ET/D

JANUARY 1981 • $1.50

ELECTRONIC TECHNICIAN/DEALER
LEADING THE CONSUMER AND
INDUSTRIAL SERVICE MARKETS

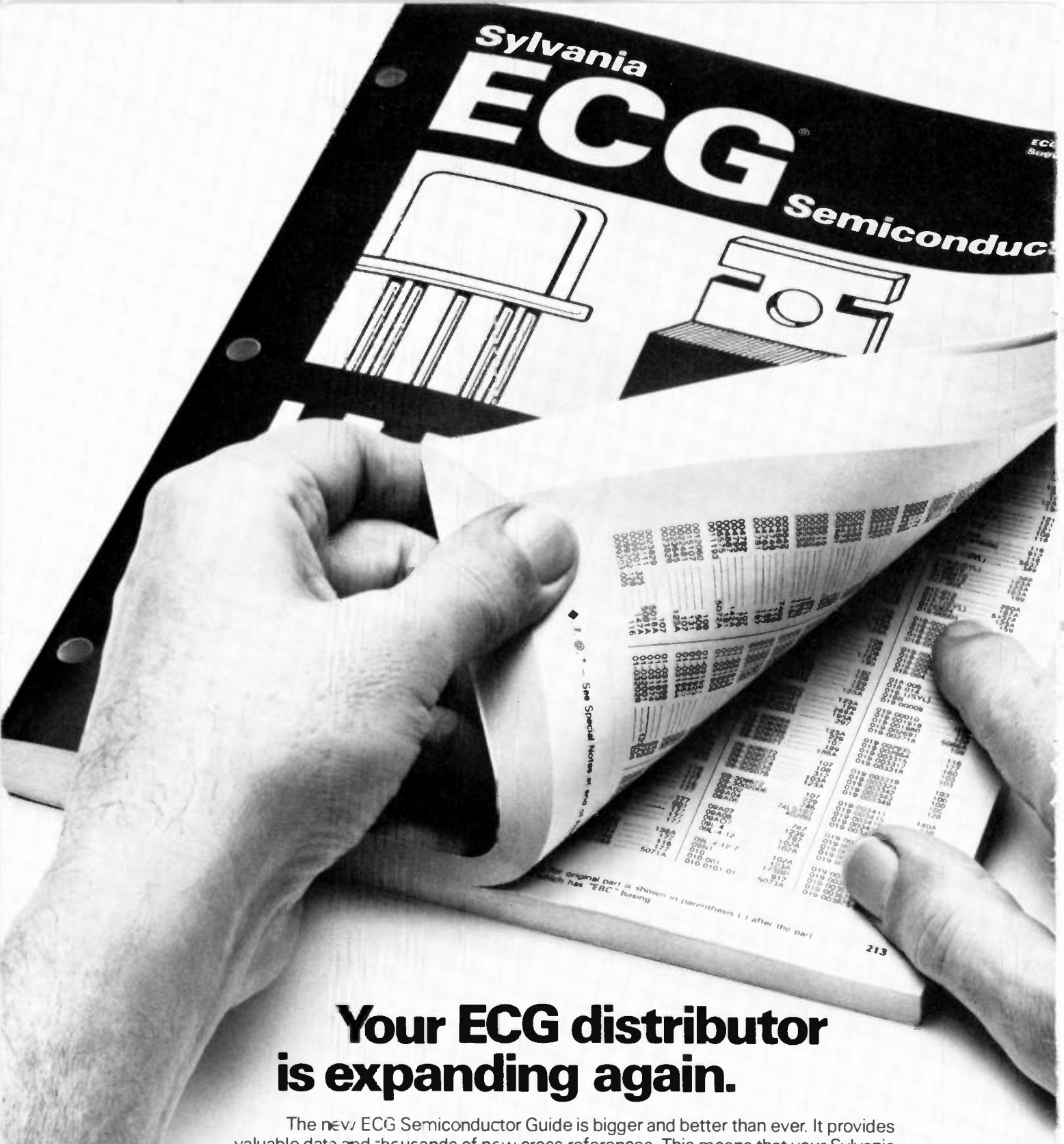
Inventory Control

Emitter Followers

Microwave Intrusion Sensors

VCR Review

HBJ A HARCOURT BRACE JOVANOVICH PUBLICATION



Your ECG distributor is expanding again.

The new ECG Semiconductor Guide is bigger and better than ever. It provides valuable data and thousands of new cross references. This means that your Sylvania distributor will be able to fill even more of your replacement part needs in just one stop. In addition to adding the 326 new types in the product line, we've also expanded the technical data section. The text on replacements and substitutions has been updated and revised. There's a section on how to make a step-by-step selection of unlisted transistors. And there are selector charts listing RF transistors by frequency and bipolar transistors by breakdown voltage and case style.

Pick up your copy of the ECG Semiconductor Master Replacement Guide today. You'll find it covers the broadest product line available from the industry's leading supplier. Get it where you get your parts—your local Sylvania distributor.

SYLVANIA | GTE

INDUSTRY REPORT

NARDA Convention

The 1981 Convention of NARDA (the National Association of Retail Dealers of America) will be held March 23-25 at the New Orleans Marriot Hotel. Julius Kretzer (Kretzer's, Mobile, AL) chairman of the Convention Planning Committee will keynote this 36th annual convention with an address entitled "Equal Opportunity Applies to Retailing Too."

Panel discussions will be held on computerization, traffic development, motivation, rentals and other subjects, all from the retailers viewpoint. A day will be devoted to Manufacturer Relations Committee sessions where dealers can exchange views with factory representatives, off record. The convention program also features programs conducted by business management professionals including Washington, DC Attorney James Goldberg with a talk on what retailers might expect from the new administration.

All retailers, including nonmembers are welcome. Information is available from NARDA, Convention Planning Committee, 2 N Riverside Plaza, Chicago, IL 60606.

Imports Rise In Third Quarter Of 1980

United States imports of audio and video tape recorder/players, television receivers and home radios were increased in the third quarter of 1980 over the same period last year, while imports of auto radios, phonographs, record players/changers, turn-tables and tape players only, declined, according to the Marketing Services Department of the Electronic Industries Association's Consumer Electronics Group.

For the first nine months of 1980, unit imports increased in monochrome television, home radios, phonographs only and audio and video tape recorder/players while decreases were recorded in color television, auto radios, phono combinations, record players/changers, turntables and tape players only.

For the year to date, monochrome TV imports rose to 4,483,130 units, a gain of 5.3 percent over 4,258,992 units imported in the first nine months of 1979.

Color television imports in the third quarter increased to 361,004 units, up 11.5 percent over the same period last year. Color television imports declined in the first nine months of 1980 to 877,387, down 18.6 percent from the same interval a year ago.

Home radio imports totaled in 1980 to date, 21,807,163 units, a gain of 3.5 percent over the first nine months last year. Auto radio imports in the first nine months of 1980 dropped to 2,568,574, off 24.7 percent from the same period a year ago.

Video tape recorder/player imports jumped 59.8 percent in 1980's third quarter to 238,655 units, compared to 149,340 in the same quarter a year ago. For the year-to-date, imports of video tape recorder/players totaled 619,586 units, up 52.1 percent over the first nine months last year.

Total U.S. exports of color television receivers jumped ahead in the third quarter of 1980 reaching 308,340 units, an increase of 288 percent over last year. Year-to-date color television receiver exports totaled 576,675 up 123.4 percent over last year. Exports also increased in the third quarter for auto radios and entertainment band radios and audio and video tape equipment.

"Electronic Yellow Pages" To Reach $2.5 Billion By 1990

Information on products and services, of the type which is currently available in telephone yellow pages, will soon be provided in electronic form, according to a newly-published report from International Resource Development Inc. The report predicts that the U.S. operators of "Electronic yellow pages" services will derive revenues of more than $200 million by 1985 and the market will pass the $2.5 billion level in 1990. Because these new "yellow pages" can be constantly updated, they can provide information on prices, special sales, etc. of the type which is currently the province of newspaper classified advertising; thus electronic yellow pages represent both a threat and an opportunity to the newspaper industry.

The availability of electronic yellow pages will help stimulate the move towards the installation of home terminals, including view-data-type equipment, integrated video terminals and handheld portable terminal devices. The report points out that hobbyists with Radio Shack, Apple and other home computers can already access electronic classified-ad services operated by Source Telecomputing (a subsidiary of H&R Block). The same terminals used for EYP access will also be increasingly used for sending and receiving "electronic mail," predicts the report.

In France the government-controlled Post, Telephone & Telegraph organization is moving ahead with its plan to phase out paper telephone directories over the next fifteen years. Consumers will be provided with a simple, inexpensive ($100) TV-like terminal device with a keyboard which will enable them to request directory information "on-line." The French expect that savings on paper, printing and distribution of paper directories, coupled with a reduced load on directory-information will more than pay for the required terminals and computer hardware.

ISCET offers PLL course.

A practical hands-on course in phase-locked-loop technology has recently been offered by The International Society of Certified Electronics Technicians. The course is designed to be used by a leader and a group of students. The training package consists of an instructor's guide, student workbooks, a text, transparencies, components for performing experiments and tests for the students. A set of materials for an instructor and five students costs $153.50. Additional materials for students only are priced at $24.10 per student in groups of five only. From: ISCET, 2708 W. Berry, Ft. Worth, TX 76109.

ETD Has New Assistant Editor

Peter B. Credit joined ET/D as Assistant Editor in late November. Pete spent four years in the Air Force and will shortly receive a degree in Electronics Technology from the University of Minnesota, Duluth, where he also studied technical writing. While in the Air Force he performed maintenance on an electronic warfare simulator, and attended various Air Force technical schools. His wife Martha is a native of Orinda, Calif. and is a graduate of the University of California, Davis. Pete is a member of IEEE and is a native of Detroit, Michigan.

AAVT Convention

The Association of Audio-Visual Technicians will be holding its fourth annual convention in conjunction with the National Audio-Visual Association Convention in Dallas, Texas January 14-19, 1981. Convention topics will include: Acoustics, AV Management, Service Seminars, Standards and the AV Technician, Videotape Editing, Multi-Image Troubleshooting, and much more. A total of twelve seminars will be presented.

Social events also are scheduled. An opening reception gives attendees an opportunity to meet with others in their field as well as representatives from other associations and manufacturers.

The cost is AAVT Members $50.00 and Non-members $75.00 before December 15, 1980. The late-registration cost is $60.00 AAVT members and $85.00 non-members. Non-member prices include a one-year, individual membership. Contact: Association of Audio-Visual Technicians; P.O. Box 9716; Denver, Denver, CO 80209. ETD

ET/D

ELECTRONIC TECHNICIAN/DEALER
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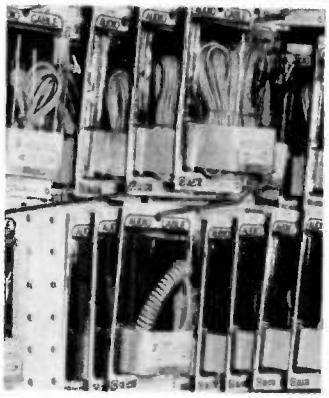
January 1981 Vol. 103 No. 1

FEATURES



On the cover: Do you wonder where all the money you have put into your business is? Perhaps too much of it is tied up in inventory. It is all too easy to have the shelves stocked with quantities of slow moving or obsolete parts. There is something you can do about it.

DEPARTMENTS

HBJ A HARCOURT BRACE JOVANOVICH PUBLICATION ABP ABC EIA

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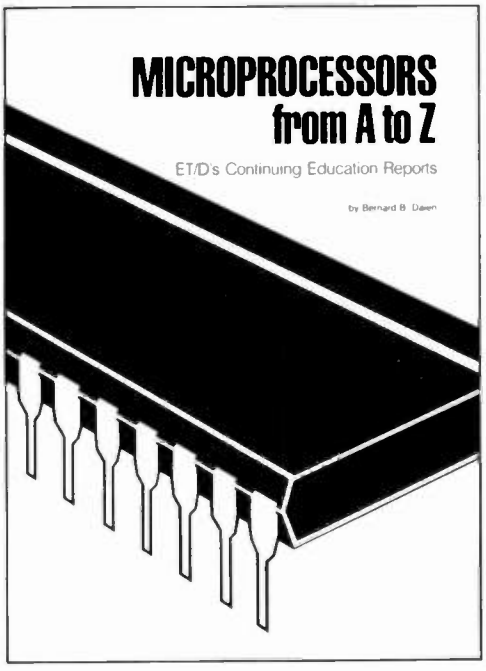
MICROPROCESSORS from A to Z

by Bernard B. Daien



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Scheduled for publication on October 1, 1980. Orders will be fulfilled within 60 days of the publication date or within 60 days of the date of order if received after the publication date.

SERVICE SEMINAR

MAGNAVOX

Microtune and one-knob tuning systems—snowy picture on VHF. Remote and non-remote Microtune TV tuning assemblies (Part No. 703954-8 and 703976-4) plus some One-Knob varactor systems may exhibit a snowy picture on UHF due to a misplaced capacitor on the UHF Tuner (340250-5 only). Capacitor C201, should be connected between the cathode of the 15V zener and ground. The drawing in the Service Manual is incorrect. C201 ground lead may be located in a different position on some tuners.

13C2 Color TV Chassis—Protection Circuit. The 13C2 Color TV chassis, used in Models BA4036 and BA4038, is designed with a special circuit that protects the chassis in the event of a momentary power surge or a CRT arc. When this circuit is activated, a momentary loss of picture may be noticed. This is a normal situation and does not indicate a need for service. A note is included in the customer's Instruction Book explaining this feature. It reads: "Your new Magnavox television includes a special circuit which protects your set in the event of a momentary power surge. On the infrequent occasions when this circuit is called upon to provide this protection, you may notice a momentary loss of picture. This operation is normal and does not indicate a need for service."

SONY

All Models having coaxial anode caps—triple green picture. All Trinitron color sets having only one lead from the high voltage block to the picture tube bell area, and no lead to the neck area, are equipped with a dual-function coaxial anode cap. This coaxial cap supplies both anode and convergence voltages to the CRT. If the outer (anode voltage) section of the cap short circuits to the inner (convergence voltage) section, a triple green picture will occur. To correct: a. Turn off the set and carefully remove the anode cap by gently inserting the recommended anode cap remover tool, Part No. 7-700-768-01, between the flexible area of the cap and the glass area of the CRT, and pull the anode cap straight out until it lifts off. b. Discharge both the anode cap and CRT button to chassis ground. c. Check the cap for damage and replace the cap/wire assembly if damage is evident. d. Carefully reconnect the cap by lining it up with the CRT anode button and pressing straight in gently. e. Rotate the cap approxmiately 10 ° clockwise and then 10° counterclockwise to insure proper seating.

PANASONIC

Model TR-5000— No picture or distorted picture VHF or UHF position. Cause: Thin metal whiskers shorting the VHF & UHF tuners to wire jumpers located on the Main PC Board directly underneath the tuners (wire jumpers J83, J84, J85, J87, & J88). To correct: 1. Pull out Main PC Board from the cabinet. 2. Remove PC Board plastic holder on the tuner side of the board. 3. Wet a thin cotton swab, with tuner cleaning solution, and insert it between tuners and PC Board. Thoroughly

clean both surfaces as illustrated. Do this to both VHF & UHF tuners even if only one is defective at this time. If the problem persists, the tuner may require cleaning inside. To accomplish this, simply remove the tuner covers and blow out any dust or metal particles that may have accumulated.

RCA

Chassis CTC 97, low brightness, color okay—dc voltages wrong on Q3011 blanker—no negative going horizontal pulse on base. To correct: Check for open R3053, 270K, 1/2W resistor. Hopp's TV and Appliance, San Antonio, TX.

Chassis CTC86B, picture very dim, no control of brightness—voltage at terminal No. 16 of lum/sync module measures low (about +13 Vdc) (Beam current voltage) should be +23 Vdc. To correct: Replace R425, 120K, 1-2 Watt resistor (open or increased in value) RY25 located in "wiretap" area. Dean R. Mock, CET, Elkhart, IN.

ZENITH

Chassis 19GC45, insufficient vertical sweep—replacing vertical module does not correct problem. To correct: Replace R203, 4.7 ohm resistor (value increased to 6 ohms). R.E. Lyon, Carlsbad, NM.

Chassis 20CC50, no picture, no H.V., no boost—damper becomes red hot after a few minutes. To correct: Remove damper tube, if H.V. returns, replace C332, .1 MFD at 1 kV capacitor in plate circuit of damper tube (shorted). Ernest Cameron, CET, Ubly, MI.

Chassis 12A12C52, vertical jitter—vertical can be adjusted to roll in one direction only. Large portion of vertical hold control has no effect. To correct: Replace defective vertical hold control P/N 63-8202. Kaz Glista, CET, Newington, CT.

Chassis 17FC45, horiz. jitter (or flutter) (circuit breaker may kick after warm-up)—amt of jitter varies with change in position of brightness control. Also black bar visible which moves from bottom to top of screen. To correct: Replace defective optical isolator Zenith P/N 800-617 and TRIAC 800-618 (located on the space command circuit board). J. Boninti, Bellrose, NY & J.E. Harres, CET, Temple, TX.

Chassis 19GC45, circuit breaker kicks open in 30 seconds—.6 amp fuse in vertical open—yoke appears to be burning. To correct: Replace defective pin cushion transformer which is mounted in yoke cover assembly. Dave Garwacki, CET, Toledo, OH.

Chassis 19FC45 incorrect interlacing at top and bottom of picture—middle of picture ok. Picture is full vertically and horizontally. To correct: Replace defective R1307 pincushion amp control (30 ohms) (open) P/N 63-10223. Scott M. Phillips, Sr., Binghamton, NY.

Chassis 19JC60Z, channel 2 on 2,3,4 (sound of 2 on 6) no other stations received—substituted 175-2025-01. Does not correct problem. To correct: Replace CR55, Zener diode P/N 103-237 on assembly no. 175-5042-01. Kevin Mueller, Wittenberg, WI.

Chassis 19CC19, no picture, sound ok—HV measures ok. To correct: Replace 3rd video amp (output) transistor (Sams 1215). Robert Boettger, CET, Edison, NJ.

Chassis 19HC 50/55, picture very dim—filaments of CRT measure 5 volts (RMS) and appear to be dimly lit. To correct: Replace CRT. Walt Macomber, CET, Seattle, WA. ETD

LETTERS

HELP NEEDED

I need help in locating a Hickok 295XRF Signal Generator.

John Augustine
530 N. 9th St.
Reading, PA 19604

Need good used 19CQP4 and 19VARP4 B&W picture tubes.

M.B. Danish
Mike's Repair Service
P.O. Box 217
Aberdeen Proving Ground, Maryland 21005

I recently bought an old RCA Radiola 25 made in 1925. Everything looks in great shape except two of the UX199 tubes are broken. Does anyone have any? Please write me. Thank you.

Steve Cooper
Cooper's TV
P.O. Box 11
Cloverdale, AL 35617

Remote control or stepper relay for a Zenith model S-74626, S-75276, or S-79636 remote receiver. Unit is transistorized but set is tube type.

Walter W. Ellett
21040 Rainbow Dr.
Cupertino, CA 95014

DOES ANYONE NEED?

The following circuit boards for a Conar–Model 316 19 in. TV. Video IF/AFT (EC44-100) Sound-Video (EC45-200) Sync/Sweep (EC46-300) Power Supply (EC47-400) Convergence (EC49-600) and Color (EC48-500) all fully assembled and tested. Perfect condition. Also, any misc. parts for this TV. Best offer.

Lloyd Stoops
Rt. 3, Box 127-B
Foxworth, MS 39483

BRICKBATS:

In the article "The Service Managers Changing Role," John Gooley characterizes the technician as a person without the mentality or sensitivity to understand poetry or Shakespeare. I know many technicians who do not fit this narrow stereotype. I think an apology is in order. I like the articles in ET/D because they contain meaty information and get to the point. Mr. Gooley's smug long winded article took two pages to make two observations. Good service management improves profitability and often managers have more technical than management training. Awaiting your reply.

Barry D'lott
PO Box 5518
Santa Monica, CA 90405

Editor: John Gooley meant no insult to anyone. After all many people do not particularly like most poetry and I suspect John is among them. He only intended to show that a particular bent of mind likes more concrete things better. It certainly is no reflection on one's mentality if he likes math and not poetry—though for some like Lewis Carroll they went together. The article was intended to show some of the problems of service management and the lack of preparation the average technician has to contend with. From what I see of the industry, this is a very common problem indeed. No insults were meant and we do apologize if any were taken.

ET/D welcomes letter of comment on the industry or the content of ET/D whether complimentary or not, and the editors will do their best to answer them individually or in this column. ETD

ET/D

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BULLETIN BOARD

A series of **Professional Test Records** is described in a bulletin available from *Columbia Special Products*. Technical Bulletin TR-2 presents specifications of a series of nine different records which can be used for testing and evaluation of pickups and systems; for pickup tracking, for pickup response and for rumble and wow testing, for the calibration of recording systems, for the acoustical testing of systems and speakers, for broadcast equipment testing, and other tests. The different records offer different combinations of tests to meet the requirements of various aspects of pickup, turntable and system testing.

Circle No. 118 on Reader Inquiry Card

A catalog of ladder, cargo, and roof racks for pick-up trucks, vans and recreational vehicles is being offered by *Vanguard Manufacturing, Inc.* The Vanguard Ladder & Material Rack Catalog features cargo carriers and ladder racks for full-size and mini pick-up trucks; roof racks for all foreign and domestic vans; and recreational vehicle cap racks for flat and dual level tops. It is fully illustrated with photos and detailed diagrams including specifications and accessories. All racks are stated to be made of heavy duty tubular steel and angle iron, and the cargo carriers feature a full swinging rear gate for easy loading.

Circle No. 119 on Reader Inquiry Card

A-V parts and services are the subject of the new third edition of the *Annotated Directory of Parts and Services for Audio-Visual Equipment*. The purpose of the Directory is to assist audio-visual service technicians in locating parts and service sources for audio-visual equipment. The Directory lists almost 2000 brand names of equipment and their current parts sources. Many of these sources are no longer the original manufacturer as the brand has been sold, discontinued, or the manufacturer has moved or is no longer in business. Also included is a listing of sources of specialty items used by service technicians, and a listing of the "Association Alphabet" containing the names and addresses of the many associations involved in audio-visual technology. The price of the directory is $10.00 + $2.00 shipping and handling to AAVT and EPIE members. The non-member price is $20.00 + $2.00 shipping and handling. Prepayment is required and cash with the order eliminates the shipping and handling charge.

Circle No. 120 on Reader Inquiry Card

A new 12-page brochure, from *Vector Electronic Company*, describes 109 professional **electronic packaging and breadboarding products** that are available, over-the-counter, from electronic and personal computer component stores throughout the United States and Canada. Highlighted are microcomputer interface boards, Vector Plugbords™, motherboards, cases, tools, wiring terminals, and kits. A complete price list is included.

Circle No. 121 on Reader Inquiry Card

This newly revised 1980-81 illustrated short form catalog describes the expanded line of **probe kits and test lead sets** from *Test Probes, Inc.* Sixteen models are featured, including oscilloscope probes, high voltage probes, RF/demodulator probes and test lead sets and several models just recently introduced. TPI's low cost probe kits are reportedly versatile, rugged and exceptionally flexible due, in part, to their "undulated wire" center conductor. TPI's safety designed test lead sets are rated to 2000 V, 20 Amps and feature a burn-resistant silicone-rubber covered cable with retractable 4 mm safety sleeved plugs. This new catalog includes descriptions, specifications and a list of options and accessories.

Circle No. 122 on Reader Inquiry Card

Semiconductor devices for MRO use are the subject of a catalog from *RCA's Distributor and Special Products Division*. This catalog lists a broad range of JEDEC numbered and RCA numbered industrial and commercial semiconductor devices available through RCA SK distributors. A cross reference directory lists many industrial (2N, etc.) numbers and RCA replacements. See your RCA SK distributor.

Circle No. 123 on Reader Inquiry Card

The 58th edition of the Radio Amateur's Handbook has just been published by the *American Radio Relay League*. The 1981 edition has been expanded by 64 pages to a total of 640 pages in an 8-½ x 11 format. There are 22 chapters of text plus a chapter on tran-

sistors and vacuum tube characteristics. Additions to the 1981 edition include information on computer generated lunar and solar location charts and equations for EME enthusiasts, digital logic family compatibility charts and interface circuits, IC op amp charts, updated spacecraft orbital parameters, and amateur ASCII and Baudot technical standards and definitions. Of special interest to the designer is a chapter devoted to radio design techniques and language. Additional construction projects featured in the 1981 edition include a 50 MHZ linear amplifier, a foldover tower and a modulated RX noise bridge.

The 1981 *Handbook* reflects the changes in the state-of-the-art in radio frequency communications and amateur radio by introducing new digital logic and op amp projects. The standard information found in previous editions of the *Handbook* is retained in the 1981 edition which includes chapters on electronic laws and circuits, HF transmitting, and single-sideband. Despite the revision and expansion of the handbook there has been no increase in price over the previous editions. Because of the contents of the 1981 *Handbook* it should have wide appeal in the electronics industry as well as continue to be the standard text for amateur radio. 640 pages, hardbound $15.75, paper edition, $10.00.

