been announced by *Pace, Inc.* Called "Ped-A-Vac", the new system includes a floor-mounted, foot-controlled vacuum generator with adjustable high flow-rate vacuum, lightweight desoldering hand-tools with low voltage (24VAC), and a low-voltage output, bench-top power supply. The new system, which utilizes a high flow rate of air through a controlled temperature hand tool, works well with capacitors,



resistors, diodes, dual in-line elements, terminals, multi-pin connectors and receptacles, and MOS/MOSFET components.

SOLID STATE DEVICES 161

Two-hundred-eighty-eight new types have been added to the ECG semiconductor line from *GTE Syl-*



vania. The new devices include: 54 low power Schottky TTL digital integrated circuits in the 74LS series; 11 standard TTL digital integrated circuits in the 7400 and 74000 series; 180 types of 5% Zener diodes in 1, 5, and 10-watt ratings; 36 linear integrated circuits for industrial and entertainment applications; 5 silicon varactor diodes; 1 germanium varistor diode; and 1 high voltage tripler.

AUTOMATIC BATTERY CHARGER 162

A new all plug-in battery charger with an 'automatic transmission' that switches from high to low charging rates and back again has been announced by *Ault Incorporated.* Because it switches from fast to float rates, this new charger is said to prevent overcharging and shortened battery life. According to the manufacturer, the new charger is powerful enough to completely recharge a battery in 5 to 10 hours. Called the Aultomatic, the charger works with rechargeable sealed lead-acid and gel-



Big Little DMM

You get bench-size accuracy and performance with our new, hand held, 3½-digit VOM. It's in a class by itself.

- Highly readable, field-effect LCD
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You can pay more. You can pay less. But you can't buy a better FET VOM.

The ultimate VoltOhmyst®

- Measures AC or DC volts. 0.05V to 1500V.
 - Current from 0.15mA to 1.5A
 - Hi- or Lo-power ohms (R X 1 to R X 1 Meg), with pushbutton polarity reversal.
 - Autopolarity, taut-band mirror-scale meter with 3 color-coded scales, separate polarity-indicating meter
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- WV-534A**
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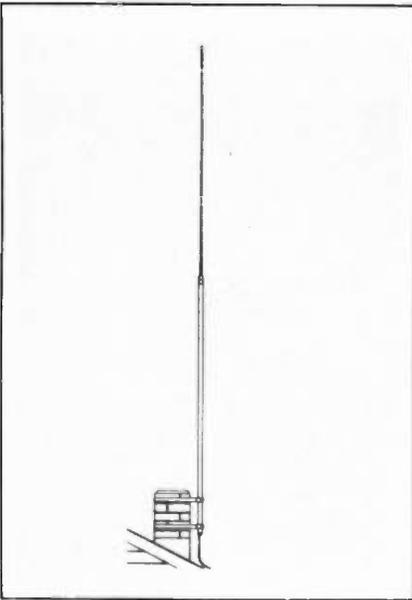
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type batteries. It is available in 6 and 12-volt models to work with batteries of 1 to 3 and 3 to 8 ampere-hour capacities. List price is \$15.50.

OMNI-DIRECTIONAL CB ANTENNA 163

A new omni-directional CB antenna for minimal space situations has been announced by *S & A Electronics*. Applications include portable base stations, apartment and marine use. Designated Model BS-110, the



new antenna is designed to withstand winds of over 100 mph. It has no radial elements to bend, or coils to burn out or detune. The half-wave dipole antenna is constructed of lightweight fiberglass with nickel chrome-plated ferrules. It has a frequency of 27 MHz and VSWR across 40 channels of 1.5:1 or less. Gain is 3.75 db. Overall height is 15 ft., 9 in. Comes with mounting bolts and matching harness.

PORTABLE DMM 164

A new RFI shielded 3 1/2 digit portable DMM has just been announced by *B&K-Precision*. Designated the Model 2810, the new instrument features .01



ohm resolution and selectable high/low power ohms. It is a full-feature digital multimeter with a basic DC accuracy of 0.5%. The digital display uses bright .3 inch LED readouts. Twenty-nine overload protected ranges provide maximum resolution. Auto-ranging capability reduces the need for frequent range changes. Another feature of 2810 is the 10 ohm range, which with .01 ohm resolution, is said to be ideal for locating a shorted winding in a transformer, motor or coil. Priced at \$119.95, user net.