Circle No. 124 on Reader Inquiry Card

Test instruments for a broad range of applications are featured in *B&K Precision's* latest general line catalog. Catalog BK-81 includes such instruments as the 1077B Television Analyst, which with its predecessors the 1077A and 1076 etc., have been in production for about 20 years, and which we understand is about to go out of production, and the Model 1250 NTSC color bar generator, the new Model 2845 autoranging DMM, seven models of oscilloscopes, six DMM's, five analog multimeters, signal and sweep generators, tube testers, several digital capacitance meters, bench power supplies, semiconductor testers, an isolation transformer, digital pulsers and logic probes, counters, CRT restorers/testers, and probes, cases, and other accessories.

Circle No. 125 on Reader Inquiry Card

A versatile six inch lathe and its accessories are described in a catalog from *Clausing Corp./Atlas Press Co.* The Atlas 6 inch lathe offers the shop a wide range of machining capabilities with accessories such as several types of chucks, tools and milling attachments and cutters. Catalog EXD-3 provides full specifications of the Atlas 6 inch lathe in both its inch and metric versions, describes chucks, faceplates, steady and follower rests, centers and tools and tool holders. Also described is an armature reconditioning kit and a variety of milling accessories.

Atlas also manufactures a 12 inch lathe in bench or pedestal models, with a full line of accessories. This lathe, sold through distributors, features a quick change gear box, 12″ swing, 36 inch centers, and has available all standard tooling and accessories, chucks, toolpost grinder, milling attachment and others.

Circle No. 126 on Reader Inquiry Card

Answers to Quiz Number 1

1. b.	6. c.	11. a.	16. d.	21. c.
2. d.	7. d.	12. b.	17. c.	22. a.
3. c.	8. b.	13. b.	18. d.	23. d.
4. b.	9. a.	14. c.	19. a.	24. a.
5. a.	10. d.	15. d.	20. b.	25. d.

You should have missed no more than 6 questions to make 75%. If you missed more, you could use some reviewing of electronic fundamentals.

NEWSLINE

COLOR TV SALES UP 21.3% IN NOVEMBER. U.S. market sales of color television receivers to retailers continued their strong second half surge in November increasing to 1,077,998 units, up 21.3% over November '79. Total sales of color TV receivers on a year to date basis increased by 1.3% over a year ago according to the Electronic Industries Association. Monochrome TV sales though up for November are down 1.9% from '79 for the year thus far. VCR sales are up 65.1% over '79 for the year so far.

RCA TO OFFER PROJECTION TV. RCA announced December 4th that it would introduce a 50-inch (diagonal) screen projection television receiver in February 1981, about a month before the introduction of its SelectaVision "CED" VideoDisc player. RCA's video disc players are to make their bows at 5000 dealers on a single day next March according to Television Digest. The price is to be $499.95 and 100 discs are to be available at prices from $14.95 to $27.95, "most under $20.00."

RCA; ZENITH PRICES UP. Zenith recently announced factory price increases of 1 to 1.5% on color TV and suggested another increase might be needed in February. RCA a few days later announced price increases of about 1% in the factory prices of 28 color models and of about 2.5% for eleven B&W models. According to an RCA spokesman color television's average retail prices are only $7 (seven) more than the average retail price of a color television receiver in 1967.

FCC APPROVED MORE SATELLITES. The Federal Communications Commission in early December approved the construction of 25 domestic satellites and the launch of 20. RCA Americom is to build 6 and launch 4, Western Union to build and launch 2, AT&T to build 3 and launch 2. Comsat General, Southern Pacific, Hughes and GTE Satellite all received construction and launching permits.

HITACHI TO PRODUCE CED DISC PLAYERS. Hitachi is, according to Television Digest, going to announce its adoption of RCA's CED videodisc system for the U.S. market and plans to begin producing 10,000 players per month in April. Radio Shack reportedly will take most of that output. Montgomery Ward is reported to be negotiating with Hitachi also.

FROM THE EDITOR'S DESK

I was invited to a local association dinner the other night. (I'm not sure how much of an honor it was, being invited at the last minute when a consumer affairs speaker wouldn't come—it seems they—the consumer affairs people—want a minimum audience of twenty and the association couldn't guarantee how many would show up.) In any case the conversation was interesting with everyone comparing gripes, and it eventually came around to service rates, estimate charges and minimum rates. Most of the service call rates and hourly shop rates appeared to be fairly realistic. Apparently some of the shops had studied their costs and were trying to adjust their charges accordingly, and they did seem to be profitable. Nevertheless judged by the cost of a plumber or electrician or several other trades and professions, consumer electronics service rates are low—as if we didn't all know it. But that is not my point, as much as I advocate that you raise your rates—everyone of you should be making $20-$25 thousand a year or more—but the point is most shops seriously lower their average with estimates not accepted, merchandise not picked up, repaired or not repaired, and by accepting junk for repair—we're all too kind hearted when some elderly person comes in with a hopeless, cheap transistor radio.

You probably do make a good, justifiably so, profit on repairs to reasonably modern equipment of some value. But you also probably lose time and money on attempting to make repairs to a 1964 color set with a flat picture tube and about 20 other problems, large and small. Do you accept portable cassette player/recorder's at less than about a $25.00 minimum? If so , you probably spend uncompensated time on many of them. At least with a high minimum, most of the junk will be refused and you can make a profit on those accepted—wasting time is wasting money.

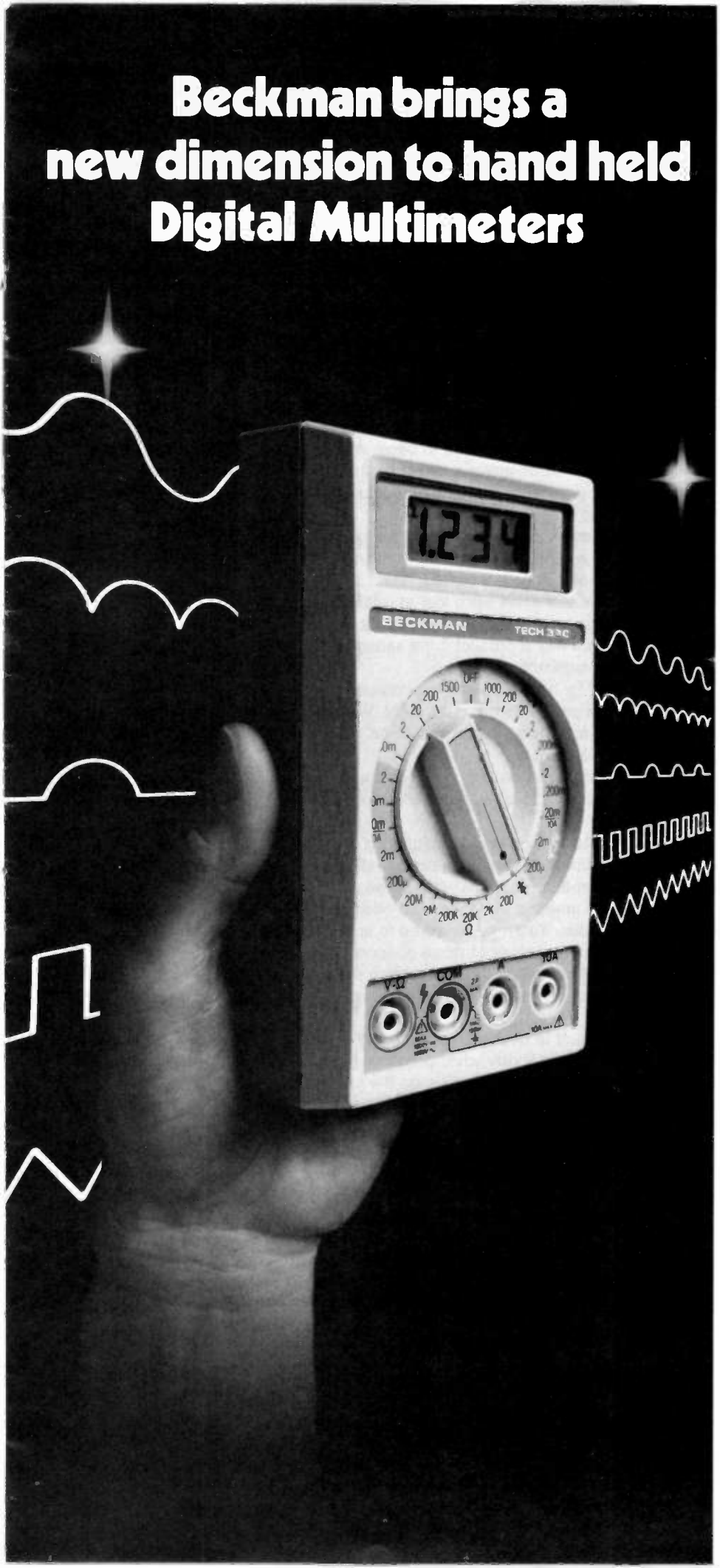
I feel you should have an estimate charge and minimum charge—collected in advance if possible—of an amount sufficient to cover the time involved. You spend enough time talking to the customer anyway. And—if you, as you should, post conspicously your minimum charges, you may discourage customers with equipment that is not economically repairable from taking up your time.

Consider the time you are wasting; you cannot make up for all of it by raising your rates on the TV sets etc., which are worth repairing.

Sincerely

Walter H. Schmitz

Beckman brings a new dimension to hand held Digital Multimeters



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The TECH 330 also accurately measures the entire audio band up to 20 kHz. But that's not all you can expect from Beckman's top-of-the-line multimeter.

Measurement Comparison Chart

Waveforms (Peak = 1 Volt)	Average Responding Meter	Beckman TECH 330	Correct Reading
Sine Wave	0.707V	0.707V	0.707V
Full Wave Rectified Sine Wave	0.298V	0.707V	0.707V
Half Wave Rectified Sine Wave	0.382V	0.500V	0.500V
Square Wave	1.110V	1.000V	1.000V
Triangular Sawtooth Wave	0.545V	0.577V	0.577V

You also get 0.1% basic dc accuracy, instant continuity checks, 10 amp current ranges, a separate diode test function, 22 megohm dc input impedance, and an easy-to-use rotary switch.

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Enclosed in a rugged water-resistant case, the TECH 330 can take a 6-foot fall onto concrete and still perform up to spec. And to further ensure reliable, trouble-free operation, the TECH 330 gives you 1500 Vdc overload protection, RF shielding, 2000-hour battery life, gold switch contacts, and fewer electronic components to worry about.

Add another dimension to your world of electronics. Visit your Beckman distributor today for more information on the TECH 330 and Beckman's complete line of digital multimeters, starting at $120.

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BECKMAN

Circle No. 108 on Reader Inquiry Card

SECURITY VIEWPOINT

In talking with retailers across the country who have tried to sell home security products over-the-counter, one thing becomes obvious. The category hasn't sold.

Many of the retailers are either cutting back on the number of security products they offer or are eliminating their security departments altogether.

While this may be discouraging for the retailers, it need not be a negative sign for the professional installer. Stagnant sales of residential products at retail should indicate a number of things to you.

For one, the consumer, by his reluctance to buy at retail is saying in effect, "I don't trust myself to install the system." For many consumers (who may very well be prime candidates for purchasing a home security system), the mere thought of attempting to install the system is enough to scare them away from the do-it-yourself approach.

You as a professional installer have to bear in mind that *ensuring the safety of the consumer and his family is the bottom line.* Naturally, the prospective buyer would really like to avoid the responsibility of actually hooking up (and possibly installing it incorrectly) the security system.

When you make your presentation, talk in terms of selling peace of mind and security, not panels, digital communicators and central stations; don't get overly technical. The prospect is confused to begin with, that's why he needs your help.

Pricing has also had an adverse effect on the sale of residential security equipment at the retail level. Some manufacturers have offered systems ranging in price from $300 and up.

Consumers have indicated that if they are going to spend $300-$600 for an over-the-counter system, they might as well spend the additional dollars needed to have a system professionally installed.

Also, many potential sales were lost at retail because no one on the selling floor had the knowledge to answer questions concerning equipment capabilities. Think about it. Would you buy a product if the salesperson couldn't demonstrate or explain it to your satisfaction?

The consumer, by his reluctance to purchase residential security at retail has made his feelings on the matter quite clear. While he was willing to purchase smoke detectors and install them himself, he will not do the same with more sophisticated equipment.

There are a number of ways to get your share of the business. Obviously, you can advertise with your local tv, radio and newspapers. This can be expensive and time consuming.

You may want to try working in conjunction with your local police department. Local law enforcement departments are usually receptive to this idea and many have "crime prevention programs" in progress.

Try arranging a meeting with them and offer your expertise as a professional alarm dealer/installer. You may be asked to speak about the merits of home security systems at a number of these consumer oriented crime prevention meetings. You will benefit as those attending will associate you with the police department, and as someone who is concerned with reducing the crime rate in your area.

You may also want to offer your services by agreeing to put smoke and intrusion detectors in your public library, civic center or other community meeting place. Do the job at your cost, or if it is feasible, do the job gratis. Arrange for the local media to be notified. The business you may generate from a good-will gesture may be literally "worth its weight in gold."

If your local radio station has a talk-show format (and most do these days) why not contact the station's program director and see if he is planning a show in the near future on crime. If he is, offer to be one of the panelists. It is a great way to bring your company before the public eye, and best of all it won't cost you anything more than a few hours of time.

What all this is leading to is really very simple. You can't always expect business to come to you. You have to watch for trends (such as the decline of security equipment at retail) and be ready to act accordingly.

Ray Allegrezza

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ETD-181

Circle No. 109 on Reader Inquiry Card

More microprocessors

An overview and update.

The applications of microprocessors continue to multiply. This expansion will require periodic updates for the technician. Here's a first installment.

By Bernard B. Daien

Practically all electronic publications now include one or more articles about microprocessors (MPUs) in each issue. Why is there such a need to write, apparently endlessly, about this one subject? And, since we already have so many companies manufacturing such a wide variety of MPU products, why do we go on developing more and more?

This short, easily read article, was written to clear away some of the confusion generated by the rapidly expanding MPU business. It is an update . . . an overview . . . about what is happening in the MPU field right now. There are good reasons why the new products and systems are appearing. If you have been trying to keep up to date in MPU trends, you will surely want to read this article in order to understand what is happening . . . and why it is happening.

Recently ETD ran a series on MPUs . . . their architecture . . . what is inside the MPU, and why it is there. ETD has published a book on MPUs written especially for consumer electronics technicians. This article, along with the past series, the upcoming book, and related articles about MPUs which will appear in ETD in the near future, enable the reader to "get his feet into the MPU waters".

Since MPUs are now penetrating consumer electronics products, consumer electronics technicians cannot put off the study of this "hot" subject any longer. MPUs today are what solid state was a few short years ago. They are here . . . they cannot be ignored! One main cause of continuing development in the MPU field is the tremendous success of the product! The widespread acceptance of MPUs offers great financial success for people who can offer better products . . . and many seek big-bucks success with new MPUs, new peripherals, new system philosophies. Each claims certain advantages . . . each has it own peculiar limitations and disadvantages . . . as a result the choices are becoming many, and more difficult. Just making a decision to buy a MPU has become a formidable task . . . with many different manufacturers literature to read, offering new ideas. Yet, one must be capable of understanding at least the basics, in order to even read the literature!

With the passage of time, these many different products and systems are continuously undergoing "shakeout" . . . some become widely accepted . . . others become obsolete. The successful products have enabled the MPU to become much more effective and powerful, without a corresponding increase in cost, or programming! In effect, they have increased the instruction set functions, without the need for special commands by the programmer. What are these new developments? They are . . .

. . . Multiple Processors.

"Multiple processing", usually abbreviated to "multiprocessing", utilizes several MPUs (often called "CPUs"), in one system, with the operations divided up among them. When operations are performed simultaneously, i.e., parallel in time, the procedure is frequently termed "parallel processing". Variations of this have been used in systems for a few years. It is a very cost effective way to improve computing power, since the several MPUs share many other parts of the system, including memory banks, input and output devices, buses, and of course, terminals.

Multiprocessing is divided into two main categories, "master/slave processing", and, "multimaster processing" (also known as "symmetrical processing"). As the name denotes, master/slave processing has one MPU which acts as a master MPU, while one or more other MPUs act as slaves, performing certain limited functions. These slaves are *always subordinate* to control of the master MPU, which has supervising authority over the system.

In "multimaster" processing, two or more MPUs, with the same authority, share the work, with supervisory power moving back and forth among them, as desired. (They are co-equals.)

Bus Problems

Both slave and symmetrical processing methods require an increase in complexity, and create some problems in implementation. One such problem arising from the use of multiprocessing is the need for better control of the buses which handle data, addressing, and control functions, in order to avoid

having several MPUs wind up trying to use the same bus at the same time! With the advent of multiprocessing, the bus system takes on greater importance than before, since the buses supply the interconnections between the various MPUs in the system, as well as performing their usual functions of providing interconnects between a single MPU and the various other parts of the system (memory, input, output, etc.).

The bus discipline problem is handled by adding some extra circuits, called "Bus Masters", which act as traffic controllers. In performing this task, a secondary problem arises as to which bus master has authority . . . i.e., the assigning of priorities. Therefore another design effort has set up a system of "bus arbitration" in which circuits called "bus arbitrators" direct the bus masters . . . automatically, without the need for a programmer to write commands into the program. This feature is very desirable, since it avoids cost, time, and programming effort in obtaining the benefits of multiprocessing.

Still another common problem arises, relating to bus control. It is necessary to insure that an MPU system using multiprocessing does not permit an alien MPU (in another interconnected system), to obtain access (undesired access) to the bus system. This is described as the need for "exclusion" (excluding alien MPUs), and provisions must be made for this.

More Multiprocessing . . .

Multiprocessing can be divided up still further, into more specialized methods than symmetrical and master/slave systems. Typical of these are, "coprocessing" (also known as "extended" processing). To better understand these, we must go back a bit in time, to the early MPUs, which needed a different peripheral for each type of input. A telephone line required a serial input device, while connection to a multi-wire parallel bus required a parallel input device. In addition, tying into another system running off a different clock, demanded the use of an asynchronous converter of some kind. It soon became apparent that better peripherals were needed, which could do more varied tasks, and so chips like UARTs were developed (Universal Asynchronous Receiver Transmitter), which can act as an input, or an output, and interface with asynchronous systems, etc.

While such peripherals can do more, and do it better, they must always be told what to do, and they must be called up (addressed). This takes programming, and when such programming must be done over and over, repeatedly, it takes more care, time, and cost in programming. Remember, once the initial cost of a MPU hardware system is paid for, it is done. But programming goes on, and on . . . and in a typical system, programming accounts for over ninety percent of the total cost! Or, as stated by MPU engineers, "software costs more than hardware in an MPU system". So anything that does not need to be done by the programmer, is very desireable. Again, MPU systems people say that tasks that are done by the MPU without the need for attention by the programmer are "invisible to the programmer". The "bus arbitrators" described previously, function invisibly to the programmer, for example.

Before long, even UARTs, and other specialized peripheral ICs were superseded by "smart peripherals" . . . more sophisticated devices, which incorporated a simple form of MPU, which were able to do a lot of work on the incoming data before passing it along to the MPU system. Of course this enabled the rest of the system to handle more work, thus increasing computing power. Unfortunately, although such smart peripherals did a better job, they were still under control of the programmer in many ways, and were not able to assist in such vital functions as memory addressing. We describe such operation as being "loosely coupled" (in the MPU system).

By contrast, when we go to "coprocessing" (extended processing), an MPU is used as the basis of a super-smart peripheral, which can do more than a "smart" peripheral, and is tied into the system more effectively. Such a coprocessor monitors the bus, determines for itself when it is needed, does the task . . . then determines that it is not needed, and stops performing the task. The coprocessor can also assist with some memory addressing, etc. This tight tie-in with the MPU system is termed, aptly, "tight coupling". All of this is done without attention from the programmer! (The exact functions performed in coprocessing vary depending upon the make and model of the MPU system.)

To sum up a bit, the difference between peripherals and coprocessors boils down to the degree of "coupling", the fact that the coprocessor employs an MPU, that it can perform more functions in the MPU system, and that it is invisible to the programmer.

Note the development from simple peripherals, to UARTs, to "smart" peripherals, and finally to "coprocessors". This is a good example of what is happening in the MPU field, and why you need to review it periodically . . . and incidentally, why so much is being published about MPUs is so that you can keep up to date! The evolution of the MPU systems is so rapid that it might be termed revolutionary, rather than evolutionary . . .

But, if you will recall, in the TV field, black and white TV began with small, electrostatically deflected cathode ray tubes, which became large, magnetically deflected tubes requiring a deflection yoke . . . then came color TV, then hybrid TV which evolved into all solid state, and finally into integrated circuit TV! Soon we will have stereo high fidelity sound added to TV broadcasts, along with Teletext . . . so you see, its the same story repeated.

The bottom line of all this is that the MPU becomes more powerful with the use of coprocessing, which is logical since any multiprocessing system divides the operations among several MPUs, which, together, are more effective than a single MPU.

More Problems . . .

Earlier we touched on one of the problem areas that has grown with the advent of multiprocessing . . . the need for better bus control, which took extra circuitry. Now we must consider the factors of the need for system expansion, system improvement, higher system speed . . . all of which require better bus discipline. Since new philosophies are all aimed at better MPU system performance, all of the above are needed. Unfortunately, there is no single, universally accepted standard for buses in use today! Several different buses are now used, by different manufacturers . . . with differing standards for the type of connectors used, the number of pins in each connector, the electrical characteristics of the cable, the number of data lines, the number of address lines, the number of control lines, etc., etc! As a result, it is often impossible for an MPU system made by one manufacturer, to communicate directly with with a similar system made by another manufacturer! This is a constant source of problems, and an inexcusable situation.

Another major problem which worsens with multiprocessing is the safeguarding of information held in memory. Since the more powerful

computers based on these multiprocessed MPUs can easily meet the needs of many users, on a time sharing basis, they require some built in security provisions to prevent one user from tampering with the operations and programming of other users, and this too is being accomplished, but again, at the expense of additional circuitry. It may be necessary that only some of the MPUs in a multiprocessing system have access to the full memory.

This is usually solved by incorporating certain "code words" which are required to gain access to some portions of the memory banks of the shared memory. Resident or alien MPUs which do not have the proper code word, are denied access to some, or all of the memory safeguarded. Again, this means more circuitry, with the addition of the required security decoders.

The newest MPUs incoporate more registers right on the MPU chip, have 16 bit data buses instead of 8 bits (and therefore can handle much more data per unit of time), have faster clocks (running at over ten MegaHertz), and addressing registers with up to twenty four bit capability of addressing up to two megabytes of external memory! Now *that* is real progress . . .
Which brings us to . . .

. . . Programming.

The increase in power and complexity of these new MPUs has also increased the need for more effective programming, for several reasons. First, the increase in work capability means there is a need for more programming . . . and second, the ability to do more complex operations means that the complexity of programming must also increase somewhat.

It is generally accepted that the best way to increase programming effectiveness is to go to higher level languages in programming. That requires the use of interpretor, or compiler programs . . . which in turn requires larger memories in order to store these programs. Fortunately we are now at the point where the solid state MPU manufacturers are starting to turn out interpretor-on-a-chip memories, to replace the older plug in printed circuit board, multi-chip memories which had to be custom programmed.

This puts us in the middle of a "chicken and the egg" situation, in which more effective MPUs require more effective programming, which in turn will lead to the demand for still better MPUs . . . and so, ad infinitum! Where it will end is anyone's guess . . . and there is certainly a lot of guessing going on, and a lot of money and manufacturing and marketing effort riding on it. As you can readily see, conditions are right for still further developments, in the foreseeable future, in this MPU field.

Slave Processing Versus Master Processing.

A major point remains to be clarified. When we earlier described the two main types of multiprocessing, slave and symmetrical processing, there was no distinction made as to the relative merits of the two systems. At first glance it would appear that the use of two or more, high-authority master MPUs, would be more powerful than the use of one master and one or more slave MPUs. However, since slave MPUs perform only certain limited tasks, they can be optimized for the performance of those tasks . . . in essence, becoming very efficient "specialists". Multimaster systems, on the other hand, offer greater flexibility, since tasks can be reallocated as needed, but this flexibility may demand that each MPU become a "Jack of all trades". Trade-offs must be made in order to achieve such great flexibility . . . (and often speed is sacrificed, for example). As you can see, there is no one "best" system, for all uses, consequently the importance of understanding these different systems has increased . . . whether you are considering buying an MPU, or expanding or updating an existing system, or just studying in order to keep up-to-date technologically.

In the light of the preceding, it is very obvious that the MPU field is rapidly increasing in complexity. People who tend to put things off until "tomorrow" will find that the bite size required tomorrow will be too large to swallow. Taking the MPU a bit at a time, now, is the easy way, even though it may not appear to be so to some. This is very similar to the sort of situation that caused many consumer electronics technicians to "retire" from the electronics trade when TV replaced radio . . . and again when color TV replaced black and white . . . and again when solid state replaced vacuum tubes . . . and it will continue so because technological progress is going to continue for the foreseeable future. The only questions that remain to be answered are . . . "Will you be one of the survivors, or will you 'retire'?" And, "if you 'retire', what are you going to 'retire' to?" Think it over before you answer . . . it's a more complex question than it appears to be! ETD

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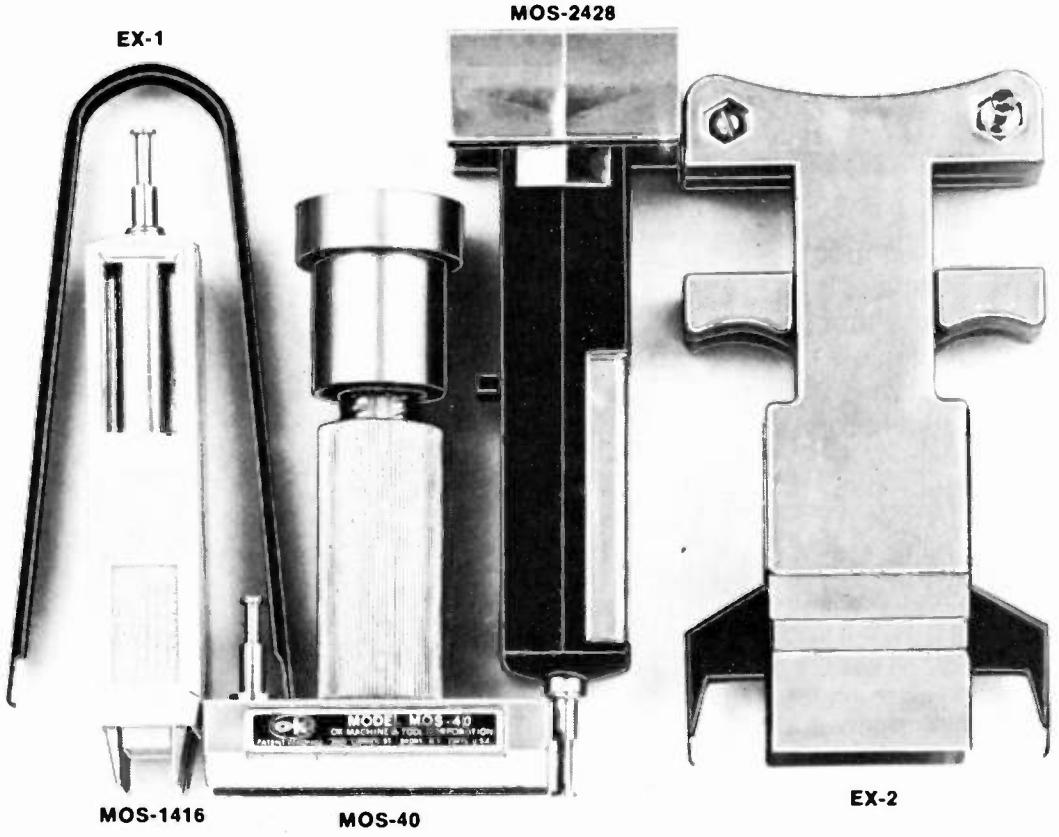

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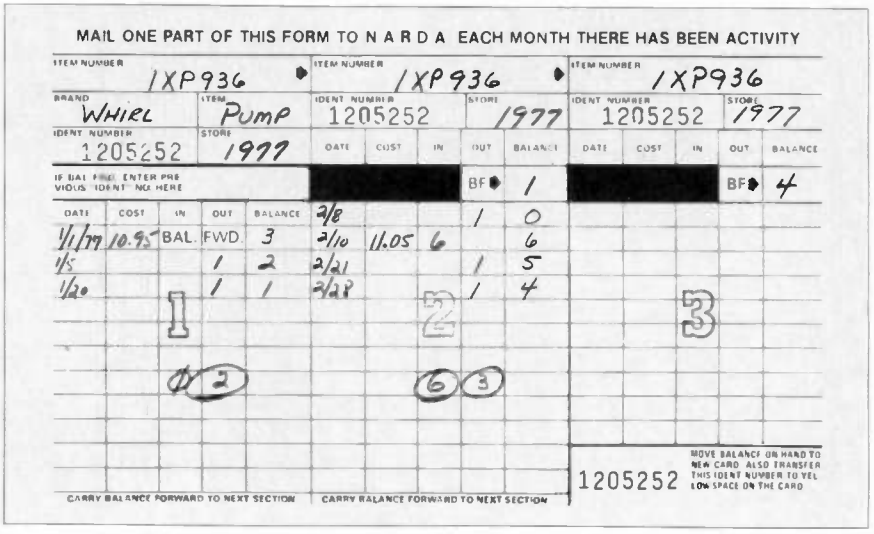
Circle No. 101 on Reader Inquiry Card

The high cost of inventory

What to do about it.

Managing inventory for efficiency, stocking enough to complete most repairs without stocking parts that move too infrequently is a science. Here are some principles of good inventory management

by John Gooley


MAIL ONE PART OF THIS FORM TO N A R D A EACH MONTH THERE HAS BEEN ACTIVITY

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DATE | COST | IN | OUT | BALANCE

1/1/79 10.95 BAL. FWD 3
1/5 1 2
1/20 1 1
2/8 1 0
2/10 11.05 6 6
2/21 1 5
2/28 1 4

CARRY BALANCE FORWARD TO NEXT SECTION

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BF 1

CARRY BALANCE FORWARD TO NEXT SECTION

ITEM NUMBER 1XP936 | IDENT NUMBER 1205252 | STORE 1977

BF 4

1205252

MOVE BALANCE ON HAND TO NEW CARD ALSO TRANSFER THIS IDENT NUMBER TO YELLOW SPACE ON THE CARD

Fig. 1. A NARDA 5 × 7 inch two-ply carbon inventory control card.

A much held theory among service managers is that if you are going to order one part, you might as well order two. It is a much held theory, but it's wrong. Parts management is a business science. It must be learned as a science. It must be practiced as a science. Applying the science is hard work . . . it is painstaking . . . it is constant.

You take your choice, of course. You could make a practice of ordering two when you need one. You can take the recommendations of the parts salesman. You can order the distributors' specials. Or you can apply your years of experience to buy what you really need. These methods have two things in common. They are easy and they are expensive. You may decide upon one of these easy methods, which automatically means that you have chosen to lose money.

Stocking too little

Not having the parts in stock when you need them causes a number of different problems for the organization. That's why the old timers always bought two when they only needed one. They truly had somethings going for them.

If it is the road man who doesn't have the part when he needs it, for most organizations, that means that the man will have to make two trips instead of one and at no additional income. That cuts down on productivity, which in turn cuts down on profit; we will come back to this in a moment.

For any technician, it throws him off stride. There is lost movement. There is frustration. There can be a certain amount of casting about trying to find the part. There may be some buttoning up, moving to a place of storage. All of this is avoided if the part is on hand when needed.

The lack of a part is less than satisfying for the customer. Most service operations claim that the most important goal is satisfying the customer. Every lack part call represents instant failure in customer relations.

Every lack part call means deferred income. Normally, you would expect to be paid the day the technician is dispatched or the day the set hits the bench. If you don't have the part, you won't collect for at least a day or two . . . and considering some channels of distribution it might mean waiting 100 days.

In the case of shop jobs, you have to provide storage area. When you put a job aside, you have to put it somewhere. If a job is normally done in a week, but is delayed an additional week awaiting the part, you need double the storage area. If it takes six weeks for the part to arrive, you need six times as much storage space. Providing this kind of space becomes very expensive. Let's get back to the

real pinch, the road man not having the part when he goes out on the call. You are not going to get any money on that first visit. You are going to spend just as much driving time as you would on a productive call, perhaps 15 or 20 minutes. You are going to spend just as much time getting into the house and getting into the set. You are going to spend just as much time making the diagnosis. You spend all this time without creating any wealth. You are going to have to wait until you get the part and then do all of this all over again.

Measure this loss as the income from one productive service call. If the average labor income for a productive service call is $25, then the average cost of a lack part call is $25.

The magnitude of this loss can be stunning, even when the error in truck stocking is only slight . . . say one call out of ten. A technician can legitamately be expected to complete six calls per day, which is 132 calls per month (6 calls a day times 22 working days in the month). If ten per cent of these result in a lack part call, that would be thirteen calls in a month. Multiply this by $25 per call and the result is $325 per month, or $3900 per year. If there are five road men in the crew, the annual loss would be in the neighborhood of $20,000 a year.

Looked at another way, an unrecognized demand for a part occurs, a $10 part that is needed an average of once a week (once every 30 calls). Because the part is not included in truck stock, the result is a lost call, valued at $25, every week of the year for a total expense of $1300. You could borrow $10 at the bank at 20 per cent interest. So proper stocking of the truck would cost two dollars a year . . . and would save you $1300.

Such are the immutable laws of economics. Ignore them at your peril.

Stocking too much

Just as there is an expense in not having parts when needed, there is also an expense involved in carrying the parts. Just as the old timers who bought two when they needed one had something going for them, they also had something going against them.

There are many expenses involved in carrying inventory, all the more dangerous because they cannot be easily seen and identified. There is no expense account labelled "Cost of Carrying Inventory."

The moment the truck arrives at the door, you have an expense . . . **freight-in.**

Somebody has to go out and take the parts off the truck, open the packages, put them on the shelf, perhaps mark them with the selling price . . . **handling.**

Somebody has to make out the receiving report, compare it with the purchase order, make the entries in the books, make out a check in payment . . . **bookkeeping.**

There has to be a shelf for the goods to go, the shelves have to be in a room . . . **storage.**

Sometimes the part gets knocked off the shelf and drops and breaks . . . **damage.**

Sometimes you can't find the part even though you know it is supposed to be there . . . **shrinkage.**

Sometimes you keep a part so long that there isn't any use for it any more . . . **obsolescence.**

If the inventory is carried on your books as an asset, then you have an increased cost for . . . **insurance.**

Similarly, the government is going to ask you to pay . . . **taxes.**

All of these costs are true and real . . . and costly.

But the most expensive cost of all is the cost of ownership, your investment in the inventory. You have to take some of your money, some of your capital, and spend it on parts which sit on your shelves. The quickest way to get a handle on this is if you presently owe the bank any money. Whatever the interest rate is on that loan is a part of what it is costing you to hold the inventory. If you didn't need all those parts, if you could turn them into cash, then you could repay the loan and save all that interest expense.

All of these expenses taken together come to between 25 and 30 per cent of the landed cost of your inventory—and it costs you that every year, so long as you have the inventory. If you have $40,000 of inventory, it costs you upwards of $10,000 a year just to have it there on the shelf. If you have $80,000 worth of inventory when you should have only $40,000, then you are wasting upwards of $10,000 a year.

So there you are. You can lose big money if you don't have the right inventory or don't have it in the right place. Or on the other hand, you can lose big money if you have too much inventory. It doesn't take too much of an error, either way, for it to be very costly. But now for the really bad news.

Most servicers are losing money *both ways* at the *same time*. They are loaded with parts that they shouldn't have, costing them money, and these parts are taking the place of those that are needed, and this situation costs money, too.

This is the nature of your problem. A medium sized service operation could be losing $20,000 . . . $30,000 . . . $50,000 . . . just because nobody wants to take responsibility for parts management.

The right amount

There is an easy formula that will tell you whether your inventory is in the ball park, or more likely, tell you how far off the market you are. Divide the total annual cost of goods sold by the number of times you want to turn the inventory. For the cost of goods sold figure, consult your end-of-the-year Profit and Loss Statement. That's presuming, of course, that your firm bothers with such luxuries as a Profit and Loss Statement. Or you can ask your accountant. Keep in mind that it is the figure for the cost of the parts sold that you want.

You will divide by the number of times you want to turn your inventory. That is a choice that you make yourself. If you are determined to make money at all costs, you will choose five or six turns a year. You will keep your inventory costs down, but you will run into a great many more lack-part situations. Or you can aim in the other direction, purposely turning your inventory only two or three time, accepting the higher cost of holding inventory in exchange for having the needed part more often. If the formula tells you that your optimum inventory should be $20,000, and you actually have $40,000, you will begin to see the magnitude of your problem.

Cutting down inventories

When you find that you are in an over-inventoried position, from a practical point of view, there are really only three things you can do . . . Buy Better . . . Return for Credit . . . Junk.

Buying more carefully is by far the best approach to the problem. It is the easiest of the three methods, the least expensive, and all it requires is your own self discipline. Quite simply, do not buy anything that will still be on hand three months later. You do not buy because there is a special. You

SERVICE PARTS INVENTORY AND TURNOVER REPORT FOR STORE #7437

IDENT NUMBER	BRAND MODEL	PART NUMBER	ON HAND	THIS MONTH SALES	LAST MONTH SALES	PRIOR MONTH SALES	Y-T-D UNIT SALES	THIS MONTH RECVD	Y-T-D UNIT RECVD	AVERAGE UNIT COST	TOTAL INVENTORY VALUE	LAST ACTIVE MONTH	Y-T-D INVENTORY TURNS
MOTOROL	TRANS												
3067C	641		5		3		3			3.16	15.84		.4
3068C	642		3				6		9	1.74	5.24	08-74	3.3
3069C	643		5						5	1.18	5.90	07-74	.0
3070C	644		1							8.50	8.50	10-73	.0
3071C	700		3							2.75	8.25	10-73	.0
3072C	701		4				1			2.49	9.96	04-74	.2
3073C	702		2							5.25	10.50	10-73	.0
1026765C	704		2			1	5			3.28	6.56		.7
3075C	705		3							4.20	12.60	10-73	.0
3076C	706		2				1			3.44	6.88	09-74	.3
3077C	707		1	1	1		5		6	14.95	14.95		2.5
3078C	708		1							1.20	1.20	10-73	.0
3079C	709		15				1		16	1.03	15.50	04-74	.2
1026366C	710		5						5	1.35	6.75	09-74	.0
3030C	712		1				1		1	3.30	3.30	07-74	1.0
3081C	713						1				.00	04-74	1.0
3082C	714		15	1			1			3.71	55.68		.1
3083C	715		4						4	.62	2.48	03-74	.0
1026367C	718		10						10	.96	9.60	09-74	.0
3084C	736		3		1		2		5	4.90	14.70		1.2
1026706C	741		10						10	1.25	12.50	10-74	.0
3085C	75		9							2.95	26.55	10-73	.0
3086C	76		5						3	3.82	19.14	10-73	.0
3087C	802		2				1		3	1.59	3.18	08-74	1.0
3088C	803		3							3.39	10.17	10-73	.0
			594	22	17	22	272	6	439		1635.41		.4
MOTOROL	TRANSF												
1026036C	2465174A43		1				1		2	30.91	30.91	04-74	1.0
			1				1		2		30.91		1.0
MOTOROL	TRANSF-K												
3090C	452		3							.32	.96	10-73	.0
			3								.96		.0
			668	22	17	22	278	11	486		2119.27		.4
NORDENE	SOLENOID												
1026708C	TPR700		1						1	5.25	5.25	10-74	.0
			1						1		5.25		.0

Fig. 2. The NARDA "Service Parts Inventory and Turnover Report." NARDA says a small shop can implement this system for from $30 to $50 per month.

do not buy because your salesman wants you too. You do not buy a "package" if some of the items in the package are slow movers. You do not buy because there is a discount. You do not buy because the price is going to go up. I am afraid I have to repeat this: You buy only what you will use up within three months.

At this point, you need two things. You need a formula and you need a Perpetual Inventory Control system so that you can apply the formula.

The formula is simply this: For each part number, you subtract the number you presently have on hand from the number you need for the next three months. How many do you need in the next three months? For convenience sake, we will use the number used in the last three months. As an example:

On hand, July 1	6
Used in June	1
Used in May	1
Used in April	3

We add the number used in April (3), May (1) and June (1), for a total of 5, and then subtract 6, with a result of minus 1. You do not buy this item. You are not "open to buy." Mathmatics tells you that you have more on hand than you can expect to use in the next three months.

But the salesman says, "We have a special on these—10 per cent off." But you know that you have more than a three months supply on hand right now. Any additional units you buy will probably be around for about six months. You know that it costs you about 30 per cent a year to carry inventory, which means that it costs you about 15 per cent to have them around for half a year. Since what it costs you (15 per cent) is greater than what you save (10 per cent), you say no . . . firmly.

If he offers a 20 per cent discount, think about it. Notice that it is not an automatic "yes." Notice that usage in the more recent months of May and June is less than in April, the demand may be falling. If you guess wrong in buying, you are the one that is left holding the bag. If the salesman keeps pressing, tell him you will be glad to take them on consignment. If he is so sure there is no risk, let him take the chances. Remember that the salesman's boss is not eager to overload you. If you over-buy this month, you won't have any money to buy next month. And since prices do nothing but go up, he would rather sell you a month and a half from now, at the higher price. It is only the salesman who wants to overload you, to get his commission.

If you apply this method religiously, you will get something pretty close to four turns on all the items that move every month. If you had used the method right along, you wouldn't be over-inventoried now. Notice, though, that this method does nothing to reduce your inventory of dead stock. For that you have to go to step two.

In step two, you take a look at all the items that have slowed down in movement. For instance, you have an item of which you have three on hand, and it has moved once in the past three months. You might consider getting rid of some of that supply. Or you might wait another three months. If the item has still moved only once in six months, and you have six on hand, you have enough on hand to last three years and it is time to get rid of some. You might set your top limit at two pieces, or only one. Ship the rest back to your supplier for credit.

Yes, I know that they often make a re-stocking charge. Yes, I know you may be buying that item again before a year is out. And then again you might not. Pay the re-stocking charge. You only pay the re-stocking charge once. You pay the 30 per cent cost of carrying inventory year after year, maybe for twenty years. The re-stocking charge is cheaper.

Finally, there is the really dusty stuff, hasn't moved in years and years. You look at it and say, "Yeah, that's the stuff Dad bought. I don't even know what it is. Well, it is paid for, it doesn't cost any more to keep it." But it does cost more to keep it.

It is taking space that you could use more productively. Every year, the week after Christmas, somebody goes out and counts it and puts the figures on a piece of paper and somebody else adds them up on a calculator.

If you are still carrying them as assets on the books, if you scrap them you will reduce your assets. If your insurance costs are geared to asset valuation, when you get rid of this junk, you will save on your insurance bill. Also, if you are in a state that assesses a business property tax, when your inventory goes down, so does your tax bill.

Oh, there is one other little incentive. If you analyze your inventory and find that $8000 worth of it is pure junk and have the junk man haul it away, tell the IRS. You have just suffered an $8000 business loss, which automatically reduces your profit for the year by $8000. And that will save you $2000 in federal taxes, or more depending on your tax bracket. Not to mention anything you might save on state income taxes. Eureka, you have just found the formula for turning lead into gold.

Inventory Control

In order to gain the benefits of a balanced inventory, unfortunately, you have to do something to keep it in balance. You have to *manage* the inventory. And of course, that is why you have the job you do . . . you're the manager. If it worked automatically, we would all be retired and living on the French Riviera. Instead it all works by manager power.

The first thing you do is learn what's going on. And for this you need a business control, in this particular case, an inventory control.

Just to make sure we are all thinking alike as to what a business control is, we define controls as: information vital to making sound business decisions, which is otherwise inaccessible, gathered in one place, and made easy to read, understand and use.

The vital information for inventory control consists of: what did we buy? at what price? what did we sell? at what price?

Half the information, the buying part, is on several hundred pieces of paper which are your Purchase Orders. The other half of the information is also recorded. It's on your service tickets. Since there may be 5000 or 10,000 of these through the course of a year, it becomes a little inconvient to spread these out on the top of your desk and figure out what has been going on.

So you use an inventory control system. And it is very simple. Every time you receive something, you mark down how many and at what price. Every time you install a part, you mark down how many (you don't even need the selling price for inventory control purposes).

To make it simple for yourself, you use a card such as the one illustrated. At the end of the month, you do some adding, some multiplying, and some dividing, and you have a report, which we have also illustrated.

For step one, you use four columns on the report. You compare the number you have used in the month with the number on hand. If the number used is higher than the number on hand, you purchase the difference for stock. If the number on hand is bigger than the number used, you do not buy. For a typical inventory, you can do this in about 20 to 30 minutes.

For step two, you check for those items of which you have many on hand and use only rarely. If you have 15 on hand and use one every three months, then you have a 45 month supply and it might be a good idea to return 12 or 14 of them for credit.

For step three, you check the last active month. If the last active month was five years ago, and you have three pieces on hand, you might safely get rid of some or all of them. You might try returning them for credit, of course, but if that doesn't work (meaning that your supplier thinks its a dead item too), then you might as well dump them. Demand for them is going to go down, not up.

Parts management is a business science. It must be learned and practiced as a science. The big boys do it. You may choose not to do it, but if you do, you will automatically have chosen to lose money.

To Manufacturers and Suppliers

There is nothing new to you in all this. You have been following . . . and indeed innovating . . . sound inventory practices for decades.

Your retailers, though, are not practicing these inventory control techniques . . . for any of a number of reasons.

Often they are not aware of the techniques. There are not too many places where a retail service manager or parts manager could go to learn of the methods.

Even more often, they do not recognize the expense of poorly managed inventory.

Thirdly, they resist the "bookishness" involved, the necessity to spend the time and effort in order to benefit by the savings involved.

It would be beneficial to manufacturer and supplier alike, I would think, if the dealer were better educated in this regard.

It would result in a better cash flow for the dealer, making it easier for him to meet his financial obligations.

The dealer's customer—the ultimate consumer—would be better served, with work completed more quickly and quite possibly at less cost.

His parts orders would be more systematized and larger, and therefore less expensive for you to handle.

The dealership would be more profitable, with additional capital available to invest in better vehicles, better training, better instruments.

Under present economic conditions, better inventory management might be the key to survival for many retail servicers. ETD

Microwave Sensors

Intrusion detectors

One of the most promising of the intrusion detectors is the microwave Doppler radar. It can be used as a stand alone unit or as part of a system. Here are features of several available units.

by Al Menegus

Microwave ovens in recent years have gained high acceptance in the American home. These same microwave beams are now being employed by electronics firms to protect the home from intruders. The fastest growing item in the electronics marketplace recently, according to industry sources is the home burglar alarm system using microwaves. Switch such a system on in the evening or when the house is unoccupied and the rooms in the home will be filled with microwave beams. An intruder will intercept one of these invisible beams and set off a strident alarm.

The home security market is unquestionably an expanding one, simply because crime has become a profitable venture particularly for those in the age group between 14 and 25 years of age which has perpetrated about 85% of all burglaries in the nation in the past few years. One out of every four residences in the United States has been hit by crime within the past year. Yet, fewer than 2% of the 75 million homes in the country are protected with an alarm system. Frost & Sullivan, Inc., a New York-based market research firm, estimates the value of manufacturers' shipments last year in the residential burglar alarms at about $140 million with a possibility of reaching $240 million or more by 1985.

In the past, the price of a good system for the American home was much too high for the family budget. A system that once would cost in the neighborhood of $800 can now be purchased for only about $200 to $300. This drop in price has been achieved by two factors. First, technology has opened up the path to low-cost units within the range of the homeowner's pocketbook. New radio signaling techniques plus the continuing decline in the cost of microelectronic circuits has virtually eliminated the need for wiring, which heretofore called for professional installation that accounts for about half the cost of an intrusion detection system. There are several electronics firms in the country now offering low-cost microwave detection systems. There are others such as Sontrix of Boulder, Colorado who will be announcing very shortly new high-end motion detection systems such as their SP-2025 space detection units, but these may only be purchased and installed by professional security alarm installers.

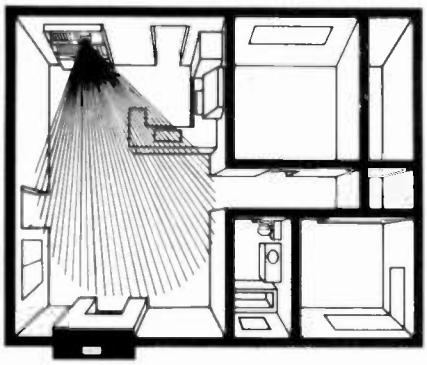

Fig. 1. The invisible, directional microwave beam is adjustable up to 50 feet for large area protection in the home.

The one firm that has appeared to make the best penetration in the low-end products in the home security marketplace is Solfan Systems, Inc. of Mountain View, California, whose president, Win H. Emert, states that "some insurance companies are now willing to cut their premiums in homes that have installed our units."

Midex-55 is one of the first professional grade microwave intrusion detection systems available to the general public. This same technology has been supplied to the industrial alarm industry for the past several years. It is a single-channel radar-like system that is as easy to install as the most simple hi-fi system. In fact, the central control unit, which features push-button controls, looks like a hi-fi shelf component. (Fig. 3). It is both a transmitter and a receiver and projects a low-power, but extremely stable microwave pattern to form a teardrop-shaped "trap-zone" up to 50 feet long, 20 feet wide and 10 feet high. (Fig. 1). Any stationary object within this zone like an easy chair or a table would reflect the projected energy waves back to the point of origin. If nothing moves within that zone, the reflections return at the same radio frequencies as sent. (Fig. 2).