TOOL KIT 165

A 15 function tool kit has been added to the *Hunter Tools* line. Designated No. 96006, the kit includes a *Plike*®, a 4 in 1 electrical tool, and an



interchangeable screwdriver and nutdriver series. The *Plike* is used where plier, crimper, stripper, or cutter is needed. The crimper crimps most types of solderless terminals. The stripper section has 6 holes for AWG solid wire in gauges #12-22 and stranded wire. The cutter has 3/8 inch sharp hand-ground edge with a shear-cut design. A spring action returns the *Plike* to an open position.

UHF/VHF DISTRIBUTION AMPLIFIER 166

A new UHF/VHF distribution amplifier with medium gain, low noise and broadband amplification has been added to the *Blonder-Tongue* MATV equipment line. The VHF section features the patented inductively coupled emitter feedband (ICEF) circuit that increases input capability while combining low distortion with a low noise figure. The UHF section features a low noise figure for snow free reception. Front panel switches on the amplifier

projection television lenses

Convert color TV to GIANT SCREEN with Model P-1.85 Plastic Lens

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- Diameter 6.5" • Length 6.5"
- Complete with mounting ring and instructions

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Model G-2.5 Glass Lens

- Focal length 12" • f2.5
- Diameter 5" • Length 4 3/8"
- Complete with mounting ring and instructions

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ALSO AVAILABLE

- Newly developed Fresnel 2 element lens in molded hood; designed for easy mounting. Also available in separate elements.
- Newly developed High Efficiency Projection Screens in sizes 30" x 40" and 40" x 51".
- Projection kit complete with TV set. ALL AT LOW, LOW PRICES.

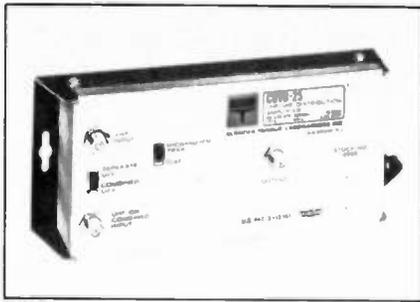
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permit the selection of combined or separate VHF/UHF inputs and the switching in of a built-in midband FM stop filter when used in an MATV system. The unit is lightning and surge protected.

SOLDERING GUNS & IRONS 167

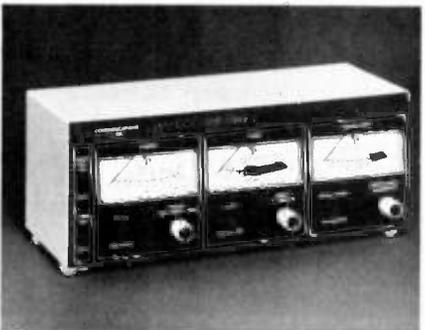
The line of industrial soldering equipment from *Weller* now also meets production line and service technicians' needs for portable tools from 25W irons to an output-controlled gun.



The line consists of three types of irons: the SP series with five models from 25W to 175W; the WP15 and WP40, each accepting eight different tip styles; and the W60 and W100 controlled output irons with 600°F or 700°F interchangeable temperature selection. Guns include 100/140W, 240/325W and a 150W output-controlled model with 600°F and 700°F power heads.

RADIO TRANSMISSION TESTER 168

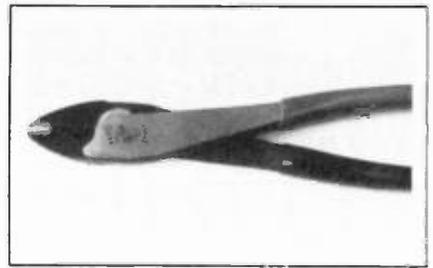
A new radio transmission performance tester that covers the 1.8 MHz-30MHz frequency range, is available now from *Communications Power, Inc.* The new tester features three separate meters, one for power,



one for standing wave ratio and one for modulation. Readings on the new meter, designated the WM-1000, are said to be fast, accurate and easy-to-read. The meter reads both average and true peak power on either 20-watt, 200-watt or 1000-watt range scales. The SWR and modulation meters allow on-the-spot calibration, and function with from one to 1000 watts of forward power.