Should an intruder enter the zone, his unauthorized movement or motion causes a frequency shift to occur. This is known as the "Doppler Effect," named after the 19th Century Austrian physicist, Christian Johann Doppler who first observed a change in sound frequencies caused by motion. The "Doppler Effect" is widely used in commercial and military jet aircraft for navigational purposes and in missile guidance systems, and police radar

"speed traps." When this frequency shift takes place in the approximately 500 cubic feet of open space where the beam is directed, it activates the alarm mechanism, and a few seconds later, the blast-horn goes off. This speaker-type horn can be positioned anywhere the homeowner desires, so that the intruder will never trace the location of the control unit. The resulting earsplitting sound of about 120 decibels lasts for eight minutes. This is more than enough time to panic any burglar into quickly vacating the invaded premises. The alarm shuts off after eight minutes and automatically resets itself in the "armed" mode.

The Midex-55 is an expandable system (Fig. 4) that can accommodate door and window sensors for perimeter protection, as well as a bedside emergency "panic button" that works even when the system is in the OFF mode. It also operates efficiently during "brownouts" and blackouts, times when there is a most likely high incidence of crime, because it has a standby, rechargeable battery with a life of about four hours. Once normal power is available from the house current upon its restoration, the battery automatically recharges itself. The supply voltage requirement is 12 vac/60 Hz. The transmitting frequency for the four channels that are available are: A—10.520 GHz, B—10.523 GHz, C—10.526 GHz, and D—10.530 GHz. The entire unit weighs only nine pounds.

Another company marketing a similar product is Microwave Sensors, Inc. of Ann Arbor, Michigan, which features the Defender D-8 Microwave Intrusion Sensor, a new detector with a range from 0′ to 125′, yet it draws only 50 milliamps of current, and operates on any voltage from 20 down to a low 10 volts ac or dc. It is an easy-to-install indoor microwave sensor featuring both range and sensitivity controls. (Fig. 5). The D-8 heads can be powered and backed up by a conventional 12-volt control panel and power requirements are so low that the backup batteries used in most control panels will furnish sufficient emergency power to back up several heads.

Key features of the D-8 include the built-in range control, which sets the actual size of the protection field and virtually eliminates false alarms; a built-in sensitivity control that permits a "step-count" to set the alarm; yellow LED (Light Emitting Diode) indicator which indicates the motion detection; and a red LED indicator that indicates alarm status. These lights are also referred to as walk-test lights. The D-8 is a small, easy-to-hide unit that weighs seven lbs. without batteries. Its decoupling circuitry stops RF interference from entering the unit through input leads, as well as polarity protection against damage to the circuitry if the dc current is reversed. The new sensor reportedly cannot be fired by CB or police radio operation or fluorescent lighting in the home.

A third entry in the home microwave detection equipment field is Seeker Security Systems, Inc. of Burlingame, California, whose president, Dan E. Andersen, states, "There has always been a gap between the customized Seeker Security System and the "off-the-shelf" consumer items. Seeker has now provided a system that can yield all of the custom features at an economical cost."

The Seeker 1 residential alarm system incorporates a sensor module that is a Doppler radar-type motion detector that is very similar to those employed for police traffic radar. (Fig. 6). In addition to the sensor module, other components in this simple, but flexible system include a control module siren, and a panic switch with two-conductor extension cable. The control panel responds to the intrusion signal from the sensor module by sounding an internal (built-in) alarm beeper and by activating the alarm siren and other warning devices connected at the rear panel. The operation of the system is controlled by four front panel switches and one rear panel switch. The control unit also supplies 12 volt dc power to the sensor perimeter and the siren which is a warbling electronic signaling device that has an extremely loud and penetrating output. The panic switch is used to manually operate the siren when the occupant is at home and desires to summon help, such as for a medical emergency or a forced entry.

The sensor module of the Seeker 1 should be placed to include as many potential entry paths as possible within the protection zone of the microwave beam. For example, it may be possible to position the module in a corner to the living room so that the microwave beam is directed past both the patio door and the main entry hall.

It has been often said that the best home burglar alarm system is a large watchdog or a continuously barking small dog, but animals are not fool-proof. In fact, any movement in the area where the microwave beam is projected will interfere with the system. It is therefore recommended that such animals as cats or dogs be isolated or confined to another room not covered by the microwave pattern.

Because of the nature of microwaves, air currents, noise, light or humidity from air-conditioning/heating systems have a minimal effect on the unit. Further, no changes in air flow should cause a false alarm. The only thing that should set the unit into alarm mode is movement through the projected pattern.

The units will not penetrate metal at all. Walls containing a lot of electrical wiring, pipes, foiled insulation,

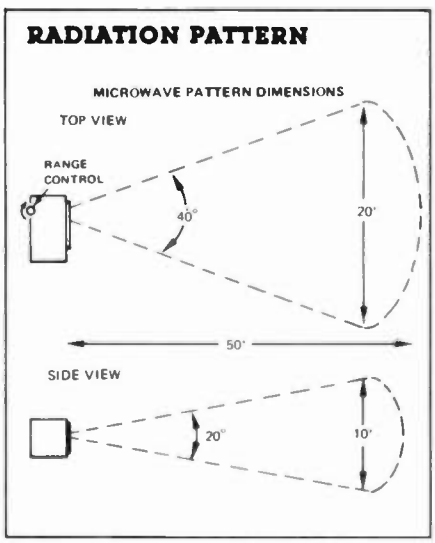

Fig. 2. The microwave pattern dimensions for the intrusion detection system.

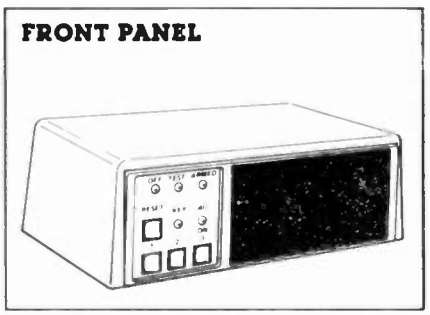

Fig. 3. The front panel with the push-button controls of the Midex-55 burglar alarm system.

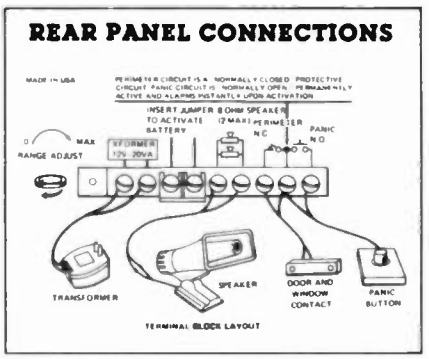

Fig. 4. A typical terminal block layout.

Fig. 6. The Seeker 1 residential alarm system.

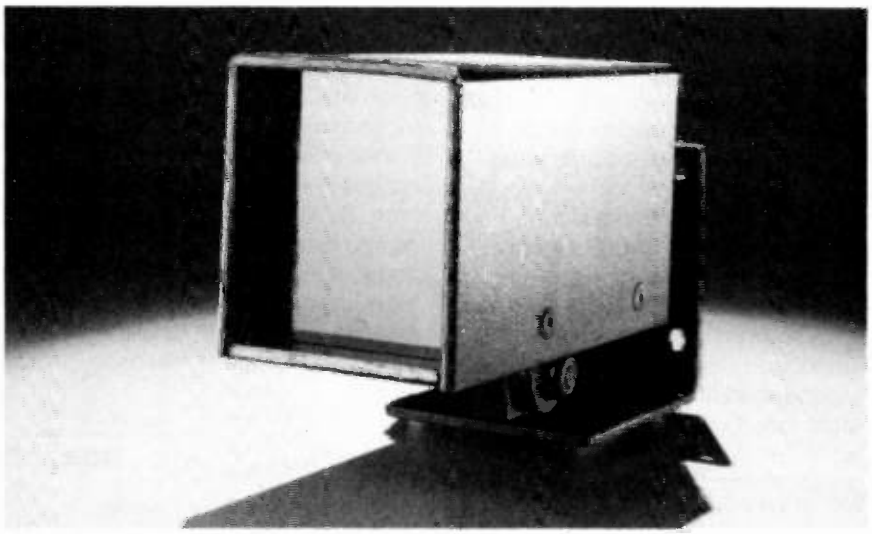

Fig. 5. The Defender D-8 microwave intrusion detector.

chickenwire or having foiled wallpaper or mirrors covering them will prevent penetration of the microwave beams. Brick, adobe, and cement also greatly attenuate the beam. Glass is penetrated with no loss in range. Walk-testing the unit as specified in the installation manual specifications will determine your precise pattern and range of microwave beam coverage.

This microwave unit cannot be wired to the police department or connected with a dialer. The alarm when triggered by the intruder will alert neighbors or passersby who can then call the police. The Midex-55 unit contains a 5-watt rms amplifier. The speaker produces 120 decibels level of sound, which is a painful noise to the ears. Its strident sound can be heard by any one outside the house who will know that a burglary is in progress. A maximum of two 8-ohm speakers can be connected in parallel to the unit and hidden from view since they can be small.

A perimeter system can be connected to these microwave units providing it's a normally closed system. There is a "delay loop" terminal to connect door and window contacts to the unit and an "instant loop" to connect emergency buttons. Both of these accessory circuits should be connected in series to the terminals located on the back of the unit and should be normally closed systems.

Since these units use microwaves, a question will arise as to the extent of radiation emitted by the unit. The manufacturers state that the radiation is completely harmless. The power output of all those units described in this article is low; it is about 500 times less than Federal safety standards. The units are also approved by the Underwriter's Laboratory as being totally safe. ETID

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The Invisible Emitter Follower

Appearances can be deceiving.

When transistors first appeared in consumer electronics a great deal was written about the new devices. The common collector circuit received its fair share of attention. Today, known as the emitter follower, it is largely neglected in trade literature, and, as a consequence, most service technicians ignore the emitter follower when it appears on a schematic. If you wish to learn more about this useful and very common circuit—read on.

by Bernard B. Daien

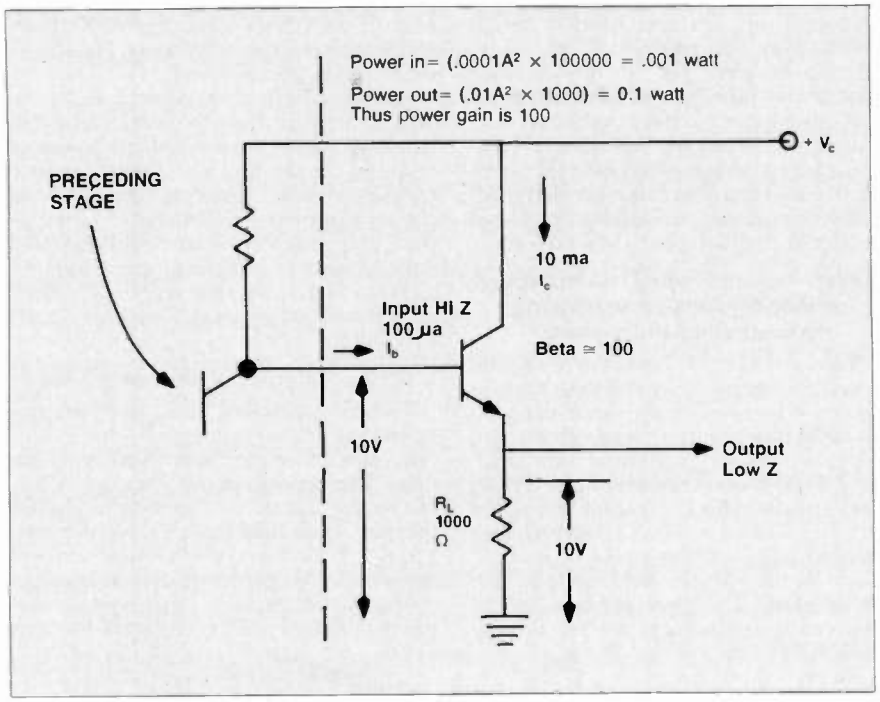


Fig. 1 The basic emitter follower

The emitter follower is a basic and essential circuit in modern semiconductor TV receiver designs. It appears in video amplifiers, voltage regulators, deflection amplifiers, and audio sections.

But, it has a couple of nasty tricks up its sleeve, that can give a service technician a very hard time.

In the days of vacuum tube sets, a coupling (blocking) capacitor was used between the plate circuit of one amplifier stage, and the input grid of the following stage. This was essential, since it was well understood that the plate had a high *positive* potential, while a grid required a *negative* potential.

With the advent of transistors, the picture changed. Assuming the use of NPN transistors, the collector of an amplifier stage would be at a positive potential, while the input base of the following stage would also require a positive, but smaller, potential. At least they were compatible! Thus it became a simple matter to eliminate the coupling capacitor.

Further, it became possible to eliminate impedance matching transformers, since the emitter follower is capable of matching a high input impedance to a low output impedance. As a matter of fact, the output impedance of an emitter follower can be so low, that for most circuit applications, it can be considered as zero! Despite this, the emitter follower has appreciable *power gain*, a fact which is usually not understood, and not appreciated.

Since the emitter follower always has a voltage "gain" (loss) of less than 1.0, people tend to assume that it operates at a power loss, but this is not true. The emitter follower has a current gain of Beta, and power varies as the square of the current! (ohms law) This is shown in Fig. 1, and explained later in this article.

Despite its simple circuitry, the emitter follower can be unstable, even oscillate at VHF or UHF, although it is inherently degenerative at the operating frequency. This is covered later in the text. (This instability of emitter followers is seldom discussed, and therefore can be quite an unpleasant discovery).

In the beginning

(Or, "How the Emitter Follower Works".)

Fig. 1 is the schematic diagram of a typical emitter follower, using a NPN transistor. The input is driven directly

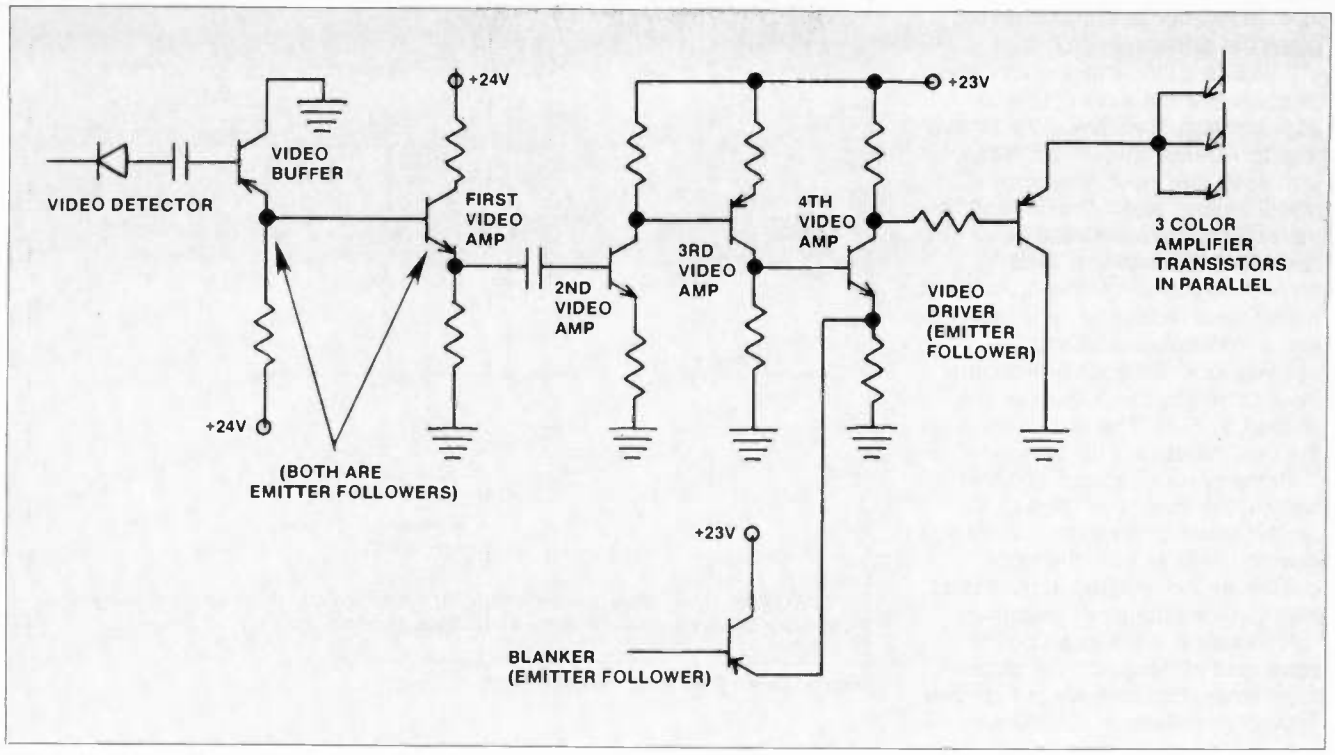


Fig. 2. Video amplifiers in the Sylvania E08 chassis

from the output of the previous stage, eliminating the usual blocking capacitor. The load resistor, R_L, has both the base current and the collector current flowing through it, but, since the base current is quite small compared to the collector current, we will disregard the base current in the load in order to simplify this discussion. The error resulting will be less than the error due to parts tolerances, and can be disregarded. We will consider three important characteristics of this circuit.

These three following characteristics make the emitter follower a very flexible and useful design tool. As a result you will find emitter followers generously distributed throughout modern solid state circuitry. These three characteristics are:

First, the input resistance (impedance) of the emitter follower is very high, reducing loading on the previous stage. This is very important, since the voltage gain of the previous stage depends upon the value of the collector load, a small collector load yielding low voltage gain, and a high resistance collector load providing high voltage gain. Ordinarily, a transistor amplifier stage, coupled to a following transistor stage cannot provide much voltage gain, because the input resistance of the second stage becomes the load resistance for the first stage. And, the input resistance of a bipolar transistor stage is quite low (the base is forward biased and draws current, and is also in parallel with the biasing resistors, which further lowers the resistance seen by the previous stage).

The facts are that as we cascade transistor stages, each stage loads down the previous stage, so that the gain per stage becomes very low. But, if we use an emitter follower between transistor stages, the emitter follower has a very high input impedance, and does not load down the previous stage, thus permitting the previous stage to achieve high voltage gain!

Secondly, since the emitter follower has a very low output impedance, it cannot be effectively "loaded down" by the input of the following stage, thus the emitter follower enables us to use multi stage transistor amplifiers, with high gain per stage, providing emitter followers are used as "coupling stages" between conventional common emitter amplifier stages.

Fig. 2 shows the partial schematic of a popular TV set, illustrating some uses of emitter followers. This Sylvania EO8 chassis uses eleven emitter followers!

Third, the emitter follower is inherently very degenerative, i.e., has a large percentage of inverse feedback, which makes it very stable as regards the effects of load changes, voltage changes, etc. This will become more apparent after we discuss just how the emitter follower works, with the aid of Fig. 1. For the purpose of this discussion we will assume that the transistor is a perfect model, and has zero voltage drop between base and emitter. In actual practice there is a small emitter-base voltage drop in silicon bipolar transistor, of about half a volt, which introduces a small, fairly constant error in our discussion, but does not produce significant effects for our purposes. In actual practice we would allow for this small voltage difference, in the circuit design.

Let us assume that the transistor used has a dc Beta of 100. (For every milliampere of input current, there will be 100 ma of collector current, and 101 ma of emitter current.) Let us also assume that the input voltage from the preceding stage is 10 volts. Since the emitter load resistor is 1000 ohms, it will take 10 ma of emitter current to produce 10 volts at the emitter (remember, this transistor has zero voltage drop emitter to base, and the base is at 10 volts potential, therefore current will flow into the base, causing an increase in current through the load resistor, until the emitter is also at 10 volts). Since the Beta of the Transistor is 100, it will take less than 0.1 ma (less than 100 microamperes), to provide 10 ma of emitter current.

Now we can figure out what the input and output resistances of our emitter follower are. Using ohms law, the input resistance is the input voltage divided by the input current, which, in this case is 10 volts divided by 0.0001 amperes, or 100,000 ohms. Note that if the emitter resistor were omitted (shorted), the input resistance would drop towards zero, since the input voltage would also have to fall towards zero without the voltage drop across the emitter resistor. On the other hand, if the resistor were doubled to 2000 ohms, the emitter current would drop to five ma, and the input (base) current would drop to 50 microamperes, which would raise the

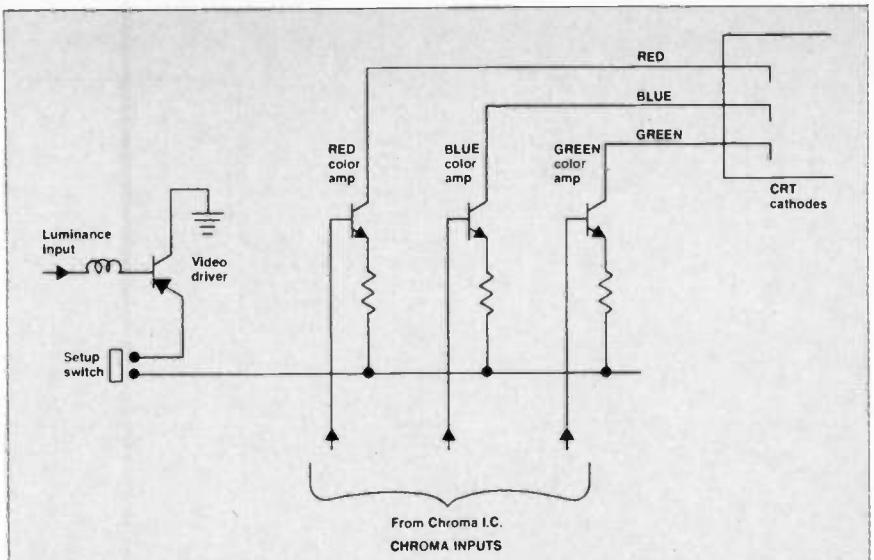
input resistance to 200,000 ohms, using the same formula.

If you do a little thinking you will discover that the input resistance is approximately Beta times the emitter resistor. Thus if the emitter resistor is increased, the input resistance will also increase, and if the Beta of the transistor is increased, the input resistance will increase. This immediately tells you that if you want a high input resistance, you had better use a high Beta transistor.

If you look at it another way, the input current is the output current, divided by Beta. The higher the Beta, the less current will be demanded from the previous stage. And, of course, the lower the value of the emitter resistor, the more current it will demand, and, in turn, the more current will be required at the input, thus lowering the input resistance.

Now let's see if we can do the same sort of thing with the output impedance. Suppose we put another 1000 ohm resistor in parallel with the emitter resistor. You would expect the output resistance to be 500 ohms, but it isn't. You will soon discover that putting another resistor in parallel with the emitter resistor hardly changes the output voltage at all, it just stays close to 10 volts. Now we would expect the 10 volts to drop to 5 volts if we cut the value of the resistor in half, but what happens is that the emitter current rises to 20 ma, which causes the base current to rise to 200 microamperes, in order for the emitter to remain at 10 volts. (Remember, the base to emitter voltage is always very small, so the emitter has to "follow" the base voltage at all times)

Now then, how much will the base voltage change if we increase the base current from 100 to 200 microamperes? That depends upon *the output resistance of the previous stage.* The higher the output resistance (the source resistance), the more voltage change, and since our emitter voltage follows the base voltage, the emitter voltage will also change. But, since the base current is less than the emitter current, the change will be quite small. In fact, since the base current is smaller than the emitter current by a factor of Beta, then the consequent change in the output at the emitter will be reduced by a factor of Beta. This means that the output of the emitter follower will have a resistance equal to whatever the source resistance is that feeds the input (base), divided by Beta. Thus, if the source resistance (the load resistor of the previous stage) is 10,000 ohms, and the Beta of the emitter follower stage is 100 then the output resistance of the emitter follower would be, closely, 100 ohms. This is much less than the 1000 ohms of the emitter resistor. Now if we put a second 1000 ohm resistor in parallel with the 100 ohms of the output we come up with less than 100 ohms, but not much. Thus *the input of the following stage does not have much effect on the output of the emitter follower* stage. If the load resistor of the previous stage were reduced to 5000 ohms, however, the output of the emitter follower would drop to less than 50 ohms!



Note. When video driver transistor develops emitter base short luminance signal is fed directly into emitters of color amps through short.

Fig. 3. Zenith 9-89 video output module

By using a moderate volume of load resistor in the previous stage, say 2000 ohms, and a Beta of 200 in the emitter follower stage, the output impedance would become 10 ohms! Simple, isn't it?

Feedback

The voltage drop across the emitter resistor (the output voltage) is directly fed back into the emitter. As you already know, an input voltage can be fed into either the base, or the emitter, since the input is really the difference between the emitter and base potentials.

Because the feedback is taken directly from the output voltage, it tends to hold the output voltage constant. A constant voltage source must have a very low internal (source) resistance, otherwise the voltage would change with changes in load current. Thus the emitter follower acts like a constant voltage supply, and must therefore have a very low internal resistance. Like any other constant voltage source with feedback, the emitter follower is relatively insensitive to changes in the collector voltage, changed in load, etc. The frequency response of the emitter follower is very good, since the feedback also tends to increase the useful bandwidth, thus making this circuit useful from dc through A.F., video, and I.F. frequencies. With suitable transistors, emitter followers have been used through the VHF TV range.

Disadvantages

It is quite easy to get the emitter follower to oscillate, with some random lead lengths, and the stray capacitances, plus the transistor's internal capacitances forming a resonant circuit at some VHF or UHF. The usual configuration is that of an "Ultra-audion" oscillator. The Ultra-audion is quite similar to the Colpitts oscillator, except that the capacitances are formed by the circuit itself, instead of being discrete external capacitors. Both circuits use a capacitive "center tap" system. In the case of the emitter follower, the load resistor acts as an RF choke, and the circuit takes off. Since most texts give the impression that the emitter follower is a rock-solid, unconditionally stable circuit, the technician can be misled into looking elsewhere for the source of the problem!

Another little problem arises quite frequently, which can throw you off the track when servicing problems arise with the follower. Since the output signal from an emitter follower is IN PHASE with the input (no phase reversal), a shorted transistor can be easily overlooked, since both the DC and the AC signals will be approximately correct, when read on a VOM, or scope! This happens if the transistor develops a simple emitter to base short. The circuit simply loses power gain, and the signal is fed straight through, via the direct short

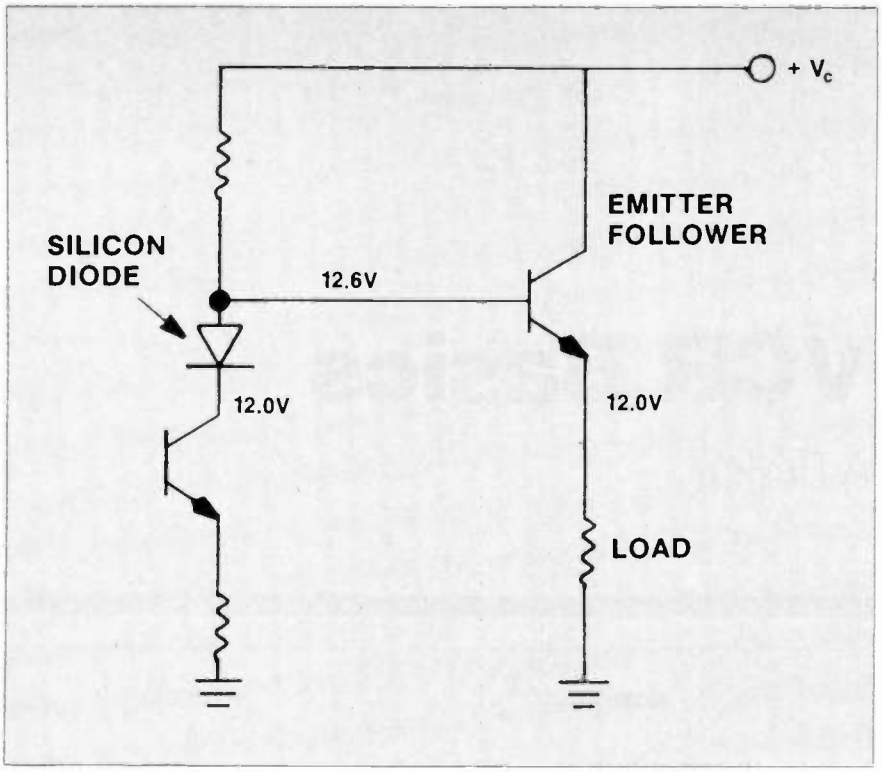


Fig. 4. Emitter follower design example

circuit path.

Fig. 3 shows a partial schematic of a popular Zenith plug in module. This module handles both the luminance (contrast), and chroma signals. The three color amplifier output transistors drive the CRT. Each color amplifier has its base driven separately, *from the chroma circuitry*, but all three color amplifiers have their emitters driven in parallel, by the luminance emitter follower. (looking into the three emitters in parallel, there's a very low impedance, therefore the driver must have a very low output impedance.) When the emitter follower driver develops a short, base to emitter, the driver is no longer able to drive the three emitters *adequately*. As a result, there is a noticeable loss of contrast, yet all the scope forms WILL LOOK OK. I have seen some of these popular modules pulled, when changing one, low cost, easily accessible transistor, will do the job in five minutes! Why?

The only reason I can think of is that the service tech is just not familiar with the emitter follower!

Applications

If your audio, video, RF. pulse, or other generator is not putting out enough stuff to drive a real load (like coax cable with a few taps on it), just add an emitter follower, as in Fig. 4. Adjust the biasing to deliver enough current to swing the load. Remember, this is a linear circuit, so it has to deliver enough quiescent current, so that the swing in current will be adequate. (Class A operation!)

If you want to pipe a signal around, without pickup on the wiring, use an emitter follower. The low source impedance prevents electrostatic (capacitive) pickup very nicely, without elaborate shielding!

If you have a small adjustable, regulated, power supply, and you need more output, put an emitter follower on it, power the collector from another, filtered, but unregulated supply, stick a fuse in the collector, and take your output from the emitter. If you use a hefty metal power transistor, on a decent heat sink, you will be able to get several amperes of output . . . more if you use a couple of transistors in parallel, with 2.7 ohm resistors in series with each base to help current sharing. Mount them all on the same heat sink to equalize temperatures. If the external power supply for the emitter followers is more than a few volts higher than needed, add a dropping resistor in the collector lead, but watch out for the ripple . . . (on the negative peaks, the voltage may be lower than you think). Using this system I have on occasion, used a small regulated, adjustable supply, with emitter follower, to drive auto radios and CBs which required over 4 amps of clean regulated 12 volt, adjustable, DC.

The more you think about the emitter follower, the more uses you will discover for it.

How low impedance

In every bipolar transistor there is an emitter junction, which behaves like a silicon diode. If you will test a common silicon diode on your VOM, you will quickly discover that the resistance is different on every range. This is because the silicon diode changes its resistance with current. If you will examine the current versus voltage drop of a rectifier diode, you will notice that it is non-linear, quite logarithmic. As a result, the DYNAMIC RESISTANCE drops as the current increases i.e., the voltage drop at 200 ma is not double the drop at 100 ma, it is *less than double*. The formula that explains this says that if you divide the number 26 by the current in milliamperes, you will find the dynamic resistance for that current. Now, since the emitter follower has a diode junction in its emitter, we must add the value of the dynamic resistance at the operating current, to the value of the emitter resistor, to find the total resistance in the emitter circuit. Just so you get a feel for the error produced by omitting this, the value of the dynamic resistance is 0.026 ohms at 1 ampere, or 0.26 ohms at 100 ma, 2.6 ohms at 10 ma, and 26 ohms at 1 ma. So you can see, although we can never go to zero in the internal transistor emitter diode resistance, it is not very important for most uses. Only if we are using very, very, low values of emitter load resistance, or very high Beta transistors, etc., is it likely to even be noticeable with test instruments. Usually the normal variations in tolerance in semiconductors, resistors, etc., overshadows this effect.

What you will notice is that the 0.6 volts emitter base drop will be present . . . and we have disregarded this up to now. When we are dealing with ac signals, the dc drop is not too important. But if we are using the emitter follower as a dc amplifier, it may be troublesome. I use a quick fix, by adding a silicon diode as shown in Fig. 4. This raises the input voltage to the emitter follower by one diode drop, thus offsetting the loss of one voltage drop in the emitter base junction. Put the diode on the same heat sink you use for the emitter follower, and it will track quite closely. This same method is used in many complementary, and OTL audio amplifiers, for biasing the output stage, and has been widely accepted.

In conclusion

I would suggest that you pick up the diagram for a modern solid state color TV and see how many emitter followers you can find, which were almost totally disregarded in the past. (Look especially in the video chain, which is usually dc coupled). Remember, emitter followers can be PNPs too, in which case they will appear to be inverted . . . but they are still emitter followers! ETID

VCR Basics

A Review

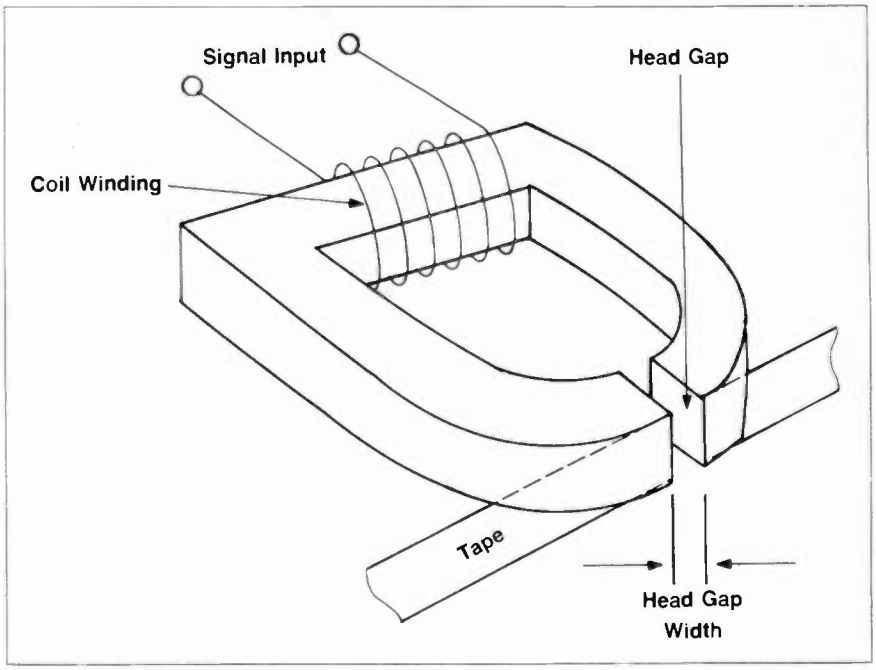
Many technicians are not yet actively servicing VCRs. With VCR sales up by over 50% this last year, you had better prepare. Here's a review of VCR principles.

by Martin Middlewood*

In many ways, VCR's are like another magnetic medium that most of us are already familiar with—the audio cassette recorder. The recording theory of both is the same, and both operate quite similarly. On the control panel, you even find the same controls: RECORD, PLAY, FAST-FORWARD, STOP, REWIND, PAUSE, AND EJECT. And like audio recorders, video tape recorders (VTR's) can be broken up into two basic groups—reel-to-reel recorders and cassette recorders. Generally, the reel-to-reel models are "professional" models and are used in industry, education, and broadcasting. On the other hand, the cassette models are generally designed for consumer use, and are smaller and easier to use. Yet, in spite of their smaller size, the consumer models still contain all the basic circuitry of the "professional" models.

Cassette model VTR's differ from the reel-to-reel models mostly in appearance. Two other obvious differences are that the VCR uses a half or three-quarter inch tape that's housed in a cassette, and is automatically threaded.

Mr. Middlewood is an engineer with the Service Instruments Division of Tektronix, Inc.



A recording head resembles a split u-ring in shape. The split in the u-ring is called the head gap. During recording, the head becomes an electromagnet. Magnetic flux lines develop at the head gap and magnetize the ferro-magnetic particles in the recording tape.

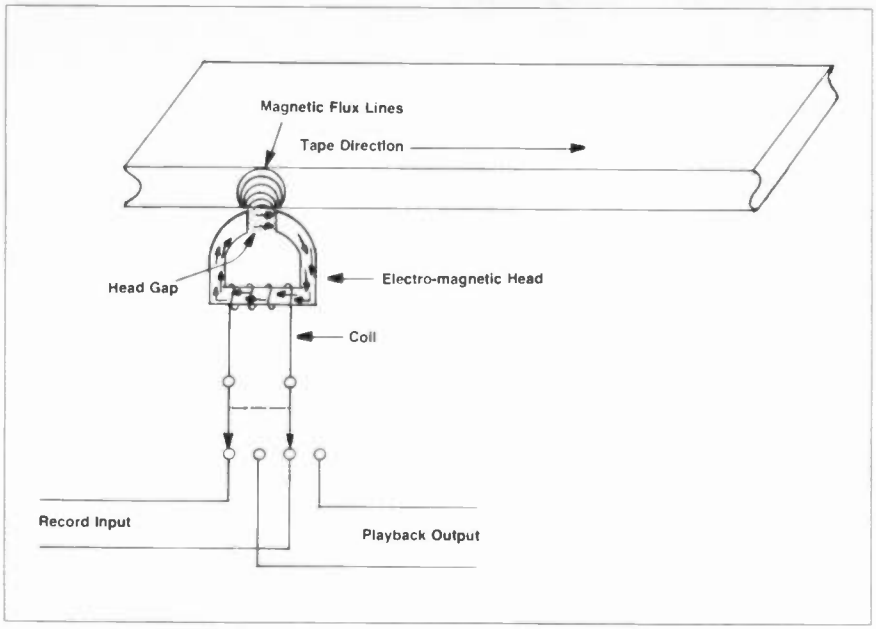
A Magnetic Recording Review

Because the audio cassette recorder is familiar to us let's see how it's like a VCR.

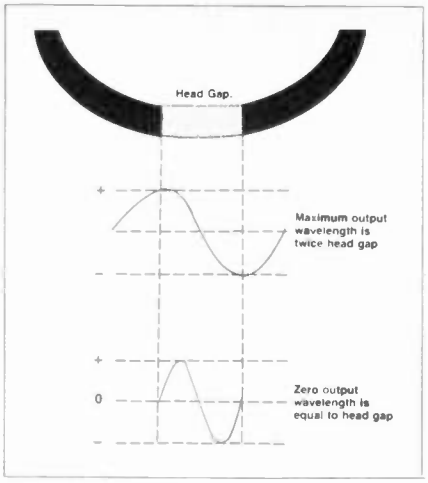
Both suffer the shortcomings of all direct magnetic recording systems. That is, they have a non-linear proportionality between the magnetization on the tape and the input voltage; they have poor response at low frequencies (the frequency limit is about 100 hertz); they also have poor response above some high frequency limit (even though some have a bandwidth of several megahertz); and they are sensitive to tape imperfections, dirt, and tape-to-head spacing. Despite these limitations, both are extremely reliable.

Audio cassette and video cassette recorders also share the common concepts of magnetic recording. Each has an electromagnetic coil, or head, that is used during record and playback. This head resembles a split, u-shaped ring. The space between the ends of the split ring is called the "head-gap." (Although it's called a gap, the head-gap isn't empty. It's filled with a non-magnetic insulator, usually a special glass, which maintains a constant head-gap width.) During recording and playback, the head-gap makes contact with the magnetic tape.

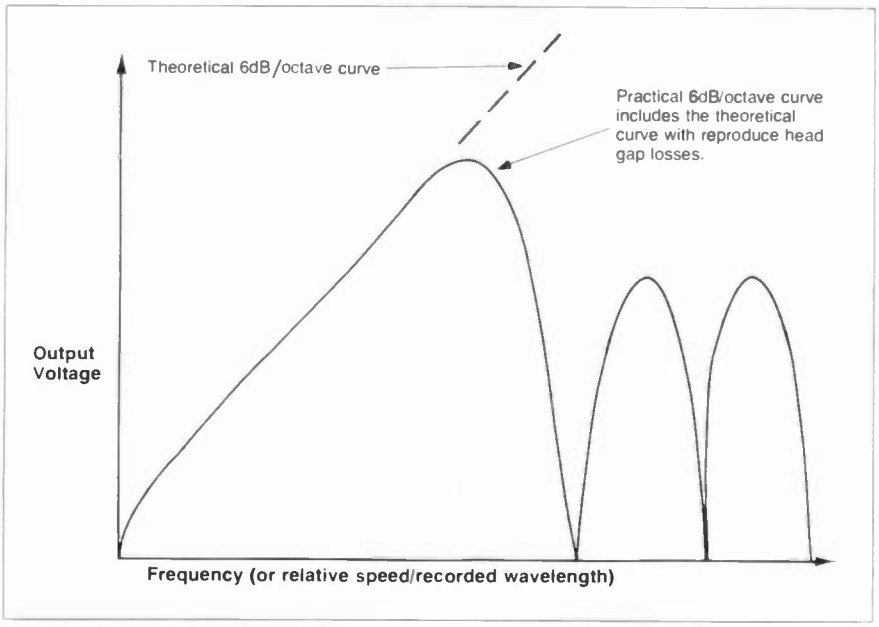
During recording, an electrical current passes through the head. The current



(Cross sectional view.) As current passes through the head coils, magnetic flux lines develop. The flux lines magnetize the tape particles. The stronger the head-coil current, the stronger the magnetic flux lines, and the stronger the magnetization of the tape particles. Thus, the magnetic tape has weak and strong magnetic bands along its length. During playback, it's these magnetic bands that induce current in the head which in turn produces a voltage at the head coil's outputs. This voltage is then amplified for audio or video playback.



A head reaches its maximum record output and maximum playback pickup when the wavelength is twice as wide as the head-gap. Head output and pickup drop to zero when the wavelength is equal to the head-gap width. Frequencies having wavelengths longer than the head-gap width are attenuated at a 6dB per octave rate. Frequencies with wavelengths shorter than the head-gap width are attenuated from full output to zero in one octave.



This simplified output of the 6dB/octave slope shows the rapid drop off of output signal due to head gap loss. The frequency response of any magnetic tape reproducing system is a function of the ratio of the head-gap width to the wavelength.

turns the head into an electromagnet, which creates magnetic flux lines between the two sides of the head gap. Then, when magnetic tape is pulled past the head, the head magnetizes the ferro-magnetic particles within the tape. The amount of current passing through the recording head determines the amount of magnetization transferred to the tape. The stronger the current, the stronger the magnetic flux lines, and the stronger the magnetization of the tape particles.

Playing back the tape reverses the process. As the recorded tape passes by the head, the magnetized particles in the tape induce a weak current in the head coil. The strength of the induced electrical signal depends upon the degree of tape magnetization. The electrical signals from the head pass into amplifiers that increase the signal level for processing into either an audio or video output.

Let's look at the head a bit more closely. The record head-gap must be wide enough to allow the magnetic flux lines to spread out from the gap enough to penetrate the ferro-magnetic coating of the tape. Also, it must be narrow enough to allow any sharp changes in flux to transfer to the magnetic tape. Thus, the head gap must be a compromise between the wide head-gap necessary for recording low amplitude signals and the narrow one necessary for recording fast (short wavelength) signals.

A head reaches its maximum record output and its maximum play-back pickup when the wavelength is twice the head-gap width. Below this wavelength there is a 6dB per octave loss. As the frequency increases and the wavelength decreases (frequency = velocity/wavelength) from this maximum output point, the wavelength will eventually reach the width of the head gap. When this happens, the output of the head drops to zero. As the frequency decreases and the wavelength increases beyond the maximum output point, the output decreases at a 6dB rate until the amplitude gets so low that the recorded material cannot be distinguished from the system noise. At frequencies above twice the head-gap width, signal drop off is much more rapid. These shorter frequencies are attenuated from full output to zero in one octave.

The recording process causes electrical signal loss. Video cassette recorders compensate for this loss by a process called head equalization. Some video tape recorders compensate for this loss in the record circuitry, most

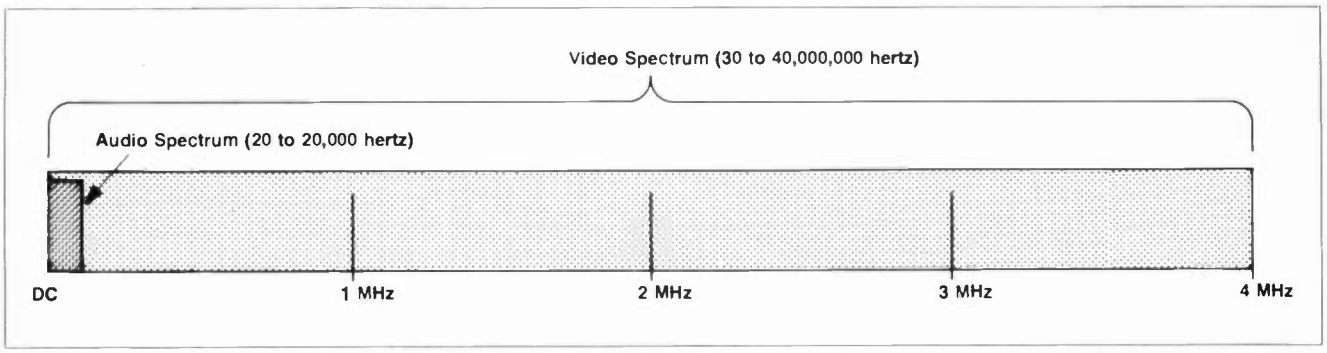
Recording

RECORDING PROCESS	TRANSMISSION MEDIUM	ENERGY CONVERSION	RECORDING AMPLIFICATION	ELECTRICAL ENERGY CONVERTED INTO MAGNETIC ENERGY	RECORDING ACCOMPLISHED BY:
AUDIO CASSETTE RECORDER	Vibration in air (sound)	Sound changed into electrical energy by microphone	Electrical energy increased by audio amplifier	Electrical energy converted to magnetic energy by an audio head	Magnetizing the ferro-magnetic particles of the audio tape
VIDEO CASSETTE RECORDER	Visible light (contrast, hue, and saturation)	Light changed into electrical energy by camera	Electrical energy increased by video amplifier	Electrical energy converted to magnetic energy by a video head	Magnetizing the ferro-magnetic particles of the video tape

Playback

PLAYBACK PROCESS	PLAYBACK MEDIUM	MAGNETIC ENERGY CONVERSION	PLAYBACK AMPLIFICATION	REPRODUCTION
AUDIO CASSETTE RECORDER	Magnetized ferro-magnetic particles on audio tape	Magnetic energy from tape converted into electrical energy by audio head	Electrical energy increased by audio amplifier	Electrical energy converted into vibrations (sound) by speaker
VIDEO CASSETTE RECORDER	Magnetized ferro-magnetic particles on video tape	Magnetic energy from tape converted into electrical energy by video head	Electrical energy increased by video amplifier	Electrical energy converted into light energy by television cathode-ray tube

The audio and video recording and playback processes are basically the same. The reason for differences is due to the physical characteristics of the different media. Also notice that the playback process of each is nearly the reverse of the recording process.



The audio spectrum is much narrower (about 20 to 20,000 hertz) than the video spectrum (about 30 to 4,000,000 hertz). The highest video frequency is about 200 times higher than the highest audio frequency.

compensate for it in the playback circuitry. In addition, the playback amplifiers are designed to compensate for tape frequency response to get an overall flat frequency response.

Audio, video recorder differences

In spite of their similar appearance and magnetic recording similarities, audio and video recorders do have several differences. Among these are the size of their cassettes, the complexity of their mechanics, the number of heads in each, and the number of signals recorded by each.

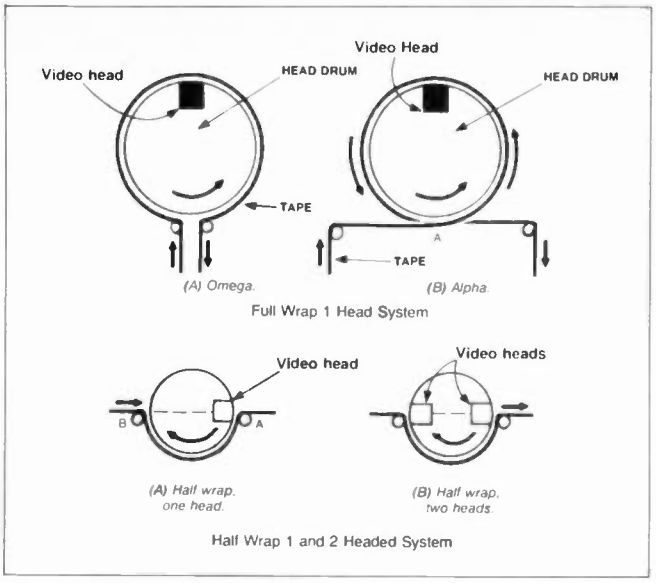
Probably one of the most noticable differences you see when you first look at a VCR is that its cassette is larger than that of an audio recorder. Video cassettes are larger to house the wider 1/2 or 3/4 inch tape. The tape has to be wider because the material on a VCR tape is recorded obliquely rather than longitudinally. A second difference about a video cassette is the cassette's "trap door." This protects the tape from being damaged by foreign matter (dust and finger prints, for example) that can cause momentary video losses, or drop outs, during playback.

Until the VCR case is removed, the mechanical differences are less obvious. But once it's off, you'll notice right away that the mechanics of a VCR are more complex than that of the audio recorder. You see a piston-like head drum, and a more complex threading mechanism. Both of these call for an electro-mechanical control system not found in audio recorders.