CRIMPING TOOL 169

A new crimping plier designed for crimping non-insulated terminals and connectors ranging from 10 to 22 AWG has been introduced by *Klein Tools, Inc.* The new tool, designated No. 1006, is tapered for use in confined spaces and has a wire cutter in the nose that has been specially hardened. Features plastic-dipped handles, one red and the other black for quick identity of the crimping side of the plier.



Inc. The new tool, designated No. 1006, is tapered for use in confined spaces and has a wire cutter in the nose that has been specially hardened. Features plastic-dipped handles, one red and the other black for quick identity of the crimping side of the plier.

FORDHAM BEST BUYS

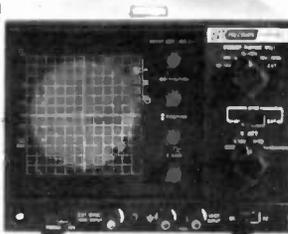
BK PRECISION OSCILLOSCOPES



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
- Large 8 x 10cm rectangular viewing area
- Front-panel Vectorscope operation with matched-sensitivity inputs
- 19 calibrated sweep ranges
- 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

Model 1472C



3" -5MHz Solid State Oscilloscope

- High sensitivity
- CB modulation monitor
- Ultra compact and lightweight (weighs only 8 1/2 lbs.)
- Vertical sensitivity 10mV/division
- New high brightness CRT and smoked-glass graticule
- Can be externally triggered
- Protective carrying case and accessory probes optional

Model 1403A



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
- Intensity modulation compatible for 5V p-p
- Illuminated graticule
- Internal 0.5 V p-p = 1% calibration source
- 100% solid state (except CRT)
- X-Y Vectorscope capability
- High performance cost ratio
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Model 1474

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DIGITAL V-O-M

170

A new 3½ digit VOM that has a .3 inch high digit LED readout display with polarity indication, .5% accuracy and low power-ohms is new from the



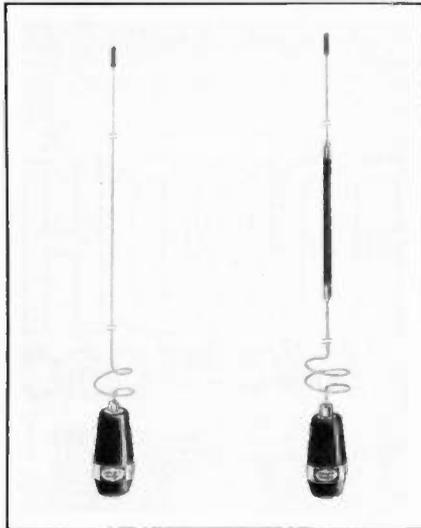
Triplet Corporation. Called the Model 3300 DVOM, the new meter offers five functions in 22 ranges. It measures 3 inches wide by 5½ inches long by 1¾ inches deep. Over-range is indicated by a blinking display, a low battery warning is included, and DC polarity is automatic with indication on the display. A fused probe provides for both high energy and normal use cir-

cuit protection. Includes long life Ni-Cad batteries and AC Adapter Charger. Priced at \$175.

VEHICULAR CB ANTENNAS

171

A new line of vehicular CB antennas and accessories has been introduced by *Phelps Dodge Communications*. The line is designed around base loaded and center loaded models. Disguise and combination antennas will be included in the line. Model 45L is a base loaded antenna with an overall length of 49 inches. Model 35S is a



center loaded antenna with overall length of 36 inches. At the base of the antennas, the antenna whip is formed into an integral open helix coil eliminating the need for springs found on conventional antennas. Whips are stainless steel, and in the case of Model 45L, centerless ground and tapered.