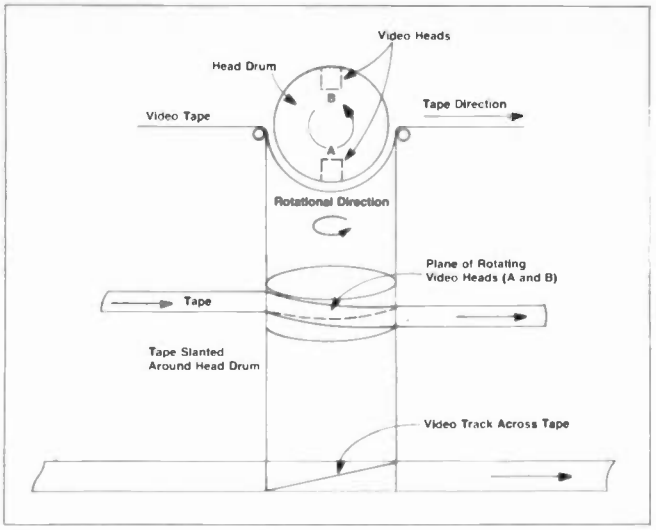
A major difference between the two that isn't immediately apparent by looking inside a VCR is the number of heads necessary to do the recording. At minimum an audio recorder needs two heads: one for recording and playback and another for tape erasing. A video recorder, on the other hand, needs several more because it records and plays back several different kinds of signals. The exact number of heads it needs depends upon the type of VCR, but in general, a VCR needs a record and playback video head, a record and playback audio head, a control head, and an erase head.

Every VCR needs at least one audio head to record the audio track. It frequently records at a slow speed, and along a narrow track at the edge of the video tape instead of using the entire tape.

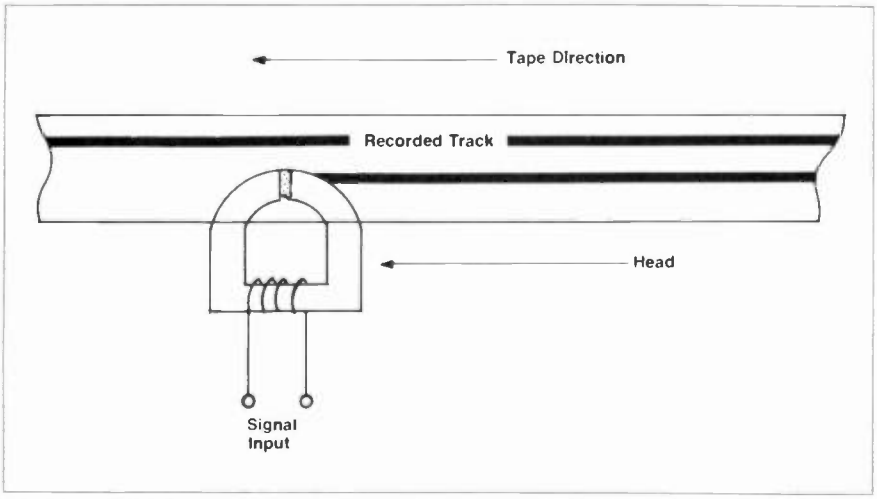
Because an audio head can only record and playback frequencies within the range of the human ear (about 20 to 20,000 hertz), it can't be used to record or playback a video signal. Video signals have a much wider spectrum (about 30



The helical scan video recording system uses either one or two video heads, and wraps tape around the head drum in one of several ways. (VHS and Beta systems use the two-headed half-wrap system or a variation of it.)



The helical scan system places two heads 180° apart on a rotating drum. The heads rotate so that one head is always in contact with the tape. Instead of longitudinal recording, however, the helical scan VCR record signals obliquely across the width of the tape. (Note: If the tape crosses the head drum from low to high, the video track recorded will be slanted the opposite of that shown in the diagram.)



Audio recorders record signals parallel to the tape edges and along the entire length of the tape. This is longitudinal recording.

to 4,000,000 hertz). To even attempt to record video frequencies in the same way audio frequencies are recorded would mean that the video tape would have to be pulled past the video head at an enormously fast rate.

Helical Scan

A video cassette recorder doesn't have to pull magnetic tape past a stationary head to maintain the same relative speed needed to record video signals. Instead, the VCR uses a system of moving heads. This is the helical scan system. The helical scan system uses either one or two video heads that are placed on a rotating drum. The general differences between the one-headed and two-headed system are in the rotational speed of the head drum (a drum with only one head must rotate faster if the tape speed and relative head-to-tape speed are to be the same as that of a two-headed system), in the way the tape is wrapped around the head drum, and in the mechanics and electronics associated with faster head drum speeds or an additional video head.

Most video cassette recorders use a two-headed helical scan system. The helical scan system, however, changes the recording format. Because they have stationary heads, audio recorders record material along the length of a tape. With the helical scan system, the heads move and the video recorder places material obliquely across the magnetic tape. This means that in a two headed system, first one head (the A-head) records obliquely across the tape. Then a second head (the B-head) records obliquely across the tape. The recorded paths that each head leaves are called the A- and B-tracks.

These tracks are themselves like tiny magnets, and if they are recorded next to one another their lines of flux will interfere with each other. To prevent the signals recorded on adjacent tracks from interfering with one another, older video recorders isolated one track from the other by a band of unrecorded tape called a guard band. Thus a recorded video tape was made up of oblique, alternating bands of recorded and unrecorded tape. Today most VCR's eliminate the guard bands. Later we'll discuss how two of the more popular VCR models, the JVC Video Home System (VHS) and the Sony Betamax, accomplish this.

Keeping Track of the Tracks

Using the VHS and Betamax helical scan system requires that the VCR know the difference between the A- and B-tracks during playback. (U-matic and some other formats aren't troubled by this problem.) Let's say that the A-head records the odd numbered tracks and the B-head the even. During playback, each head must pick up the tracks that it recorded. Without some means of control, no one could guarantee that the heads would be picking up the proper tracks when a tape was being played back. The A-head might be reading the even numbered tracks, or it might be reading between tracks. So the VCR needs some way to ensure that each head picks up only the tracks it recorded.

Movie projectors have such a means of control. They use a sprocket wheel that fits into sprocket holes along the

Audio Cassette Recorder contrasted to Video Cassette Recorder

	AUDIO CASSETTE RECORDER	VIDEO CASSETTE RECORDER
SIGNAL FREQUENCY RANGE OF SYSTEM	about 20-20,000 hertz	about 30 to 4MHz
TAPE SPEED	19 CM/S (7.47 IPS)	Beta 1 4 CM/S (1.57 IPS)
	9.5 CM/S (3.73 IPS)	Beta 2 2 CM/S (0.78 IPS) Beta 3 1.33 CM/S
	4.75 CM/S (1.87 IPS)	VHS 3.34 CM/S (1.34 IPS) 1.65 CM/S (0.65 IPS)
RELATIVE TAPE TO HEAD SPEED	as above	Beta 690 CM/S (272 IPS) VHS 580 CM/S (228 IPS)
HEADS	stationary	stationary audio head stationary control track head stationary erase head two rotating video heads
TAPE WIDTH	¼ inch	½ inch
NUMBER OF TRACKS	2-4 audio	1 audio 1 control A & B video tracks
HEAD GAP	about 2-4 microns	about 0.5 microns
RECORDED WAVELENGTH	12.6 mmicron for a 15kHz signal	1.5 micron for a 5MHz signal
MECHANICS	Simple	Complex

length of the film to keep the images projected from flittering and jumping. A VCR uses a similar system to ensure that each pass of the A-head coincides with an A-track. But instead of using a mechanical control system, such as a sprocket wheel, it uses an electrical one. It uses a fixed control head to place electronic pulses on a track near the tape edge in order to identify one of the tracks as a reference track.

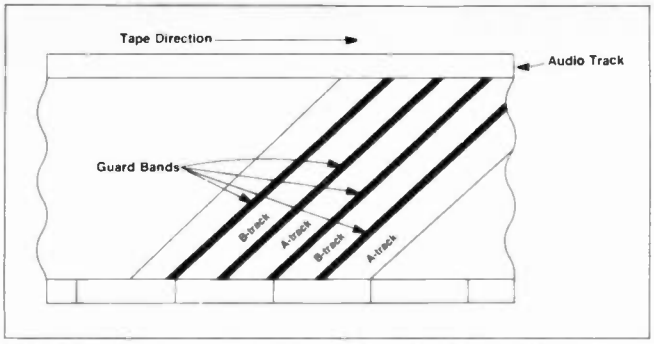
During recording, the control head places electronic pulses on the control track. These pulses identify one of the tracks as being recorded by either the A- or B-head. For the purpose of description, let's say that they identify the A-tracks. This makes the A-track the playback reference track. Every time the A- head isn't properly aligned with an A-track, the VCR adjusts the head drum speed or the tape speed until the A-head is again in the proper position. (Some VCR's reference tape-to-head speeds to an external video or a 60 hertz signal.)

Recording Formats

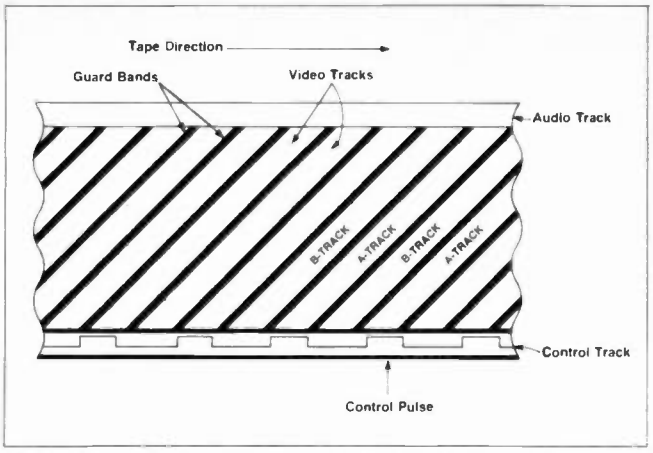
As we have seen, oblique recording can be accomplished in several ways. The variety designed into VCR's doesn't stop there. Even among the two-headed helical scan systems, we find differences. Two of the most popular helical scan systems, Sony's Betamax and JVC's VHS, illustrate this. Although these VCR formats are alike in several ways—both use a slow moving tape and a rapidly moving head, both eliminate the guard bands between the A- and B-video tracks, and both record television luminance and chrominance signals in its own standard manner—neither can play back tapes recorded by the other. This is because each accomplishes these similar tasks by different recording techniques, or formats.

There are a number of physical and electro-mechanical differences between the two machines. A point of great contrast not mentioned is how each eliminates the guard bands between the video tracks. Just recording the tracks next to one another won't work. Placing the A- and B-tracks adjacent to each other increases the crosstalk between the tracks and produces a noisy picture during playback. Nevertheless, to increase their playing time both Beta and VHS recorders squeeze their video tracks together.

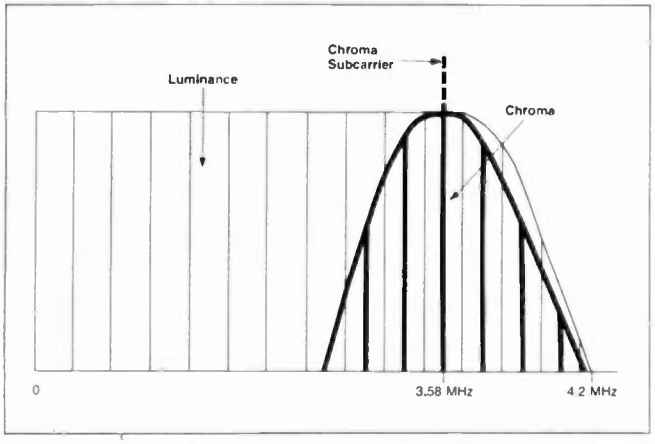
Before discussing how crosstalk is eliminated in both recording formats, we



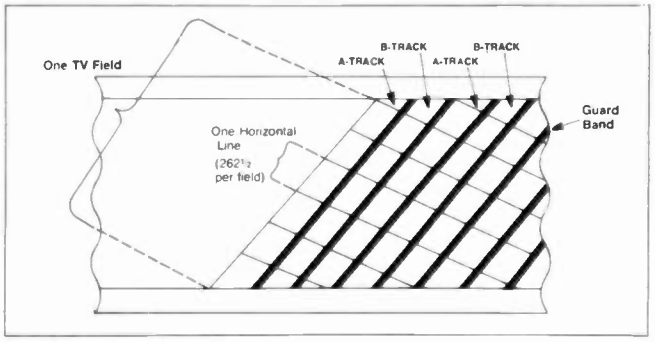
The helical scan recorder records alternate A- and B-tracks separated by guard bands. These guard bands prevent the signals recorded on one track from interferring with those recorded on a neighboring track. Interference between tracks is called crosstalk.



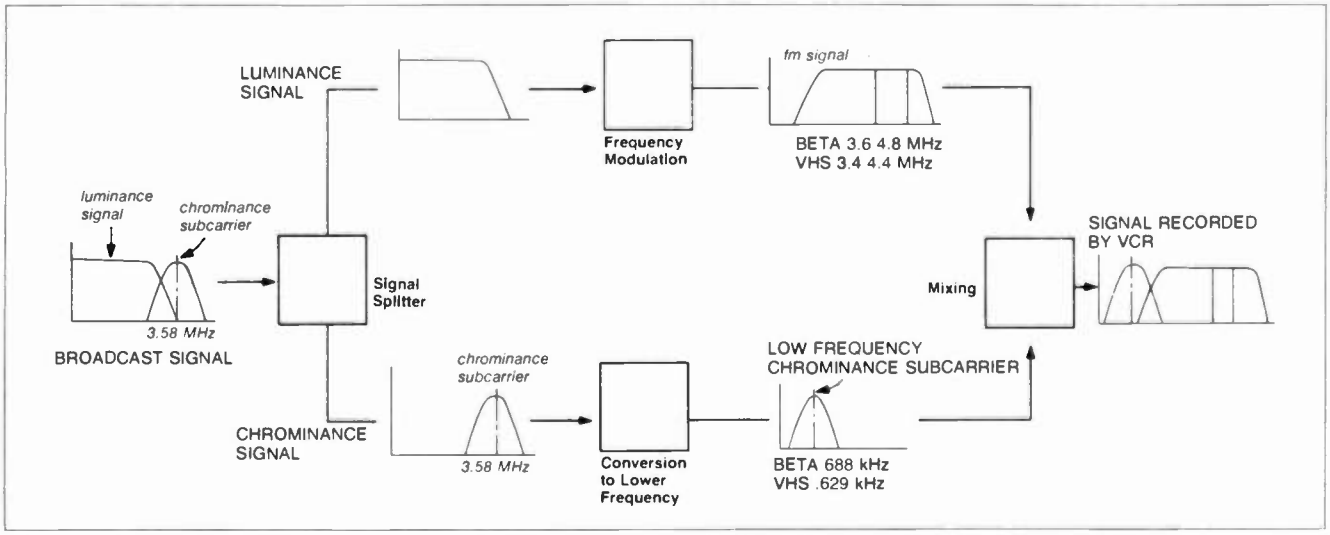
The stationary control head records a control pulse on the control track corresponding to every other video track. The VCR can then use these pulses as reference signals to align the A-head with the tracks it previously recorded.



We think of the luminance and chrominance spectrums as being continuous blocks of frequency. In reality, these blocks are made up of a series of individual spikes. Frequency interleaving, the process of dovetailing these spikes, makes possible a multiplexed transmission. When a television or a VCR receiver receives the two dovetailed signals, it must separate them and independently process the luminance and chroma signals.



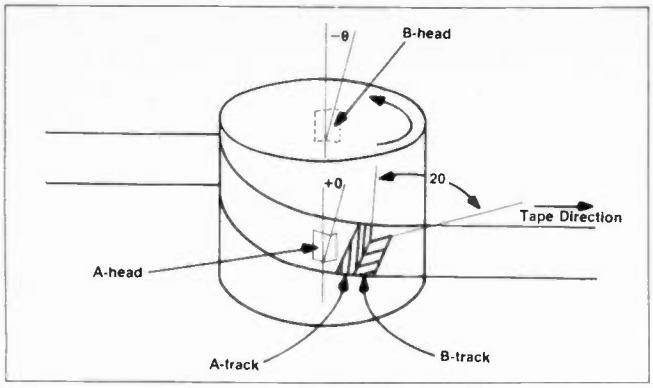
This diagramatic illustration of recorded television signals isn't to scale, but it illustrates the relationship between the television field and the horizontal line. A field is made up of 262 ½ horizontal lines; two fields constitute a television frame. Television frames appear at the rate of 30 times per second. If the protection provided by the guard bands is eliminated, it's easy to see how signals recorded on the A-track could magnetically "leak" over onto those signals recorded on the B-track. The result is, of course, poor image reproduction.



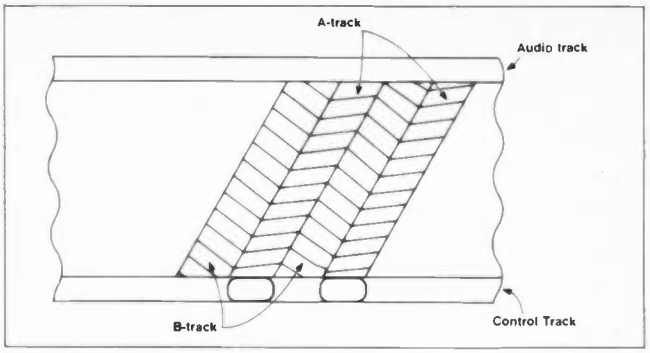
To record the broadcast television signals at the frequency response of the video heads, the VCR separates the luminance and chroma signals. There it frequency modulates the luminance signal and converts the chrominance signal down to a lower frequency. Azimuth recording prevents luminance crosstalk. During recording the initial steps are taken for the elimination of chrominance crosstalk.

need to describe briefly what is recorded on the video tape. The picture on the television screen doesn't change one frame at a time like the picture on a movie screen. Nor is it made up of colored tones blending into each other like a color photograph is. Instead it's made up of thousands of tiny dots like a newspaper picture. When taken together these dots look like a picture.

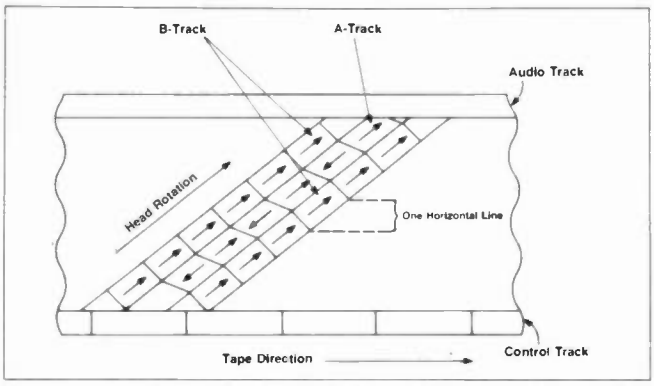
There are thousands of "dots" in a television picture, or frame: Five hundred



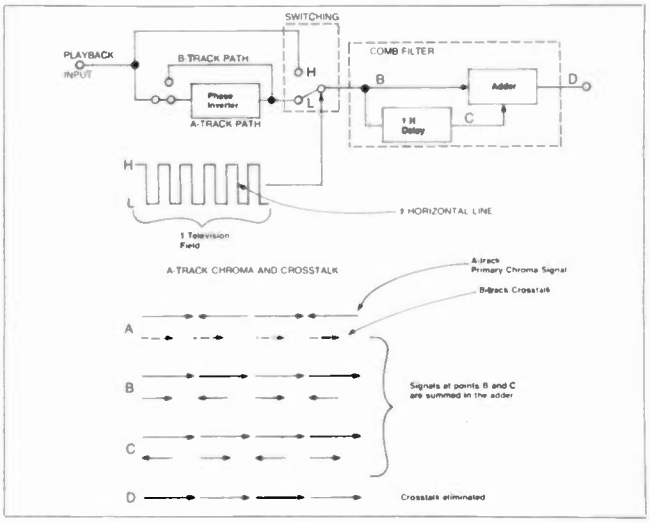
To eliminate crosstalk between neighboring video tracks, both the VHS and Beta machines set their azimuths a few degrees off the perpendicular angle you might expect between the head gap and the edge of the video track. VHS machines set their heads +6° and −6° off this perpendicular angle, while Beta machines set theirs at +7° and −7° off this angle. The slanting of the video heads means that the material recorded by one head isn't picked up by the other. Material recorded on the B-track that magnetically leaks onto an adjacent A-track is rejected by the A-head during playback. Therefore guard bands aren't necessary.



Both the VHS and Betamax formats slant the azimuths of the A- and B-heads in opposite directions. This slanting of the video heads means that the material recorded by one head is separated from the material recorded by the other by several degrees (Betamax by 14° and VHS by 12°). This makes it less likely that the A-head will pick up anything recorded by the B-head.



Beta recorders invert the phase of alternate horizontal lines on the A-track. The phase of the horizontal lines on the B-track remains unchanged. During playback, the Beta machine restores the original phase relationship of the signals. Then after a delay of one horizontal line, successive horizontal lines are compared. Because the A-track horizontal lines are inverted during recording, and therefore require inverting during playback, the crosstalk picked up from the B-track is also inverted. Then when the signals on each horizontal line are fed through a comb filter, the crosstalk is cancelled.



During recording, every other horizontal line of the A-track is inverted. During playback, the horizontal lines of the A-track are restored to their original phase relationship. Then as the horizontal lines in each field shift from a high to a low, the comb filter compares each horizontal line with the one before it. When these are summed in the adder, the video output from the comb filter has no crosstalk. (The same happens to the B-track playback information, but the phase inversion process is bypassed.)

and twenty-five rows of dots. (Forty and a half of these rows are used for the black bars at the top and bottom of the television frame.) Each television frame is divided into two fields. One having the odd numbered rows and the other the even. This gives each television field 262−1/2 rows of dots. Each of these rows is called a horizontal line.

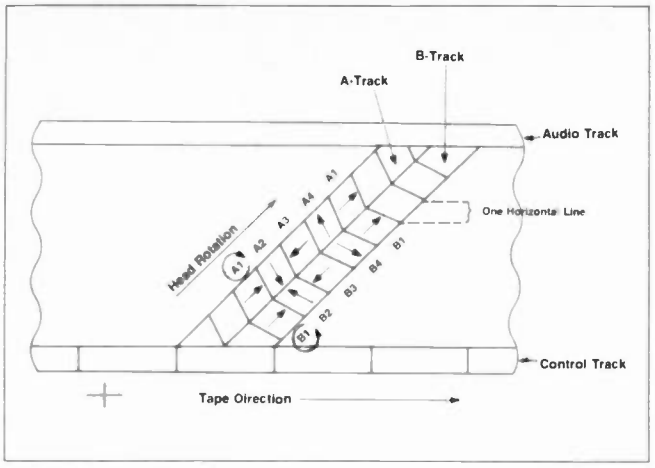
Luminance and chrominance signals make up the picture in the television frame. As broadcast, these two signals occupy the same spectrum. This is accomplished by a process called frequency inter-leaving. The luminance signal ranges from 0 to 4.2MHz, and the chrominance signal centers around the 3.58MHz chroma subcarrier. In this form some of the chroma signals fall beyond the recording capabilities of the video head. Recording the luminance and chroma signals is further complicated because of the frequency interleaving principle which makes a multiplexed broadcast transmission possible.

To overcome these recording problems, the VCR circuitry separates the luminance and chroma signals. It frequency modulates the luminance signal which brings it up to 3.6MHz through 4.6MHz in the Beta VCR's and to 3.4MHz to 4.4MHz in the VHS recorders. The chrominance signal is then frequency converted to a lower frequency (688kHz for Beta machines and 629kHz for VHS); this process is known as the color under scheme. Then the two signals are mixed and the fm luminance signal acts as a bias signal for the chrominance signal when the two are recorded on the A- B-tracks of a video tape. Because these two signals exist simultaneously on adjacent or overlapping tracks, two types of crosstalk, luminance and chroma, have to be eliminated.

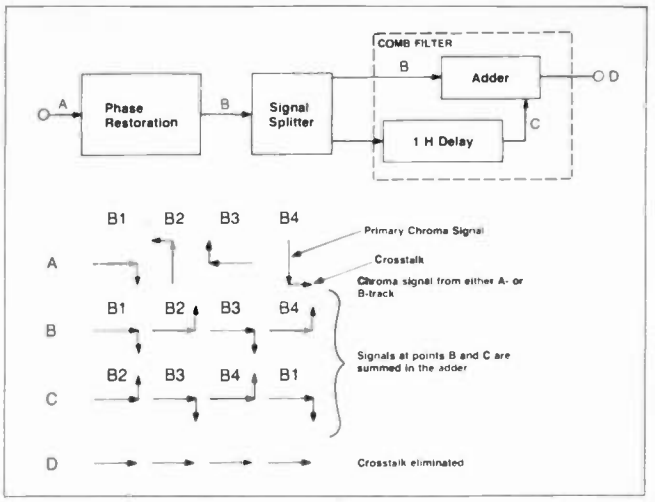
Eliminating cross talk

You're probably aware that in audio recording there's a high frequency loss whenever the angles, or azimuths, of the record and playback heads are different. The higher the frequency, the greater the loss. This principle of azimuth loss is used advantageously in video cassette recorders to eliminate crosstalk.

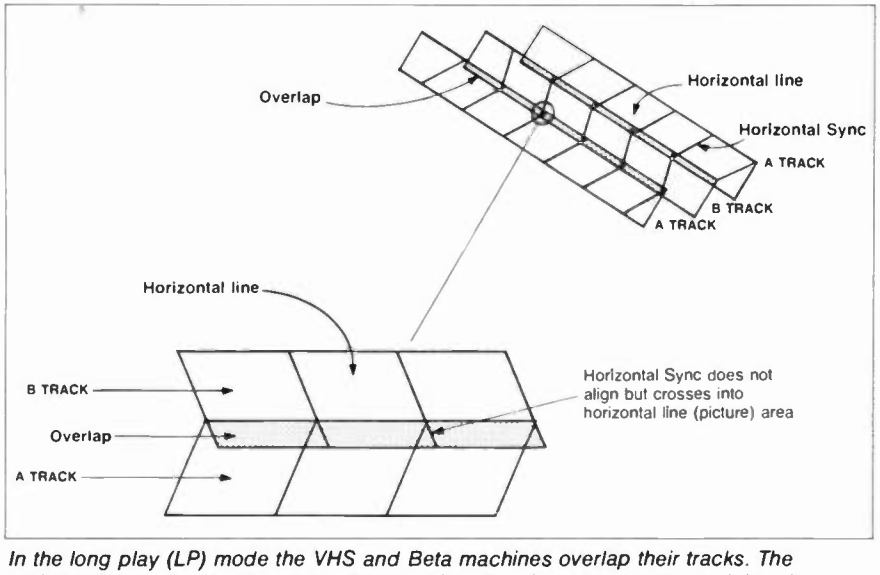
To eliminate luminance crosstalk from the playback signals, both the VHS and Beta recorders angle their heads a few degrees off the perpendicular angle that you might expect to find between the track and the head gap. Beta recorders set their azimuth 7° off perpendicular



The VHS recording format eliminates crosstalk between adjacent video tracks by shifting the phase of each horizontal line. The lines of the A-track are shifted clockwise in 90° increments; those of the B-track are shifted counterclockwise in 90° increments. During playback, after the original phase relationships are reestablished, the signals are delayed by one horizontal line and fed into a comb filter which compares and eliminates the crosstalk.



In a VHS recorder, the chroma signals that were rotated 90° clockwise or counterclockwise during recording are restored to their original phase relationships during playback. This phase restoration also changes the phase of the crosstalk. After the phase restoration, the information from the video track is split and delayed by one horizontal line. Then, when these two signals are summed in the adder, crosstalk is eliminated from the comb filter output.



In the long play (LP) mode the VHS and Beta machines overlap their tracks. The horizontal sync pulses of each track extend into the picture area of the neighboring track. Azimuth recording prevents the pick up of crosstalk between the overlapping tracks, but the overlapping tracks creates new signals, called beat signals. The most noticable of these is the beat signal caused by the horizontal sync pulse, because its frequency never changes. The beat signals are signals not originally in the video, thus they have no true azimuth and can be detected by both video heads. A method of phase cancellation prevents the beat frequency from being seen on the television screen.

while VHS machines set their heads 6° off perpendicular. Both slant one head in a positive direction and the other in a negative direction. When two tracks are recorded next to each other this makes them 14° (or 12°) apart.

During playback, each head rejects the high frequencies signals not recorded at its azimuth, which for the most part are luminance signals. But in order to eliminate the chrominance crosstalk the video recording machine must first process the chroma signal.

In both formats, this processing begins during recording. During recording, both formats record an entire television field on one video track. This means that one head is recording the odd numbered horizontal lines and the other the even. The Beta format overcomes chrominance crosstalk between these horizontal lines by using a phase inversion system of recording. (For simplicity, we'll ignore the phase relationships of the NTSC broadcast standard.) The Beta recorders process the horizontal lines on the B-video tracks without any change in their phase relationship. But, prior to recording the A-video tracks, every other horizontal line is inverted. During playback, the original phase of the A-track video signals is re-established. Then after a delay of one horizontal line, the successive horizontal lines on each track are compared in the comb filter. Because the A-track horizontal lines were inverted during recording, and therefore require inverting during playback, the interfering crosstalk is also inverted. In short, the sum of interfering crosstalk and the signal from the previous horizontal line is zero, which makes the signal leaving the comb filter free of crosstalk.

The VHS system eliminates chrominance crosstalk by successively shifting the phase of each horizontal line 90° within each field. The A-track's horizontal lines (A1, A2, A3, etc.) are shifted clockwise in 90° increments: Horizontal line A2 leads A1 by 90°; A3 leads A2 by 90° and so forth. The phase of each horizontal line on track B shifts counterclockwise in 90° increments: B2 lags B1 by 90°.

During playback, the phase of each horizontal line is restored (derotated) to its original phase. That makes each successive line in phase with the next. Then after being delayed by one horizontal line, each horizontal line is compared to the next (A1 to A2, A2 to A3, and so forth). Although the signals on each derotated horizontal line are now in phase, the crosstalk on each is 180° out of phase. Thus, when the signals leave the comb filter, the crosstalk has cancelled itself out. The rotation, derotation, delay by one horizontal line, and signal comparison via a comb filter eliminate the crosstalk

A CET Test Preparation Quiz

Find those weak spots

The editors of ET/D, believing that a sound grounding in fundamentals is essential, and that passing the CET tests is a valid indication of such knowledge, are here offering the first of a series of quizzes on electronic basics

by Frank R. Egner, CET

Based on many years as an electronics instructor, it is evident that most electronic technicians forget a lot of their electronic fundamentals over a period of time. There are some that insist that basic theory is no longer important because we are in a "modular world" where all we need do is locate and replace defective modules. This theory is very hard to accept. Even in modularized equipment not all circuits are "plug-ins". And just because a circuit or circuit group is on a module does not mean it is unrepairable. Repair can often be more economical than replacement.

However, to make electronic repairs efficiently, a working knowledge of basic concepts is necessary. Interpreting schematic diagrams, proper use of test instruments, correct interpretation of test indications, and knowing how a circuit is supposed to operate are all necessary to make valid tests and diagnose malfunctions during repair operations.

If you have taken the Certified Electronic Technician (CET) associate or journeyman exams or the FCC license exams, you know that emphasis is placed on electronic fundamentals and component and circuit operation. Many employers of electronic personnel require applicants to take a comprehensive electronics exam, based heavily on electronic fundamentals, to establish trainability, placement, and starting salary.

Conclusion: Knowledge of electronic fundamentals, and the ability to apply the knowledge, is still very necessary, regardless of the trend toward modularized equipment.

If you haven't already become a CET, why not make the effort and prepare yourself for the test? Passing the test and becoming a CET earns recognition and prestige for your technical knowledge, which was gained through study and hard work. And it provides recognized evidence of your competency in your field of electronics.

A practical way to check your knowledge and recall of electronic fundamentals is by taking quizzes. But a quiz is only effective if you make an honest effort to solve the problem or determine the correct answer before "peaking" at the solution. Still, the correct answers should be readily available to check your responses and provide necessary feedback to correct wrong conclusions.

The questions in this quiz may be easy or difficult, depending on how much of the basics you have forgotten. The quiz covers basic concepts and should serve as a good review. Give it an honest try and see how well you can do.

Quiz Number 1

1. A 6K ohm resistor (R1) is connected in series with the parallel combination of a 12K ohm (R2) and a 6K ohm (R3) resistor across a 30vdc source. The power dissipated by R3 is:
   a. 12mw.
   b. 24mw.
   c. 60mw.
   d. None of these.

2. Two series connected resistors, color coded red, red, red, silver, would be within tolerance if their total resistance measures:
   a. 4,840 ohms.
   b. 3,960 ohms.
   c. 4,700 ohms.
   d. All of these.

3. An electromagnet is being operated below saturation. The magnetomotive force (mmf):
   a. Decreases as the number of coil turns is increased.
   b. Is independent of ampere-turns (NI).
   c. Increases directly as current increases.
   d. Increases as ampere-turns is decreased.

4. The plastic core of an electromagnet is replaced with an iron core. The result will be:
   a. An increase in reluctance.
   b. An increase in permeability.
   c. A decrease of residual magnetism.
   d. A decrease in magnetomotive force (mmf).

5. Two 100K ohm resistors are connected in series across a 50 vdc source. A 1000 ohms-per-volt VOM on the 50v range is being used to measure the voltage drop across one of the resistors. Disregarding meter and resistor tolerances, the meter will indicate:
   a. 12.5 vdc.
   b. 25.0 vdc.
   c. 16.6 vdc.
   d. 20.0 vdc.

6. Current flow in an ac circuit can

be measured indirectly with an oscilloscope using a 10 ohm metering resistor in series with the circuit. On the 0.01 v/div range, a deflection of 3.4 divisions across the 10 ohm resistor indicates a peak-to-peak current flow of ____ in the circuit.
a. 0.034 ma.
b. 0.34 ma.
c. 3.4 ma.
d. 34 ma.

7. To convert the current measurement in question 6 to RMS current, the measurement must be:
a. Multiplied by 1.414.
b. Divided by 0.707.
c. Multiplied by 2.828.
d. Divided by 2.828.

8. An LC circuit is resonant at 150 KHz. The inductance is 1 mh and has a dc resistance of 30 ohms. If Q = XL/R, what is the Q of the resonant circuit?
a. 50.
b. 31.4.
c. 97.3.
d. 159.

9. The bandwidth of the circuit in question 8 is about:
a. 4.8 KHz.
b. 3 KHz.
c. 1.5 KHz.
d. 0.94 KHz.

10. A common emitter amplifier has a static base current of 40 microamps and a current gain of 75. An input signal causes a plus and minus 10 microamp change in base current. The output signal, developed across a 2.2K ohm resistor load, will be
a. 37.5 v p-p.
b. 1.65 v p-p.
c. 2.2 v p-p.
d. 3.3 v p-p.

11. The unfiltered output of a half wave rectifier, having an input of 120vac, is measured with a dc voltmeter. The meter indication will be about:
a. 53.5v dc.
b. 107v dc.
c. 168v dc.
d. 120v dc.

12. Solid state devices may be either unipolar or bipolar. An example of a bipolar device is a (an):
a. JFET.
b. PNP transistor.
c. MOSFET.
d. All of these.

13. A certain receiver has an input of 50 microwatts and an output of 3.2 milliwatts. Expressed in decibels (dbs), this is a power gain of:
a. 10.6 db.
b. 18 db.
c. 60 db.
d. 64 db.

14. A triode tube Hartley oscillator is tested with a VOM. Oscillation is indicated when:
a. Plate voltage measures less than B+.
b. Cathode voltage is greater than O volts.
c. Grid voltage measures negative.
d. All of these.

15. A 1000 ohms-per-volt dc meter has a meter resistance of 100 ohms and a full scale current of 1 ma. What value shunt resistor will permit dc currect measurements up to 10 ma full scale?
a. 900 ohms.
b. 10 ohms.
c. 9 ohms.
d. 11.1 ohms.

16. An avalanche diode is more commonly known as a:
a. Tunnel diode.
b. Junction diode.
c. Crystal diode.
d. Zener diode.

17. The time constant of a resistor-inductor network can be calculated by the relationship:
a. t = RL.
b. t = R/L.
c. t = L/R.
d. t = RL/R.

18. An emitter-follower amplifier provides:
a. Low input impedance.
b. High voltage gain.
c. Signal inversion.
d. High current gain.

19. A common collector amplifier has a base current of 80 microamps and a collector current of 7 milliamps. The output signal, developed across a 1000 ohm load, will be:
a. Smaller than the input.
b. 7v in amplitude.
c. 87.5 times larger than the input.
d. Beta times the input signal.

20. An N-channel enhancement type MOSFET:
a. Requires a negative gate voltage to conduct.
b. Requires a positive gate voltage to conduct.
c. Does not require a gate voltage to conduct.
d. Conducts when gate-source voltage is applied.

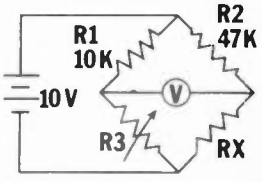
21. A free-running plate-coupled multivibrator operates with 300v B+. Voltage testing indicates normal operation when:
a. Ep1 = 75v and Ep2 = 300v.
b. Eg1 = 0v and Eg2 = -20v.
c. Ep1 = 180v and Ep2 = 190v.
d. Eg1 = 10v and Eg2 = 10v.

22. A parallel RCL circuit has an applied frequency of 60 KHz. R = 1K, L = 10 millihenries, C = 0.001 microfarads. Under these conditions, the circuit is:
a. Capacitive.
b. Inductive.
c. Resistive.
d. Resonant.

23. The lightly loaded output dc voltage of a bridge rectifier using an LC pi-type filter has decreased more than 20%. The most likely cause is:
a. One of the bridge diodes has opened.
b. The output filter capacitor is open.
c. One of the bridge diodes has shorted.
d. The input filter capacitor is open.

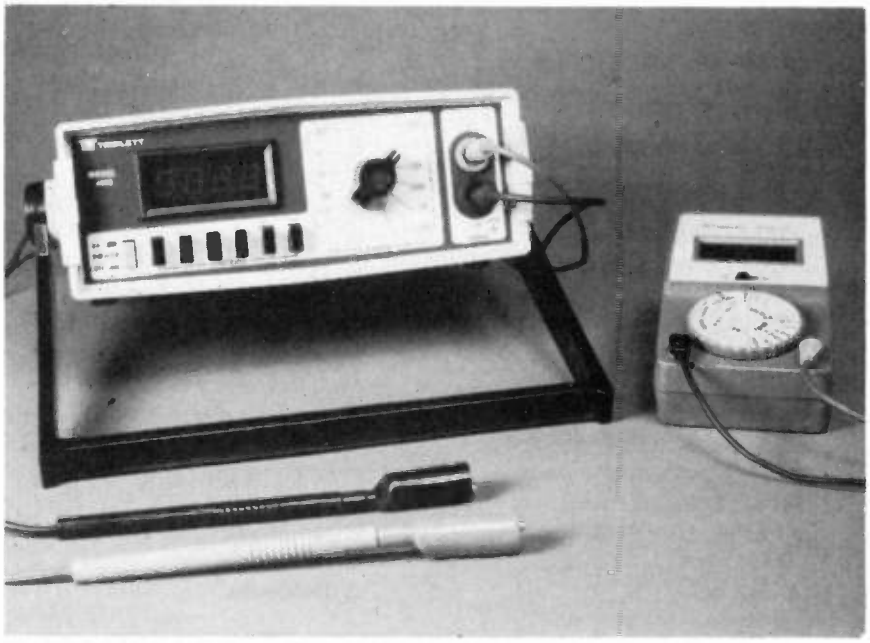
24. The horizontal sweep frequency of a certain television receiver is 15,750 Hz. The pulse repetition period of the horizontal sync pulses will be:
a. 63.5 microseconds.
b. 634.9 microseconds.
c. 0.63 milliseconds.
d. 6.35 milliseconds.

25. R3 in the bridge circuit of figure 1 balances the bridge when it indicates 18 K ohms. Then the value of RX must be:
a. 846 ohms.
b. 846K ohms.
c. 8.46K ohms.
d. 84.6K ohms.



You'll find the answers on page 10

TEST INSTRUMENT REPORT



The Triplett Model 4000 and Model 3400. For more information circle No. 150 on the reader service card.

DVOM's from Triplett

A complimentary Pair

by Walter H. Schwartz and Peter B. Credit.

The Triplett Model 4000 bench DVOM and Model 3400 hand held DVOM make a useful complimentary pair filling nearly all shop or field DVOM needs.

Triplett's new Model 4000 is a 3 1/2 digit meter featuring a basic dc accuracy of ± 0.2% with auto-zero and auto-polarity. All function selections are made by pushbutton switches and range selection is made by a rotary switch. The safety of the user is enhanced by a pair of recessed input jacks which serve all functions, eliminating the need to change leads when changing function or range.

The heart of the Model 4000 is a 3 1/2 digit dual slope analog to digital converter. This one chip contains all the analog and digital circuitry necessary to process the analog signal and the digital circuitry to drive the digital LED display. Resistance measurements are made by determining the ratio of resistance of the unknown resistor and a precision reference resistor in series with it. The manufacturer's specifications for the Model 4000 indicate its basic dc voltage accuracy to be ± 0.2% + one digit, except on the 1000v range where it is ± 0.5% + one digit and the ac voltage accuracy is ± 0.5% + 2 digits and ± 1.0% on the 1000v range from 40 to 1000Hz and 1.0% up to 10kHz and 200v.

The Model 4000 has high—5volt—and low—200mv—ohms ranges for easy testing of and around semiconductors. The application notes section of the manual supplies the information necessary to correctly set up and test most semiconductors.

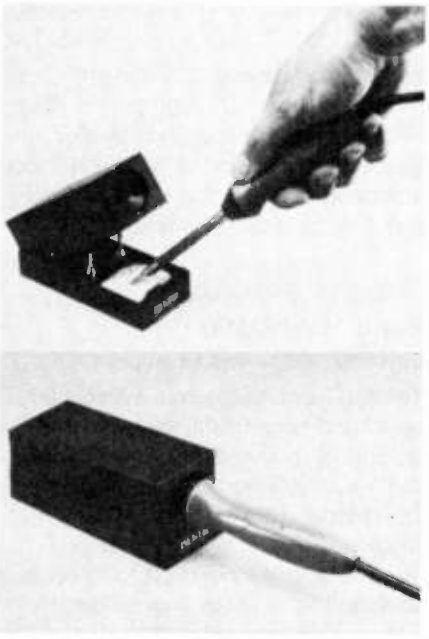
Current ranges of the Model 4000 are from 200ma to 2000ma full scale. The ac, dc and resistance ranges are 200 ohms to 20 megohms full scale.

The Model 3400 is a 3 1/2 digit, hand-size unit with a single rotary range switch (and an ac-dc slide switch), a 0.5 inch LCD readout, auto-zero, auto-polarity, overrange and low battery indications. Its typical dc accuracy is 0.5%. It too has high and low power ohms on alternate ranges; the 200, 20k and 2 megohm ranges are low power; the 2k, 200k, and 20 megohm ranges are high power. The Model 3400 has voltage ranges of 2, 20, 200, and 600 volts full scale, ac and dc milliampere ranges similarly to 2000ma and resistance ranges as previously mentioned. It also has 200mv ac and dc ranges.

The 3400 is a handy little handfull with a shape that is comfortable in the hand. It has one minor problem: the switch knob on the unit we examined was rather thin and therefore harder to turn than it should be. We understand that the knob on later production is thicker at the rim and easier to grasp.

Both DVOM's appear to be of very good quality construction, glass epoxy circuit board, extremely well fused, good safety leads, very readable displays, etc. The Model 3400 is priced at $140 and the 4000 at $235 both with test leads and instruction manual—and spare fuses. ET/D

NEW PRODUCTS



Soldering Iron Stand

Circle No. 131 on Reader Inquiry Card

Wahl Clipper Corporation, has introduced a new soldering iron stand for its "Production 50" temperature-controlled soldering iron, and its "Industrial 30" iron with the long-life element. The new stand is a combination soldering iron stand and caddy. When closed it contains the shaft and tip, allowing an iron that has not yet completely cooled down to be placed in a tool box or caddy without damage to adjacent components. The soldering iron stand/caddy also protects the shaft and tip from possible damage in transit. In the "open" position, the stand functions as a standard soldering iron stand. The stand also features a tip wiping sponge and well.

Industrial Chemical Line

Circle No. 132 on Reader Inquiry Card

GC Electronics has introduced four new categories of industrial and chemical products. The first category contains heavy duty general purpose cleaner and degreaser, Cat. No. 10-1000 (16 oz.) and 10-1004 (24 oz.) and Industrial Strength Dri-Kleener and degreaser, Cat. No. 10-1006. For more delicate applications there is tape head cleaner, Cat No. 10-1012 and Adjust-n-Dust, Cat. No. 10-1065. The second category contains spray-on vinyl strip-koat, Cat. No. 10-1100, while the third category contains Dri-Freez, Cat. No. 10-1200 (15 oz.) which reportedly cools down to −45° C. The fourth category included CTF (cutting and tapping fluid), Cat. No. 10-1301, a metal lubricant for reducing tap and cutting blade damage. A dry-film lubricant which is specified to resist friction up to 500° F, fluorocarbon release agent and lubricant, Cat. No. 10-1317, is included, as is the Paintable Mold Release, Cat. No. 10-1330, for easing the releases of molded plastic parts which may require painting. A specialty lubricant, Thread-Free-Er, Cat. No. 10-1335, helps with releasing tight, seized, or rusted parts.

DMM

Circle No. 133 on Reader Inquiry Card

Now available from the *Simpson Electric Company* is its new Model 467 portable DMM which uses a combination of digital and analog LCD displays to analyze both steady and pulsating signals, plus differential '+' and '−' peak-holding capability and fast pulse detection and indication. In the differential peak mode, the Model 467 can make percent modulation and signal tracing measurements. In the pulse detection mode, it can give visual and/or audible indication of pulse presence, and logic states. Other standard features include 26 ac/dc voltage, current and resistance ranges, true RMS ac voltage and current

measurements, a reported 0.1% basic dcv accuracy, continuity detection with both visual and audible indications, high-energy double fusing protection, high-voltage transient protection and overload capabilities. The size of the Model 467 is 2 × 5.6 × 4.6 in., it weighs 1½ lb, and it operates on a single 9 volt alkaline battery. Optional accessories for the 467 include a universal temperature probe, rf probe, high voltage probe, ac Amp-Clamp adapter and leatherette case. Price is $239, and includes a 9 V battery, U.L.-approved test leads with screw-on alligator clips, and instruction manual.

Two Color Truck Door & Equipment Signs

Circle No. 134 on Reader Inquiry Card

Seaton Name Plate Corporation has announced the availability of new two color self-stick truck and equipment signs. All signs are manufactured in two colors with combinations offered in red, blue, black or green on white weather-proof vinyl. These signs reportedly will

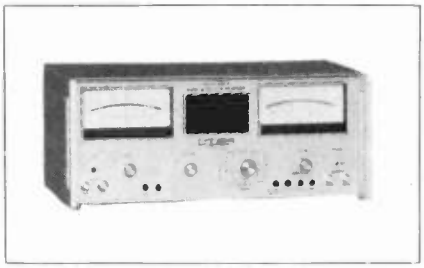
not wrinkle or buckle and they resist oils, solvents, acids and outdoor weather. They are available in four sizes: 16¼ in. × 24½ in., 12¼ in. × 18½ in., 5½ in. × 8¼ in. and 3 in. × 4½ in. Free samples and price information are available.

Wow/Flutter Analyzer

Circle No. 135 on Reader Inquiry Card

A new wow and flutter analyzer, Model 1600 has been introduced by *BPI.* Features include wow and flutter metering, absolute speed and drift measurement, oscillator, voltmeter and audio output. Phase lock loops are used in measuring wow and flutter to reportedly as low as 0.005% unweighted and 0.002% weighted. Two internal oscillators have a reported frequency accuracy of 0.1% with less than 0.05% THD. A wideband AC voltmeter is calibrated in RMS and dB and can be used for checking output levels. An internal audio amplifier allows the operator to listen to wow and flutter

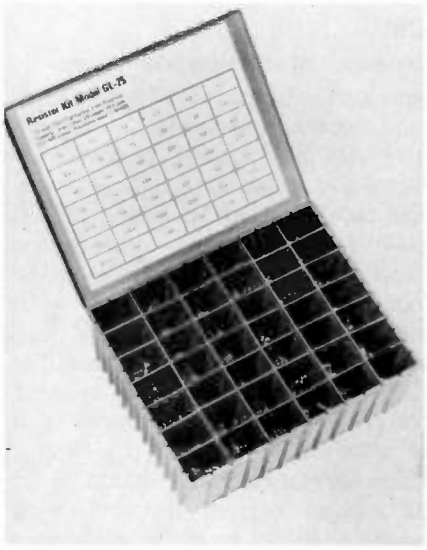
reducing the need to visually monitor the meter. Options include an RIAA magnetic phono cartridge preamp and a 19 inch rack mount. The price of the Model 1600 is $795 without accessories.



Resistor Organizer

Circle No. 136 on Reader Inquiry Card

Available from *Century Electronics* is a wide assortment of fixed resistors in an organized storage case. The GL-25 Econo-Pak Resistor Organizer contains 840 ¼ watt resistors in 42 of the most commonly used resistance values for the hobbyist as well as for the service technician and repairman. Each resistor value is pre-packaged in its individual

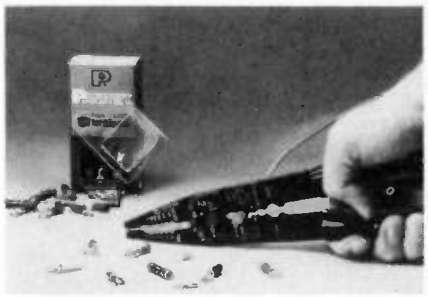


compartment for quick selection of any desired value. The compact Econo-Pak Resistor Organizer measures 7½ in. × 6⅛ in. × 3 in. and is priced at $29.95, FOB: Factory.