TWO-METER TRANSCEIVER

172

A new two-meter P.L.L. frequency synthesized multi-mode transceiver has been introduced by *Hallcrafters*. Designated the H2M-1000, the new transceiver is designed to operate in



FM, USB, LSB, and CW modes. In the FM mode, the unit provides 800 channel coverage at 5 KHz steps, and VXO variation of ± in SSB/CW modes. The unit has a Simplex mode and repeater offsets of ± 600 KHz and ± 1 MHz. The H2M-1000 can be operated on either

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To add an internal current measuring function (up to 1 ampere) to its line of miniature digital multimeters, NLS developed new miniature Rollaball rotary switches. Rollaball switches are of an unbelievably simple design which makes them extremely wear-free and they exhibit outstanding electrical characteristics. Check the specifications and prices below and then compare prices, performance and the variety of NLS' Digital Multimeters to any DMMs anywhere. Volksmeters have more capability and perform better at lower prices.



MODEL	RANGES	DC ACCURACY	RESOLUTION	DIGITS	PRICE
LM-3A	VDC, VAC, DCmA & ACmA - 1, 10, 100 & 1000. *100% over-range - 1000 VDC or VRMS AC & 1 A max.	±1% Rdg	1 mV	3	\$125
LM-3.5A*		±0.5% Rdg	1 mV	3-1/2	\$147
LM-40A	OHMS - 1kΩ, 10 kΩ, 100 kΩ, 1 MΩ & 10 MΩ	±0.1% Rdg	100 μV	4	\$190
LM-4A		±0.03% Rdg	100 μV	4	\$227

Size: 1.9" H x 2.7" W x 4.0" D

Rechargeable Batteries & Charger Unit Included.



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AC or DC and has two panel meters: a combination "S" and RF output meter plus a discriminator meter.

CAPACITANCE METER 173

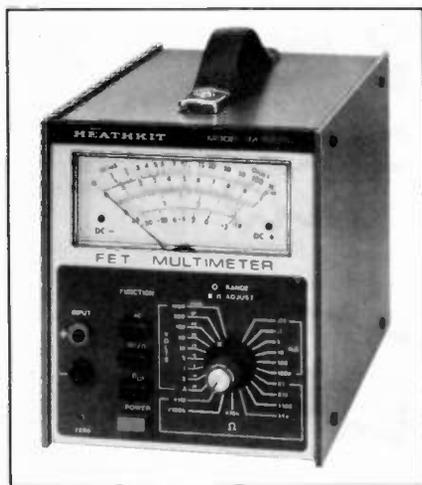
A new instrument for measuring capacitance between 1 pf and 200,000 mfd is available from *Valhalla Scientific*. Designated Model 2020, the new instrument provides an output frequency directly equivalent to the capacitance of the capacitor being tested, and this frequency may be dis-



played on any conventional frequency counter. For example, a capacitor having the value of 4.7 mfd will generate an output signal frequency of 47,000 Hz accurate to within +2% of range. The Model 2020 sells for \$175.

FET MULTIMETER 174

A new FET multimeter, designed for bench operation, has been introduced by the *Heath Company*. The new unit, designated IM-5225, features analog volts/ohms/current/DB scales, high and low voltage ohms function, and autolarity circuitry with front panel LED polarity indicators. Nine

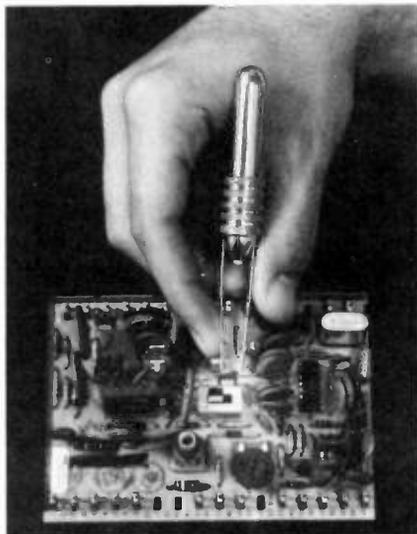


ranges allow AC and DC voltage measurement to 1000 volts and the 7 range ohms function spans impedance measurement from X1 ohm to X1 meg. Meter functions are selected with a 24-position switch. A 2-ampere quick blow fuse and clamping diode and transistor circuitry have been incorporated to accomplish meter overload

protection. The IM-5225 is available in kit form, \$119.95, and assembled, \$160.00.