Crimping Tool

Circle No. 137 on Reader Inquiry Card

A new terminal crimping tool that provides multi-purpose performance is announced by *Panduit Corp.*, Electrical Products Group. The CT-160 crimping tool installs insulated and non-insulated terminals, disconnects, and splices wire joints on wires from 22 to 10 AWG. It forms an insulation sleeve to provide insulation grip or support on nylon or vinyl terminals. In addition, the tool cuts



and strips wires and cuts and rethreads screws for both U.S. and metric sizes. Another feature is the plier nose for light duty use. The design of the CT-160 tool reportedly provides low crimping forces and has cushioned handles.

Hand Held DMM

Circle No. 138 on Reader Inquiry Card

Keithley Instruments has introduced a new hand held DMM, the Model 135, reportedly being the first hand held DMM ever to offer 4½ digit resolution. The Model 135 features include five functions, 20 kHz ac bandwidth, 0.05% dc accuracy, overload protection, and an annunciator which warns user when

10% of the battery life remains. Battery life is said to be 100 hours using standard alkaline batteries. Accessories supplied are battery, test leads, and operators manual. The price of the Model 135 is $219.

Work Benches

Circle No. 139 on Reader Inquiry Card

The *Penco* "Open Type" work bench is available in four top constructions and 12 sizes. The benches shown feature a top of pressed wood bonded to steel. Benches featuring the pressed wood

over steel top are available in 10 sizes ranging from 48 in. wide, 28 in. deep, and 30¼ in. high, to 72 in. × 34 in. × 34¼ in. Standard accessories include: stringers, shelves, back and end stops, risers, electrical outlet strips, case and drawers with one tray and bench drawer mounting kits.

PC Board Service Kit

Circle No. 140 on Reader Inquiry Card

New from *Jensen Tools Inc.* is a tool kit for repairing printed circuit boards, with emphasis on small component removal and replacement. Included in the JTK-47, is a 35-watt soldering iron with stand, fork and hook soldering aids, a multi-position work holder and quick-adjust

vise for holding circuit boards, DIP extractor and a miniature chain nose plier, all of which are furnished in a 19 × 7 × 7 in. steel tool box with tray and with room for additional tools.

Multitester

Circle No. 141 on Reader Inquiry Card

Sanwa Company has introduced its Model TX-301, a combination multimeter with the facility to measure SWR and RF power. The multimeter section features include six functions with hfe measuring capability. The SWR/power meter section frequency range is 3.5MHz to 144MHz, with the SWR range being 1:1 to 3:1. RF power output capability is 120 watts. The input-output terminals for the SWR/power meter section are standard PL-259 style. The Model TX-301 comes complete with test leads and operators manual.

VCR Basics

continued from page 47

on each horizontal line in the VHS system.

Beat frequencies

Earlier we mentioned that in the long play mode both the VHS and Beta recorders overlap their video tracks. Azimuth rejection is sufficient to prevent crosstalk pickup, but the overlapped video tracks create a new set of signals which have no true azimuth. These are beat frequencies, and because these have no true azimuth, they're picked up by both heads. Most beat frequencies aren't a problem, because they are constantly changing and thus don't show up on the television screen. The beat frequency caused by the horizontal sync pulses is constant, however, and therefore quite noticable on the television screen. To prevent it from being seen, a method of phase cancellation, called FM Interleaving Recording, is used. This doesn't eliminate the beat frequency, but allows it to optically cancel itself on the television screen. FM inter-leaving signals appear on the screen so that the alternating light and dark areas of every adjacent horizontal line are out of phase. This makes the alternating light and dark areas that appear on the screen invisible to the human eye.

Conclusion

In spite of their differences, the Betamax and VHS video cassette recording systems are the dominant VCR formats in the consumer market today. Eventually, either could dominate the VCR market, or perhaps a new system could gain supremacy. In any case, as service technicians, you'll be faced with many manufacturers' VCR's to repair, and each will have its own idiosyncrasies. You can't know all of them. But you can know how they operate and have a general knowledge of their electronics. Once you know that, you can rely on experience and the service manual to extend your knowledge. ET/D

SECURITY PRODUCTS

Security System

Circle No. 144 on Reader Inquiry Card

A new outdoor microwave security system for perimeter protection that reportedly has a 500 foot range is available from *Racon, Inc.* The Model 17000, comprised of a transmitter and a receiver is said to have an adjustable zone coverage of 20 to 500 feet in length and one to 40 feet in width. Detection sensitivity is field adjustable. The Model 17000 is said to be tamperproof and environmentally protected against adverse weather conditions due to its all-aluminum construction with center line mounting. Temperature and humidity changes, RFI and power line transients reportedly do not affect operation. The Model 17000 features LED indicators for diagnostics and remote testing capability and can be used as a portable system. The system is offered with rechargeable batteries, Class 2 transformers and mounting brackets. Both RFI and conducted power line transient protection are built-in.

Phone Intercom Systems

Circle No. 145 on Reader Inquiry Card

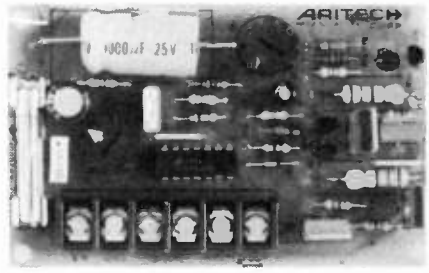
Two new Bogen-Phone intercom systems, Series TIM and Series TIS are now available from *Lear Siegler's Bogen Division*. The two phone intercom systems incorporate electronic amplification and tone calling with each telephone having a separate paging button for use with a PA system. Conference calls are possible in either system. Only a single power supply (PRS-10) is needed for each system and no central exchange is required. The phones can be wall-mounted or placed on a desk. Series TIM is a multiple-channel system with a reported trunkage of 100%. it allows several simultaneous conversations. Up to twenty-five stations can form a system in which each user can call anyone else selectively with the push of a button. Larger systems can be employed, with each station able to call up to twenty-four others. The TIM-6 can contact any of six stations. A plastic protected directory is next to the call buttons. The TIM-12's twelve buttons can call twelve other stations; a slide-out directory is provided. The TIM-24, with the same call buttons and directory as the TIM-12, also has an A/B Group Selector that enables each of its call buttons to connect with either of two different stations, for a total of twenty-four. Each phone is equipped with a junction box for easy installation. Bogen's Series TIS is a common-talk-line system; each phone selectively can call up to twelve other stations. Each station has an LED that lights up to indicate when this in-house phone system is in use. A four-model series, the TIS provides a choice of phones that will call

one, four, eight or twelve other phones. The TIS-4 has call buttons that connect with any of four other phones. A plastic-covered directory is next to the buttons. The TIS-8 is similar, but with eight buttons. The TIS-12 has call buttons for twelve system phones and a slide-out directory. The TIS-4, TIS-8 and TIS-12 come equipped with their own junction boxes. The TIS-1 calls one other station. It also can be used to create a non-selective calling network of up to sixty phones when used with a public address system and a TPA-10 paging adapter. The caller uses the TIS-1 to page through the PA speakers. The paged individual can reply from any other TIS-1 in the system. The TPA-10 paging adapter also can be used to tie in any TIS and TIM phones to a PA system to permit phone paging. It also has an input and a separate volume control for a music source. This means that paging and music can be at different sound levels. The music is silenced automatically during paging. Other optional accessories for both series include the TBR-10, a paging/talkback adapter that can be used with an amplifier and one or two loudspeakers to provide zoned paging with hands-free reply through the PA loudspeakers; the RY-20, a loud-bell relay for use with an external bell in noisy areas; and the HC-10, a ten-foot coiled cord for station handsets where freedom of motion is needed during calls.

Siren Driver

Circle No. 146 on Reader Inquiry Card

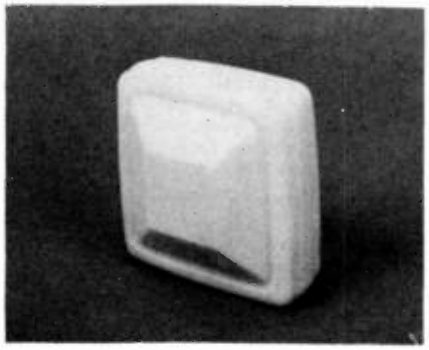
Aritech has announced its new AD-200 electronic siren driver, which has two outputs: steady and yelp. The steady channel (fire alarm signalling) has priority overide. It operates on 6 to 18 Vdc, 18 Vdc with 8 ohm load. The AD-200 measures 4 × 2.5 inches, and is installed with double sided tape.



Microwave Motion Detector

Circle No. 147 on Reader Inquiry Card

NJR Corporation has announced a new microwave motion detector, the Model 6007M. The 6007M is a doppler sensor designed to detect moving objects by microwave doppler frequency shifts. The high impact plastic enclosure measures slightly over one inch in depth allowing for a near flush mounting on either walls or ceilings. Adjustments for angels of protection are made internally,

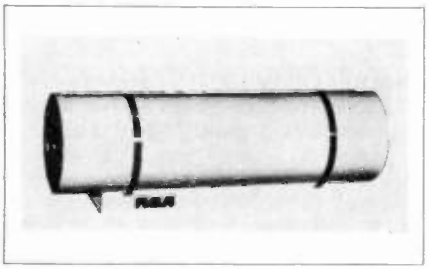


as is range adjustment. The pattern of protection is said to be approximately 180 degrees and the range adjustable from four to twenty-five feet. Antenna performance is shown by an LED indicator which is located under the top casing. The LED displays red when sensing motion and green when in operation but no motion detected. The LED is not visible once the top casing is in place. The 6007M operates on 12 VDC and has a normally closed/common/normally open output.

Environmentally Packaged SIT Camera

Circle No. 148 on Reader Inquiry Card

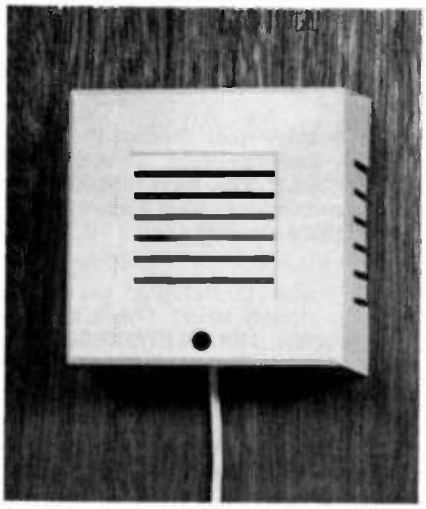
A prepackaged, sealed, pressurized, CCTV SIT camera reportedly capable of reliable unattended very low light level operation in severe environments, is now available from *RCA Closed Circuit Video Equipment.* The model TC1036/H is an environmentalized version of the RCA TC1030/H SIT camera and reportedly operates at ambient temperatures from −40 to +60°C, and altitudes to 50,000 feet (15,244 m). The TC1036/H camera is said to withstand military and space environmental tests for sand and dust, fungus, salt atmosphere, explosion and acoustic noise. Automatic light Range (ALR) circuitry within the TC1036/H is stated to provide a 100 million to one light range, automatically adjusting for scene illuminations from bright sunlight to as low as 0.00033 footcandle, the equivalent of quarter moon light. AGC circuitry compresses bandwidth at lower light levels to optimize signal-to-noise, and Auto-Beam Control (ABC) is said to eliminate the need for periodic beam readjustment. Auto Black plus Keyed Clamp maintain constant pedestal setup over the entire light range. Low-bloom RCA Silicon Intensifier Target (SIT) camera tubes prevent bright highlights from obscuring scene detail. A phase locked loop synchronizes the EIA RS-170 compatible sync to zero power line crossing for optimum switching and VTR recording. The sync can be used to drive other cameras. These TC1036/H cameras can also be locked to external sync or composite video. Four fixed lens models, 12.5, 25, 50 and 75 mm, are available as well as three zoom lens models, 20-100 mm (5x), 18-144 mm (8x), and 16-160 mm (10x). Optional user price starts at $7,415.00.



Audio Light

Circle No. 149 on Reader Inquiry Card

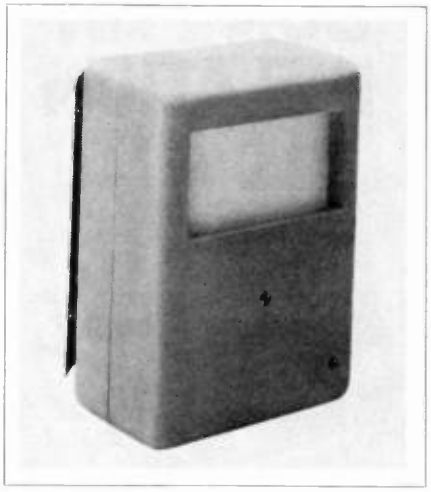
The sound-alert audio light is a new security product introduced by *MRL, Inc.* The audio light reportedly detects any breaking and entering sound and then activates any light up to 300 watts. Features of the audio light include a triplette receptacle on the output cord, an automatic reset function and sensitivity adjustments.



Passive Infrared Intrusion Detectors

Circle No. 150 on Reader Inquiry Card

Alarm Device Mfg. Co. has introduced two, new passive infrared intrusion detectors, Models 650 and 651. The model 650 is said to have a range in excess of 50 feet and the 651 in excess of 100 feet. Both units have built-in zone locators for visual indication of all zones of coverage. (17 zones in the no. 650, 6 zones in the no. 651). The 17 zones of the no. 650 are predeclined at a correct angle. The zones are staggered so that 9 main zones reach out to 50 feet, 5 zones to 30 feet, and 3 zones to 10 feet. The zone positioning is such that



walking under the pattern is prevented. The no. 651 has its main zone reaching to 100 feet, two intermediate zones to 60 feet and three short zones out to 12 feet. Both models are reportedly designed so that temperature and incidental infrared energy does not set off the alarm. Both models provide multifunction LED, memory, silent relay and high LED disable functions when combined with the appropriate controls. ETD

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SAMS Photofacts #300-600, $300.00; B & K Model 415-Sweep, Marker Gen., $200.00; RCA Voltohmysts, Model WV97A and Model WV77A $30.00 ea. Louis Sventona, Fastronic Service Inc., 321 Portson Road, Lake Ronkonkoma, NY 11779. Phone 516-588-4855.

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

DECODER KIT, TV, (sine wave encoder system) Los Angeles chan. 52, Chicago chan. 44, Detroit chan. 20, Florida chan. 50, etc. Latest model, complete kit $139. Distributors wanted, quantity discounts. Catalog free. Write Simple Simon Electronic Kits, Div.-Les Gaskell Enterprises, 11852 S. Hawthorne Blvd., Hawthorne, CA 90250. Tel. (213) 675-2335.

19" COLOR TV'S, used commercial models. RCA XL-100 and others. 10 lot minimum. Kamcor, Ltd., 88 S. Washington Ave., Bergenfield, NJ 07621.

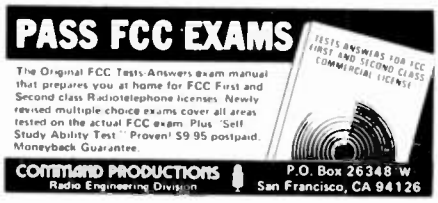
TV AND RADIO TUBES 49¢ EA!! Send for free color parts catalog. Your order free if not shipped in 24 hours. Cornell Electronics 4215-17 University San Diego California 92105. TF

FOR SALE TV TROUBLE ANALYSIS TIPS. Over 300 symptoms/remedies by circuit area. Tough ones I found in years of servicing. e.g. Poor sync-C66 shorted-Wards-GEN-12349A-SAMS 995-2. Save time and money. Due to demand, send only $12.50 to CHAN TV, 8151 Grandview Rd., Chanhassen, MN 55317.

Cheater cords, safety with clip, 10 lot $6.99. Zenith 800-860 safety capacitor, only $3.99. 30 watt soldering iron, special $2.49. ½lb. roll multicore solder $3.99. Original ECG 523 Boxed $15.95. Jeff Tauber, Redcoat Electronics, 66-15 Thornton Pl., 212-261-9479, Forest Hills, NY 11374.

WHOLESALE TV PARTS-transistors (TM/PTC/ECG) Thordson Yokes & Flys; Resistors; Capacitors; Triplers; Tools; Tubes 72% off; Sams 5.95; Video Tapes. Video Movies bought, sold, rented. Send for free catalog. Astro Electronics, Old Grand Union Shopping Ctr., Rt. 9W, Stony Point N.Y. 10980. 914-942-2173. 3/81

FOR SALE: Sams, Television Test Equipment, Sylvania Color Jig, Tubes and Modules, Misc. Antique Tubes. Write for itemized list. Telecom TR, 412 10th St. Box E, Gothenburg, Ne. 69138, (308) 537-2552.



SCRAMBLED-TV WHAT IT IS-HOW IT WORKS. New publication explains how the two encoding/decoding systems used today work. Theory, circuits, etc. Send $9.95 to: Workshop, Box 393ETF, Bethpage NY 11714 TF

POWERFUL universal **CRT** tester/rejuvenator. Simple Circuit, cheap parts! Plans, trade secrets to bring back the "dead" ones! $2.00. **ROBINSON,** 510 Granada Pkwy., Lindenhurst, New York 11757.

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TV, STEREO, SALES AND SERVICE BUSINESS, established since 1962. Zenith franchise, only shop in rapidly growing central Calif. town. $20,000+ inv. Write: Waterford TV PO Box 172, Waterford, CA 95386.

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HONOLULU, HAWAII T.V. Service business, very busy money maker. Good Location, low rent with good lease - 1,000 sq. ft. shop. Equipment includes Van & Station wagon, electronic testing equipment, Stock of parts & office equipment & supplies. Move to beautiful Hawaii and start making Big Money now! Price $75,000. Terms possible. Contact: Bert Bortnick, 808/373-2091 or 531-1302 - 345 Queen Street. Suite 600, Honolulu, Hawaii 96813.

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AD INDEX

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TEST INSTR. RPT.

NEW PRODUCTS

SECURITY PROD.

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

UNIVOLT'S DT-810 DIGITAL MULTIMETER

The unique space age digital multimeter with transistor gain (hFE) measurement capability should be the only multimeter you own.

Ora Electronics has offered in the past many fine Digital Multimeters (D.M.M.'S). We still sell the famous D.M.M.'S such as Beckman, Fluke, Hickok, and others. We have always followed the advance in technology used in D.M.M.'S, and we always wanted to supply our many good customers with the most Ideal Multimeter, at a price they can afford. In the past we had to sell good, but expensive Multimeters, expensive but "fair" Multimeters, and plain "cheap" Multimeters.

WE FOUND IT!

Several months ago, a famous Test Equipment Manufacturer, walked in to our headquarters with a Prototype of a Digital Multimeter. We were very impressed it had almost everything we wanted plus a bonus, the only question remaining was "how expensive is it?" When we heard the answer, a big smile appeared on our faces. After several improvements we are proud to offer it. After you read the features (and price) I am sure you are going to order one or more, of these fine D.M.M.'S that we call the "UniVolt".

LCD DISPLAY.

The unit has a 3.5 Digit liquid crystal display. The sharp digits are 14mm high and have a viewing angle of 140°.

HIGH ACCURACY.

The basic D.C. accuracy of the UniVolt is 0.5% of reading +1 digit, which makes it one of the more accurate instruments in its class. The input impedance is very high,10 mega- Ohms (10,000,000) Ohms, which helps in measurements of low voltage and high frequency signals.

MEASUREMENT RANGES.

The UniVolt has D.C. voltage range of 100uv to 1000V in five steps, A.C. voltage range of 100mV to 1000V, current measurement range of 100mA to 10A (DC) and resistance range of 1 to 2,000,000 Ohms.

CONTINUITY & DIODE TEST.

A fast and accurate continuity test mode utilizes a built-in buzzer to indicate continuity. The same mode is used to check diodes and their approximate forward voltage.

EASE OF OPERATION.

The UniVolt is small, it measures 6½" x 3⅜" x 1¼". It's light weight, only 9.87 oz. including battery! It utilizes push buttons, for easy one-hand operation and the front panel has a unique color coding for reduced errors.

OVERLOAD PROTECTION

The unit has an extensive overload protection on all ranges. On D.C. current ranges it uses a .5A GMA type fuse. A spare fuse is supplied with the unit at no extra cost.

MAINTENANCE FREE

The heart of the UniVolt Multimeter is a 40 pin L.S.I. chip; the Intersil ICL710G. This space ages chip has proven to be one of the most sophisticated and reliable micro-electronic circuit in use, it is supported by minimum amount of external parts, which are over specified to insure failure safe instrument. Of course, Ora Electron cs stands by this instrument and guarantees it for one year (See specific warranty information).

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OTHER FEATURES

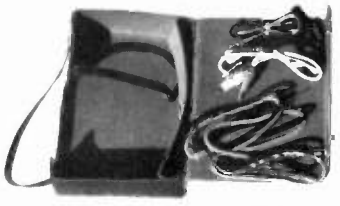
It uses one 9 volt carbon battery (included), which last approximately 200 hours of continuous use. Its sampling time is 0.4 seconds, operating temperatures of 30°F to 104°F, and operating humidity of less than 80% R.H.

BONUS!!

We left the best to the end. The UniVolt DT-810 has something unique. It has a **transistor gain (hFE) measurement mode!** This unique feature enables you to measure hFE values of 0-1000 of either P.N.P. or N.P.N. transitors.

SPECIAL PRICE

We had originally decided to sell the unit for $119.95, but in order to promote the new advancement in D.M.M. design, represented by the UniVolt, for a limited time only you can buy this incredible unit for only $99.95 including: standard red & black test leads, a fresh 9v carbon battery, a spare 0.5A GMA type fuse and an instruction manual.



FREE CASE

We have worked long on the UniVolt project and we hate to see scratches or bad looking units. So we decided to go all the way, when you buy the UniVolt DT-810 Multimeter (and for a limited time only!) we will give you absolutely free a hard vinyl leatherette, carrying case, with felt padding and a compartment for your test leads. The regular selling price for this case mode CC-01 is $8.00.

ACCESSORIES AVAILABLE.

The only two accessories available are: UP-11, hFE probe with special plug and 3 color codes alligator clip, and the UP-12 I.C. clip adaptor, which will help you hook your multimeter to any I.C. pins. (You can buy both probes for only $6.00, but only when you purchase the UniVolt DT-810 now.)

ORDER NOW!

It's very easy to order your UniVolt DT-810 multimeter. Send $99.95 (California residents add 6% sales tax) plus $2.50 delivery charge to the address below, if you want the optional accessories, please add $6.00 (California residents add 6% sales tax). A cashier check or money order will help speed your order. Credit card holders (master card or visa) can call our toll free number **(800) 423-5336**, in California it's (800) **382-3663**. C.O.D. orders will be accepted, but you must pay by cash or money order and a C.O.D. charge of $1.40 will be added. If you decided to buy another brand of Multimeter, please call us too, we carry many other types of multimeters and test equipment at low prices.

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Horizontal Output Transistor Equivalent to ECG 165

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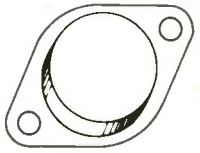
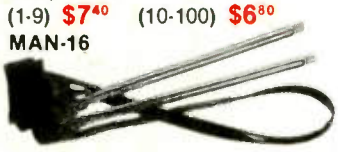


2.40

Minimum order of 10

Stock up on these popular TV parts while prices are low!

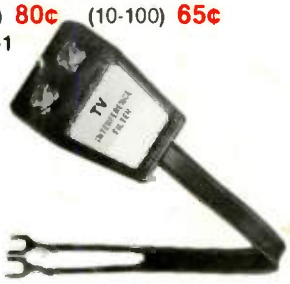
Sony Trinitron Dual Antenna
Sony AN16
(1-9) $7.40 (10-100) $6.80
MAN-16



UHF/VHF/FM Splitters
300 OHM
(1-9) $1.39 (10-100) $1.19
SPL-701

75 Ohm
(1-9) $1.45 (10-100) $1.30
SPL-702

TV Interference Filter
(1-9) 80¢ (10-100) 65¢
TVI-1

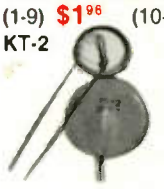


75 Ohm to 300 Ohm Converter
(1-9) 65¢ (10-20) 55¢
TVT-1

F-59 Connectors with Ferule
14¢ ea.

(on minimum order of 100)

Universal Globar Resistor Kit
2 Universal Globars for color TV automatic degauss circuit. Contains a thermistor and a varistor. Fits many famous make color TV's
(1-9) $1.96 (10-100) $1.85
KT-2



High Voltage Tripler
Equivalent to ECG-500A
(1-9) $12.40 (10-100) $11.80
HVT-500A

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