TWEezer TOOL WITH LIGHT 175

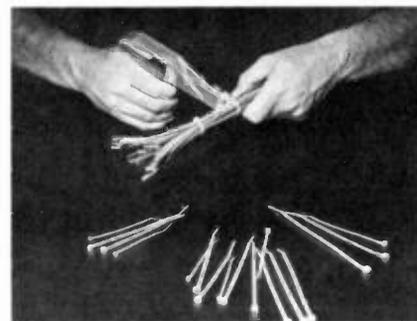
A new tool for electronic servicing that incorporates a twist-on light and tweezer points has been introduced by *Tweezer-Lite Co.* The device features



precision tips made of surgical grade, stainless steel and a battery-powered light for pin-point illumination. The light is turned on with a twist of the handle.

NYLON CABLE TIES 176

One-piece nylon cable ties that self-lock when hand or tool applied, have been introduced by *Waldom Electronics*. Called "Speedy-Ties," the new product is available in 13 lengths from 3½ to 14 inches with a standard head or mounting head for fast attachment to a panel or chassis. Cable bundle diameters of 1/16 to 4 inches can be fastened with these new ties.



They are said to be resistant to temperature extremes, diluted acids, solvents, grease, alkalis and fungus. They feature a releasable locating tip that simplifies proper positioning. A tension control application tool is also available. Sold in 100's, 1000's, and in bulk packs.

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20,000 OHM/VOLT VOM

177

A new 20,000 ohm/volt compact VOM, designated Model 110, has been introduced by *B&K/Precision*. For checking the low resistance of coil, transformer and motor windings, a



ten-ohm mid-scale range is featured. Resistance ranges cover 0-1KΩ, 100KΩ and 1 megΩ. Three DC current ranges (0.05mA, 25mA and 250mA)

and five DC voltage ranges (0-2.5V, 10V, 50V, 250V and 1000V) are featured. DC accuracy is +3% at full scale. Five AC ranges (0-10V, 50V, 250V, 500V and 1000V) provide mea-

surements within +4%. All functions and ranges utilize the same two input jacks. Meter scales are color-coded. Ohmmeter is powered by an AA battery. Priced at \$24.50. ■

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CX101G	6.20	2SA606	1.70	2SC1014	1.00
LA4032P	2.90	2SA607	1.80	2SC1061	1.20
M5115P	4.75	2SA634	.85	2SC1096	.80
MB3705	4.00	2SA699	.85	2SC1116	4.00
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uPC566	1.80	2SB405	.60		
uPC1025H	3.75	2SB556	5.50		
SN76115N	2.50	2SC373	.50		
		2SC1170B	5.80	2SC1678	2.00
		2SC1173	.85	2SD213	3.25
		2SC1226	.85	2SD235	.85
		2SC1306	3.30	2SD261	.60
		2SC1358	7.00	2SD361	.95
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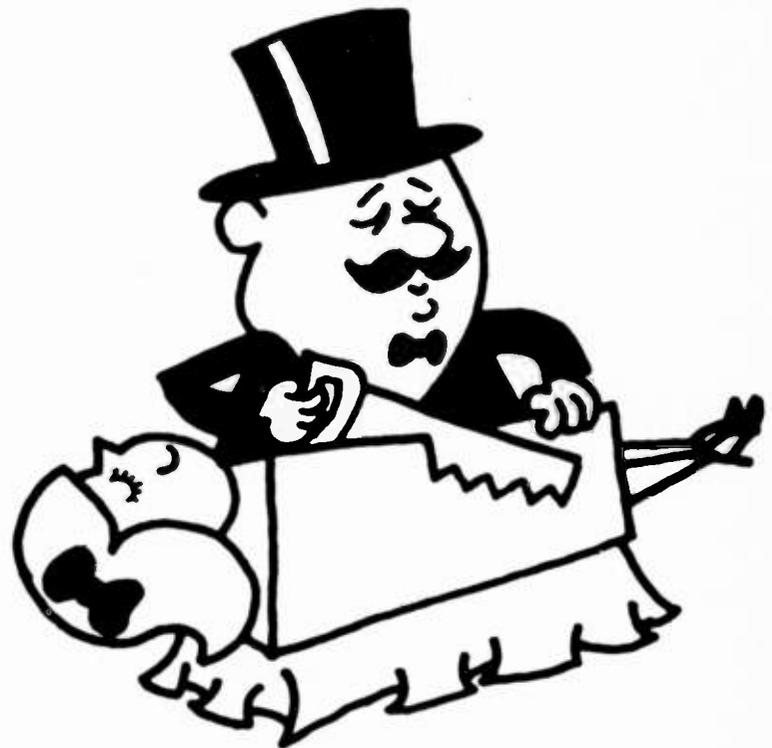
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DIGITAL

continued from page 24

The two's complement of a binary number is found by complementing the binary number and then adding 1 to the least significant digit. For example, find the two's complement of 1011:

(Number) 1 0 1 1
 (Complement) 0 1 0 0
 (Add 1 to the complement) + 1
 (Two's complement of the original number) 0 1 0 1

To subtract in binary we merely add the two's complement of the subtrahend to the other number. For example, subtract 0100 (decimal 4) from 1011 (decimal 11).

```

  1 0 1 1
- 0 1 0 0
  -----
    ?
  
```

First, we find the two's complement of the subtrahend:

```

  0 1 0 0
  1 1 (carries)
  1 0 1 1 (Complement)
  + 1 (Add 1)
  -----
  1 1 0 0 (Two's Complement)
  
```

Now all we have to do is add the two's complement to 1011:

```

  1 0 1 1
+ 1 1 0 0
  -----
  0 1 1 1 (decimal 7-answer)
  
```

"carry 1"

Note that the answer included a carry "1", this tells us that the resultant answer is positive. If the answer had produced no carry "1", it would have been negative.

Multiplication and division are a little more difficult. They involve shifting techniques which we need not discuss now.

THE BINARY CODED DECIMAL

BCD is a type of notation that is used extensively in digital electronics, especially any device that has a numerical display. The BCD notation uses binary numbers to represent decimal quantities. Each decimal digit is represented by a four-bit (I.E. Binary Digit) binary "word", that is weighted

$$2^3 + 2^2 + 2^1 + 2^0$$

$$\text{or } 8 + 4 + 2 + 1$$

For example, the binary coded decimal notations for 0-9 are:

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

Any similarity between these and the least significant four bits is purely intentional. But notice that in BCD we group the bits into groups of four each (8421) and the maximum value allowed for each group is 9 for obvious reasons.

10	0001 0000
11	0001 0001
12	0001 0010
•	•
•	•
•	•
20	0010 0000
21	0010 0001
22	0010 0010

BCD is the common code used in those circuits which drive either a seven-segment digital display (as shown in the figures) or a Nixie® tube display.

In our next article we will discuss the concept of digital gates and then get into some of the more common digital circuits and logic families used in today's circuits. ■

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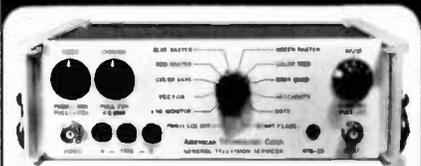
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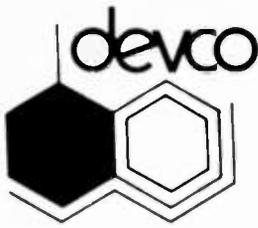
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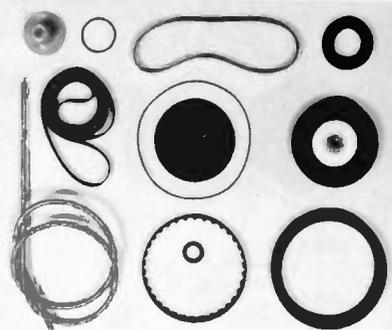
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